GENERAL CONDITIONS OF CONTRACT

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AIR CONDITIONING & MECHANICAL VENTILATION WORKS

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GENERAL REQUIREMENTS

3.1.1 GENERAL.

These specifications are for the HVAC works only. However, the Instructions to Tenderers, Form of Tender, Conditions of contract, Note on Pricing, Preliminaries Section and any Supplementary Conditions of Contract applicable to Main Contract shall be applicable to this contract also.

The terms Contractor and Subcontractor used in these documents and drawings are to be considered to be meant as Contractor for HVAC works.

3.1.2 INTENT.

Contractor shall be responsible for proper performance of all HVAC systems in accordance with relevant IS standards and codes and design parameters listed hereinafter. Contractor shall ensure that execution of total work is in accordance to this.

Provide all items, articles, materials, operations, sundries, labour, supervision, guarantees, allowances for overhead and profit, etc., to achieve a fully functional and acceptable.

The precedence of documents and drawings shall be as determined in the Main Contract. However, considering the specifications as an integral part of the work together with the drawings and any item or subject omitted from one, but mentioned or reasonably implied on the other as properly and sufficiently indicated and provide the same under the work.

The Contractor is responsible for developing his own take off of materials and is to make available as approved by Consultant /Client.

3.1.3 EXAMINATION OF SITE AND DRAWINGS.
Visit the site of the proposed works and obtain all information assess the existing conditions and limitations and all proposed works on adjacent sites and in adjacent areas which might affect the works on this site, whether by Private Individuals or by Government Authorities or others.

Examine the documents including the Specifications and Drawings of all before bidding and again before commencing any portion of the work.

Neither Client nor the Consultant shall be responsible for any claim for extra work or expenses resulting from the failure of the Contractor having fully aware of Site Conditions.

3.1.4 PERMITS FEES AND INSPECTIONS.

Arrange for inspection of all works by the external agencies as and where applicable. This is to occur on an on-going basis throughout construction to avoid delays to the project.

Pay fees/charges as levied by the Local Authorities for inspections, approvals, temporary services, connections, etc. at no additional cost to contract.

3.1.5 CONTRACT DRAWINGS

The drawing, specifications and bill of quantities shall be considered, as a part of this contract and any work or materials shown on the drawings and not called for in the specification or vice-versa, shall be executed as if specifically called for in both.

The drawings for services works are design drawings, diagrammatic, and intended to convey the scope of work and indicate general arrangement and approximate locations of equipments, fixtures, pipe and duct runs, etc. The drawings do not intend to indicate architectural or structural details. These cannot be used as shop drawings. The contractor shall examine all architectural, structural, plumbing and sanitary and electrical equipment before starting the work and prepare execution drawing containing all details mentioned under. Contractor must develop own detailed shop drawings based on actual site conditions for work at site, the same shall be submitted to consultant/Client for approvals prior to commencement of erection activities at site.

Any discrepancies, which in his opinion appear on them, have to be reported to the consultant/Client and get them clarified. He shall not be entitled to any extras, for omissions or defects HVAC drawings or when they conflict with other work.

Do not scale drawings. Obtain accurate dimensions to structure and architectural items from drawings of those trades. Confirm by site measurement. Verify location and elevation of all services before proceeding with the work.

Make at no extra cost, any changes or additions to materials, and/ or equipment necessary to accommodate structural conditions (pipes or ducts around beams, columns, etc.)

Install all ceiling mounted components (Diffusers, grilles etc.) in accordance with the reflected ceiling drawings, which are to be prepared by the Contractor, and coordinated with all trades/agencies engaged at site. These must be submitted for approval and be approved before any work commences on site.

Leave space clear and install all work to accommodate future materials and/or equipment as indicated and/or supplied by other agencies of work of the contract. Install all pipe runs, conduit runs, cable trays, etc., to maintain maximum headroom and clearances, and to conserve space in shafts and ceiling spaces and under floors, and to provide adequate space for service and maintenance.

Confirm on the site the exact location of outlets and fixtures.

3.1.6 SHOP DRAWINGS, BUILDER’S WORK DRAWINGS AND MATERIAL SUBMITTALS

After award of Contract, submit programme of works in bar chart schedule and action plan along with the programme, submit a schedule detailing proposed submission dates for all Material Submittals, Shop drawings and Builder’s work drawings. Allow few days to review by the Consultant/Client for each such submission.
Contractor must obtain, from the Consultant/Client, approvals of all materials, equipment and drawings within appropriate time to facilitate progress of work at site.

Prepare drawings in conjunction with all trades concerned, showing sleeves and openings for all passages through structure and all insert sizes and locations.

Prepare composite construction drawings, fully dimensioned, of piping and equipment in shafts, mechanical equipment rooms and areas, and all other critical locations to avoid any conflict arising thereof.

Shop drawings should include all details pertaining to access, cleanouts, tappings, sleeves, electrical connections, drains, location and elevation of pipes, ducts, conduits, etc., obtained from consultation with, and agreement of, all trades involved.

Prepare drawings of equipment foundation or support as the case may be. Prepare drawings for the support of ducts, pipes, electrical cabling with all details. Drawings for wall openings, trenches etc must be submitted for approvals.

Prepare all drawings to scale as agreed with the Consultant/Client. Generally, the scale shall be 1:50 for layouts and 1:20 for Details and Sections, etc. Forward these drawings, approved by all trades concerned to the Consultant /Client for review/records.

The Consultant/Client will only consider shop drawings bearing the stamp of the Contractor and all Subcontractors involved, check for all pertinent information such as physical dimensions, make, performance, electrical characteristics and indicate the intended use and location before submitting these drawings.

Assume responsibility for accuracy of equipment dimensions related to space available, accessibility for maintenance and service. Ensure that shop drawings indicate working weights of all related equipments.

Submission of technical submittals for all equipment and materials covered in the contract to be made upon finalization of the contract for approvals of Consultant/Client. The submission of samples, wherever raised by Consultant/Client, will be subject to the same procedure as that of shop drawings. One set of such samples shall be required to be brought and kept at site till completion of entire work.

The Consultant /Client will mark the drawings "Approved / Approved with comments / Revise and Resubmit / Not Approved. Same practice will be followed for the material submittals. Contractor will take action based on the comments accordingly.

The Consultant's/Client review shall not relieve the Contractor from responsibility for deviations from the Contract documents, unless he has, in writing, called the Consultant's/Client attention to such deviations at the time of submission of drawings. The Consultant's/Client approval shall not relieve the Contractor from the entire responsibility. Any approval by the Consultant/Client shall be on the understanding that any item submitted shall be ordered with options and modifications to fully meet the specification. Any fabrication, erection, setting out or other work done in advance of receipt of stamped drawings shall be done entirely at the Contractor's risk and cost.

Contractor shall submit one complete set of original drawings, as built drawing with updated details as per site conditions.

Contractor shall indicate foundation, water supply & electric power supply for HVAC equipment on drawing and same shall be coordinate with other respective agency in coordination with Consultant/Client before execution of work.

Furnish prints of the reviewed details to all other parties who may require them for proper coordination of their work, and furnish all information necessary for the work as a whole.

Obtain Manufacturers’ installation directions to aid in the proper execution of the work.

3.1.7 OPERATION AND MAINTENANCE MANUALS
Upon successful Testing & commissioning, submit one draft of Operation and Maintenance Manuals for review and approval of Consultant /Client.

The minimum information required is as follows:

(a) Catalogs highlighting the Make, Model, Sr. No and other necessary details for all Material, test certificate, Manuals and Equipment installed.
(b) List of Local Agent / Supplier for all Materials and Equipment with Telephone, Fax and Email address.
(c) Detailed description of systems operation.
(d) Procedures for Preventive regular and the breakdown maintenance, with Manufacturer's Operation and Maintenance Catalog for all Systems / Equipments.
(e) Commissioning date for all Systems / Equipment.
(f) List of recommended spares.
(g) Trouble shooting – Cause / Remedy charts.
(h) Safety procedures.
(i) Startup / Shutdown interlock sequence.
(j) Emergency / Shutdown log sheet format.

Upon approval of the draft by the Consultant, submit 4 set of manuals to Consultants for onward submission to Client.

3.1.8 COOPERATION

Confer with all trades installing equipment, which may affect the work, and arrange equipment in proper relation with that equipment installed under all Divisions of the Contract.

Furnish all items to be built in by others, in time, complete with all pertinent information, commensurate with the progress of the work.

Store materials neatly and out of the way and clean up all refuse caused by the work daily, to ensure that it does not disturb or hamper the work of other agencies.

3.1.9 PROTECTION AND STORAGE

Protect the buildings and structures from damage due to carrying out of this work.

Protect all mechanical & electrical works from damage. Keep all equipment dry and clean at all times.

Cover all openings in equipment and materials. Cover all temporary openings in ducts and pipes with polyethylene sheets or caps until final connection is made.

Any damages to the equipment and material resulting from improper protection and storage arrangement made by contractor will have to be made good at his own cost, failing which the same be liable for rejection.

Due care must be exercised while installation/erection of equipment and material, to avoid damages to the equipment and material mentioned in this division and the work/material of other agencies.

Contractor to include for all necessary insurance coverages for their workers & material at site, copies of the same be produced prior to commencement of work.

3.1.10 EXISTING WORK AND EQUIPMENT

Before Contractor undertakes work in any area he must prepare a list of deficiencies in that area which affect his works, or which could possibly be construed as being caused by himself if not noted. In the event that such deficiency list is not prepared, then he shall be deemed responsible for such deficiencies. Any list shall be brought to the attention of the Consultant/Client forthwith.
3.1.11 SUPERVISION.

The contractor will maintain at site, as necessary for the performance of the Contract, qualified personnel and supporting staff, with proven experience in erecting, testing, and adjusting projects of comparable nature and complexity. Such staff will be fully dedicated to the project and be available at site for continuous supervision activities.

Before commencing work the Contractor will submit details of the proposed Engineers and Supervisors, including copies of their qualification and experience Certificates. If in the Consultant's/Client opinion the proposed Engineers or Supervisors are not adequately qualified or are otherwise unacceptable, the onus is on the Contractor to submit alternates until such approval is given.

Where the Contractor's staff becomes during the Contract deficient in performance, the Contractor is to remedy the situation by immediate and appropriate replacement, to Consultant's/Client approval.

Approval of the Contractor's Engineers or Staff shall in no way prevent the withdrawal of that approval at any time during the Contract should the Consultant/Client so desire. In the event of such disapproval, Contractor will be required to rectify the position as stated above.

In the event of any negligent or severely detrimental behavior the Consultant/Client has the right to order the removal from site of any Engineer, Supervisor, or worker on a "forthwith" basis.

3.1.12 WORKMANSHIP.

Good workmanship and neat appearance are the prerequisites for completion with the various sections of this specification. Work shall carried out in accordance with the statutory rules and conform to relevant rules and I.S Specifications.

Install equipment, ductwork, conduit and piping in a workmanlike manner to present a neat appearance and to function properly to the satisfaction of the Consultant/Client. Install ducts and pipes parallel and perpendicular to the building planes. Install all piping and ductwork concealed in chases, behind furring, or above ceiling, except in unfinished areas. Install all exposed systems neatly and group to present a neat appearance.

Install all gauges, thermometers, etc., to permit easy observance.

Install all equipment and apparatus which requires maintenance, adjustment, or eventual replacement with due allowance for this.

Install valves to guarantee proper sensing. Shield elements from direct radiation and avoid placing them behind obstructions.

Install all panels and boards, etc., to permit easy operation.

Include in the work all requirements of Manufacturers as shown on their drawings.

Replace all work unsatisfactory to the Consultant/Client without extra cost and to the standard required by the Consultant/Client. This applies to any item, which is found to be defective in service during the maintenance period, or extended maintenance period as appropriate.

If the contractor employs sub-contractors for works like equipment installation, ducting, piping, insulation etc., the same is to be communicated in advance to the consultant/Client with a detailed profile of the sub-contractor including their experience, skilled personnel and machine/tools availability for undertaking such works. The sub-contractor can start work only after acceptance/clearance issued by consultant/Client.

3.1.13 MATERIALS AND EQUIPMENT.
All materials used on the project shall be brand new and in compliance with the technical specification mentioned in the contract. Equipment/material Manufacturers mentioned in the list of makes alone will be accepted. Obtain approval of all manufacturers from the Consultant/Client. Contractor is advised not to submit any brand, which does not appear in the “List of approved makes”.

“New” is defined as newly manufactured, and delivered to site as such. Any Equipment which in Consultants/Client opinion second hand or has been mishandled before delivery to site, shall be rejected.

All materials used on this project shall bear the third party quality assurance stamp like British Standard kitemark, UL, FM, and/or other quality assurance authority as appropriate, in the opinion of the Consultants.

Each equipment should be factory tested and certified all QA/QC test certificates to be submitted for review of consultant. If deemed necessary factory inspection may be undertaken by consultant/client.

Each equipment should be properly tagged, with name plates carrying all details relevant to the machine for ease of identity and reference.

3.1.14 CLEANING.

Each day as the work proceeds and on completion, clean up and remove from the premises all rubbish, surplus material, equipment, machinery, tools, scaffolds, and other items used in the performance of the work. Clean out dirt and debris and leave the buildings broom clean with no stains and in a condition acceptable to the Consultant/Client.

Where electrical items form part of the visible finish in the rooms, protect from over-painting, etc. and give all items a final cleaning before handing over of the project.

3.1.15 ACCESSIBILITY.

Each item of equipment shall be located so as to be accessible for maintenance or repair without removing adjacent structures, equipment, piping, ducts, or other materials. For the large Air Handling units the Contractor shall ensure that these can be built up on site from components, which can be taken into the area.

Any item of equipment needing maintenance shall be located so as to be accessible for maintenance or repair without removing adjacent structures, equipment, piping, ducts, or other materials.

3.1.16 CUTTING AND PATCHING.

Inform all other Divisions in time concerning required openings.

 Obtain the approval of the Consultant/Client before doing any cutting. Supporting members of any floor, wall or the building structure shall only be cut and in such a manner as approved by the Consultant/Client. All reinstatement work must be done to the same standard as the original work.

3.1.17 INSERTS, SLEEVES AND CURBS.

Under this section supply necessary sleeves and other inserts to other trades.

Use only factory made, threaded or toggle type inserts as required for supports and anchors, properly sized for the load to be carried. Place inserts only in portions of the main structure and not in any finishing material.

Supply and locate all inserts, holes, anchor bolts, and sleeves in good time when walls, floors, and roof are erected.

Pass insulation unbroken where pipe or duct is insulated. Size sleeves to provide adequate clearance all around.
Use the following materials for pipe sleeves:

a) Through all interior walls above grade use PVC Class 150 pipes, machine cut, flush with finished structure.

b) Through all exterior walls above grade use PVC Class 150 pipes, machine cut, flush with finished structure inside and to suit flashing on outside.

c) Through all exterior walls below grade and all other waterproof walls use PVC Class 150 sleeves, machine cut. Check flashing specification for further details.

d) Through all waterproof floors, janitor's closets, mechanical rooms, kitchens, roofs, use PVC Class 150 sleeves, machine cut. Extend sleeves 100 mm above finished floor upwards and cut flush with underside of floor. Refer to flashing detail through waterproof floors.

e) Provide 100 mm high, 100 mm wide watertight concrete curbs with 20 mm chamfered edges around all pipes passing through waterproof floors except where furred in. ReadConcrete specification before proceeding with curbs.

Pack all sleeves between the insulated pipe and the sleeve or where un-insulated between the pipe and the sleeve with loose fiberglass insulation. Seal the annular space as follows:

a) For all horizontal sleeves in exposed areas, use a seal equal or better fire rated than the wall to be sealed.

b) For all vertical sleeves through roofs, janitor's closets, equipment rooms, use permanently resilient silicone based sealing compound, non-inflammable and waterproof.

Ensure that the seal is compatible with floor and ceiling finishes. Check the room finishing schedules for further details and clarify if necessary with the Consultant.

c) Through roofs, provide curbs and sleeves as shown on drawings and to suit flashing requirements.

Use the following sleeving for ducts:

For rectangular duct openings through walls and floors a removable hardwood box-out shall be provided of the required size. Soft wood or plywood will not be acceptable.

Wherever applicable, through fire walls, build fire dampers into wall, or make detailed fixing in accordance with Consultant's/Client instruction. Through floors where ducts are not furred in or enclosed in a duct shaft, provide 100 mm high and 100 mm wide watertight concrete curbs, with 25 mm chamfered edges all around. Extend sleeves where used flush to top of curb. Read Concrete Specification before proceeding. Through floors where duct is enclosed in a duct shaft or furred in, provide the watertight curbs at the extreme top and bottom only.

After ducts are installed, pack the opening and seal the packing as follows:

a) Use fiberglass insulation for packing.

b) Seal the packing in openings through floors with permanently resilient silicone base non-inflammable waterproof compound. Press duct supports firmly down into caulking before bolting it down to curb.

c) Through all vertical walls seal the fiberglass packing using permanently resilient silicone based sealant.

Brace duct sleeves and box-outs to retain their position and shape during the pouring of concrete and other work.
Provide bracing for each duct at every passage through structure to prevent sagging.

3.1.18 ACCESS PANELS AND DOORS.

Install all concealed mechanical equipment requiring adjustment or maintenance in locations easily accessible through access panels or doors. Install systems and components to result in a minimum number of access panels. Indicate access panels on as-built drawings.

Provide the respective Division of work with panels, doors or frames, complete with all pertinent information for installation.

Ensure that access doors are installed in a manner to match the building grids where applicable.

Prepare detail drawings showing location and type of all access doors in coordination with other trades before proceeding with installation and hand these to the Contractor to obtain approval.

Size all access doors to provide adequate access and commensurate with the type of structure and Architectural finish. Should it be necessary for persons to enter, provide a minimum opening of 600 x 450 mm.

Ensure proper fire rating of access doors in fire separations

Lay-in type ceiling tiles, if properly marked may serve as access panels.

3.1.19 GENERAL WELDING REQUIREMENTS.

All welding shall be generally in accordance with ANSI B31.
Tack welds shall be performed by fully qualified welders and all tack welds shall be of a length equal to twice the pipe thickness and shall fully penetrate the pipe walls wherever required.
Where welding is carried out in the proximity of inflammable materials special precautions shall be taken to prevent risk of fire or other damage to the building fabric.

Where oxyacetylene cutting equipment or any welding plant is being used by an operative for any of the works defined in the contract documents, then fire extinguishers shall be supplied and carried as part of the equipment. The operators of cutting and welding equipment shall be trained in the use of the fire extinguishers, which they carry and all extinguishers shall be fully charged and ready for use. In all cases, extinguishers shall be positioned immediately adjacent to the position where cutting and welding is being carried out and shall be readily accessible for use in the event of an emergency.

All accommodation, benches, tools, welding plant, acetylene, oxygen or electricity, filler rods and electrodes, which are necessary for installations where welding is required shall be provided as part of this contract.

Welding shall not be done at a temperature of 5 degrees Centigrade or below unless the parent metal is preheated by torches or other approved means until it is warm to the hand (about 27 degrees C) for about 150mm either side of the joint. No welding shall be done below minus 18 degrees C. After preheating, the heated portion including the welded joints shall be covered with muffs or suitable insulation materials to allow cooling free from draughts. Any open ends of the pipe or assembly shall be effectively sealed to prevent heat flow by convection.

All welded pipe assemblies shall be constructed so that individual welded joints do not affect each other. The distance between the centres of adjacent welds shall be not less than twice the bore diameter of the pipe.

No welded joints shall be left partially completed. Any joints tacked in position must be promptly finished within the working day. The Consultant/Client will reject all work not done in accordance with this instruction.

Where work is rejected, pipes must be machine cut at least 150 mm either side of rejected welds and proper weld preparation must be used on the shortened sector. Where shorter fill-in sections are required...
because of such rejection and reworking, then new full sized lengths must be supplied by the Contractor.

Where pipes with longitudinal seams are specified, pipe seams shall be arranged such that adjacent seams are opposed 45 deg. from each side of top dead centre and branches shall be made only with weldable fittings.

All filler metals which are coated shall be protected from excessive moisture changes. Filler materials or flexes which show any sign of deterioration shall not be used. If requested by the Consultant/Client samples of filler rods to be used shall be submitted to him for approval before any work is done on site.

3.1.20 TESTS FOR WELDER QUALIFICATION.

The purpose of the welder's qualification tests is to determine the ability of the welders to make sound and acceptable welds. Before any site welding on the contract is allowed, each proposed welder shall carry out the tests required in the presence of the Consultant/Client.

Any weld test specimens which have been suitably marked and approved shall be kept on site by a responsible person, so that they can be produced at any time, at the request of the Consultant/Client.

All accommodation, benches, tools, welding plant, acetylene, oxygen, electricity, test pieces, filler rods, electrodes, facilities for cutting and grinding, polishing, bending and examining, which are necessary for welders qualification tests shall be provided by the Contractor. In the absence of any items for inspecting the welds, the Consultant/Client may submit the finished samples to an independent laboratory for testing at the Contractor's expense.

Under no circumstances shall a welder be employed on the contract, either on or off the site for welding operations other than those for which that welder is qualified.

Copies and records of all test reports shall be promptly given to and kept by the Consultant further submission to Client.

Even welders holding a certificate for welding are to be tested at this job site in full accordance with the specifications.

The Contractor shall be responsible for the quality of welding and brazing and shall provide the testing of the welders employed. Certificates of such proficiency test, together with stamped samples provided for Engineer's review before welding work is commenced.

Qualification tests certified by consultant will be made for butt and branch welds in pipes. One test piece per welder will be required for the qualification of welding of pipes exceeding 100m nominal diameter.

In addition, test pieces will be required for each position of a pipe. These positions will be horizontal and rotated while welding, horizontal and fixed while welding, vertical and fixed while welding for each range of nominal diameters specified.

3.1.21 PAINTING AND IDENTIFICATION.

All painting of plant, equipment, storage vessels, ducting, pipes, refrigerant piping, and the like shall be carried out by contractor.

Painting shall be applied to all exposed pipe work, ductwork and associated components, valves, fittings, etc., equipment, supports of any kind, insulation, plain mild steel, copper, or cast iron surfaces, refrigerant piping. Steel piping shall be painted even if to be insulated, before insulation is carried out.

All the refrigerant & water piping should be painted as per the standard colour code.
The following items do not require site painting:

(a) Insulation having any of the following finishes:
   (1) Aluminum foil.
   (2) Metalwork.
   (3) Polysisobutylene sheeting/ bitumen coating.
   (4) Vinyl-glass/ resin-aluminum foil laminate.

(b) Equipment or plant or supports or frames delivered to site with any of the following finishes:
   (1) Painted finish, other than primed only, provided that the finish is not damaged in any way.
   (2) Stainless steel or plastic coated steel.
   (3) Stoved enamel.

All surfaces to be painted shall be prepared by thoroughly cleaning and removing all rust, grease, oil, dirt and surface corrosion, using wire brush, emery paper and/ or degreasing medium as required. The paint shall be applied in accordance with the maker's instructions and the type of paint to be used shall be in accordance with the following:

For factory applied finishes, repainting or refinishing of any surfaces damaged during shipping, erection or construction shall be done using only factory-supplied materials. After finished painting is completed, identify each piped and ducted service. Locate identification and flow arrows:

(a) Behind each access door.
(b) At each change of direction on all joining pipes and ducts.
(c) At not more than 10 meters apart in straight runs of exposed pipes and ducts, but on both sides of sleeves.
(d) At not more than 10 meters apart in straight runs of pipes and ducts behind removable enclosures such as lay-in ceiling but on both sides of sleeves.
(e) Above each floor or platform for vertical exposed pipes, preferably 1.5 meters above floor or platform level.

P.V.C. tape identifying bands may be used as an alternative.

Use stencils and stencil paint onto all piping and ductwork. After completion of the works provide to Owner usable stencils for each service. Use wording shown in the description section of the legend on the Mechanical Drawings, or as instructed in writing by the Consultant/Client.

Wherever insulation is to be painted, the paint used shall comply with all the fire resistance requirements for insulation finish, and shall be carried out by the insulation subcontractor.

In all cases the actual grade of paint to be used shall be suitable for the operating surface temperature and shall be approved by the maker for the application concerned. In certain cases the grade of finishing coat may not require the application of undercoats; in which case these may be omitted, provided that the Consultant's/Client approval in writing is obtained beforehand.

All insulated or un-insulated pipework in concealed positions shall be identified by means of 75 mm wide identification bands, painted neatly on, at right angles to the pipe axis at intervals not greater than 3 meters.
In addition the name of the service and pipe diameter shall be stenciled on in a visible position with an arrow indicating the direction of flow. Flow and returns shall have the letter “F” or “R” added to the identifying name. The identifying band colours and the finishing colour of the services to be painted shall be agreed with the Consultant/Client prior to application, but for tendering purposes shall be in accordance with the colours and procedures given in ASHRAE Guides.

Conditioned Air Supply: Blue
Conditioned Air Return: Purple
Fresh Air: Green
Toilet Exhaust: Brown
Kitchen Exhaust, concealed: Red
Condensate: White

Ductwork shall be identified in accordance with the procedures laid down in SMACNA.

All equipment located in concealed positions shall have a nameplate secured to the item giving the following information:

Equipment reference number (as indicated on the record drawings.)
System.
Room/ Area served.
Duty/ output information.

The nameplate shall be 100 x 100 mm approximately, of white plastic 3 mm thick with the above information engraved in black lettering and the plate shall be secured by screws, bolts, clips, etc., as appropriate to the item concerned.

This plate is in addition to any nameplate supplied by the manufacturer of the item giving detailed specification information for the equipment.

3.1.22 FLUSHING AND CLEANING.

Flush all fluid-carrying systems after completion as specified elsewhere. Discharge the flushing fluid through all strainers and out through line sized valves with hose ends. Clean all strainers. Repeat flushing operation to the approval of the Consultant/Client until the water is running clear, colourless and odourless.

3.1.23 INSPECTION, TESTING AND ADJUSTING.

All the works provided as part of this Contract shall be commissioned in accordance with all relevant Specifications and Codes of Practice (ASHRAE / CIBSE) and to the entire satisfaction of the Consultant/Client.

The Contractor shall employ the services of a specialist company approved by the Engineer regularly engaged in providing a testing balancing and commissioning service.

Carry out all tests specified. Carry out all tests required by Authorities having jurisdiction. Test equipment to the requirements of, and where necessary, in the presence of the Manufacturer.

Provide all equipment, labour, and instruments, loading devices, incidentals, and pay for all fuel, power and sundries required to carry out the tests.

All installations shall be inspected and tested in sections as the work proceeds and on completion as composite systems and it shall be noted that the Consultant/Client or any of the other relevant Authorities may require inspecting or testing any equipment during manufacture at the Manufacturer's works. All necessary arrangements shall be made as part of this Contract.

All tests shall be arranged in cooperation with the Consultant/Client and his Engineer and all other
All necessary skilled and unskilled labour shall be provided for attendance during the tests (including pre- and post- test activities,) and the test media shall be provided and subsequently disposed of except where specifically stated otherwise.

The testing and adjusting is the contractual responsibility of the Contractor but actual performance of the tests is expected to be the sole responsibility of the Specialist Company.

Have all testing and balancing performed by only persons who are thoroughly versed in this type of testing and balancing and with proven ability. Submit names, complete with experience records, and references for approval of the Consultant/Client.

Any defects occurring at any time during the test duration shall be made good and a complete re-test shall be carried out, all at no cost to the Contract.

Prepare test report forms for each test to be performed and submit these to the Consultant/Client at least two weeks prior to the commencement of any tests.

Test only after the system installation has been completed and the system has been put into continuous operation. Perform the testing, adjusting, and balancing when outside conditions are commensurate with the design conditions for the given system. Add dummy loads to the system if outside and inside conditions are less severe than the specified points.

Duplicate signed test certificates shall be provided after each test, which will be countersigned by the Consultant/Client who witnesses the test for further submission to Client. The test certificate shall give the following particulars:

- Apparatus or section under test.
- Maker's number (if any).
- Nature, duration and conditions of test.
- Result of test.

No test shall be valid until the test certificate is provided.

Duplicate copies of test certificates carried out at Manufacture's works shall be forwarded to the Consultant/Client for approval prior to dispatch of the article to site.

No section of the works shall be insulated or in any other way concealed prior to testing and inspection and subsequent concealment where applicable shall only take place following written authority from the Consultant/Client.

All necessary facilities, measuring and recording instruments including test pumps and gauges for inspection, testing and commissioning requirements shall be provided and shall be checked or calibrated as necessary before use.

The Consultant/Client reserves the right to call for a demonstration of the accuracy of any instruments provided.
All representatives present during inspection, testing and commissioning shall be fully conversant with the system concerned and the method of system and instrument operation.

Manufacturer's or Specialist Subcontractors' representatives shall attend where specifically indicated elsewhere in the specification or where necessary to ensure full service and cooperation is available to the Consultant/Client to enable the works to be tested and commissioned in accordance with the requirements of the specification.

All necessary precautions shall be taken to safeguard against damage during inspection, testing or commissioning. Any damage so caused shall be made good at no cost to the contract.

All tests shall last for the minimum time period stated or longer if necessary to ensure all sections have been fully examined as required by the test.

3.1.24 INSPECTION OF THE WORK.

The representatives of the Client and the Consultant will make periodic visits to the site during construction to ascertain that the work is being executed in reasonable conformity with all plans and specifications, but will not execute quality control at all times. Contractor must maintain site order book and quality control as intended in the contract documents.

Correct all deficiencies immediately as noted during field inspections.

Request in writing that a final inspection of all services.

Do not issue this written request until:

All deficiencies noted during job inspections have been corrected.

All systems have been balanced and tested and are ready for operation.

All balancing reports have been submitted and reviewed.

All instruction manuals have been submitted and reviewed.

The cleaning up is finished in all respects.

All spare parts and replacement parts specified have been provided and receipt of the same acknowledged.

3.1.25 TESTING & COMMISSIONING OF SERVICES.

All checks and tests as per the manufacturer's drawing/manual, relevant code of installation and commissioning for various type of equipments shall be carried out by the contractor as part of installation work.

All piping systems shall be flushed, chemically cleaned and then filled with treated water, or appropriate fluid, vented as necessary, and brought to operating conditions and the flows then regulated to the design values.

All water circuits shall be balanced by means of the regulating valves provided and flow rates shall be determined on a temperature and pressure drop basis. Flow through pumps shall be measured by relating the pressure drop across the pump to manufacturers test curves. A copy of the test curve indicating the final operating point shall be forwarded to the Consultant for further submission to Client.

All refrigerant systems shall be tested for leaks and vacuum shall be held for at least 24 hours before breaking with nitrogen gas and Vacuumed, purged and charged according to A.S.H.R.A.E. standard methods. All safety controls and interlocks will be tested as part of the commissioning procedures.

Flow through coils shall be adjusted to give the design temperature difference. In general water
systems shall be balanced in accordance with the guidelines. Upon completion of balancing and testing operations for heating and cooling systems, temperature measurements shall be taken in all rooms and the readings tabulated in schedule form together with hourly ambient temperature readings taken over the measuring period. Two copies of the schedule shall be forwarded to the Consultant for submission to Client.

All ventilating systems shall be commissioned in accordance with the procedures recommended. Duplicate schedules of commissioning results shall be forwarded to the Consultant/Client and shall detail the recorded air volume and percentage deviation from design air volume, for each air input and extract terminal. Wet and dry bulb temperature measurements shall be taken in all rooms served by air supply systems and the results indicated on the schedule of commissioning results. Also ventilation fan shall be tested for the capacity, spray performance, static pressure of fans, power consumption, noise level and vibration isolation and result shall conform to the approved data furnished by the contractor.

These shall be recorded together with external ambient wet and dry bulb temperatures measured at hourly intervals over the measuring period.

Sound pressure levels (dBA) shall be measured in all rooms containing supply or extract terminals, all plant rooms, all rooms immediately adjacent to plant rooms and all rooms located above or below plant rooms. The Consultant/Client may at his discretion request a spectrum band analysis of sound pressure in any locations.

All motors shall be meggered and a minimum IR value of 1 megan shall be obtained.

All automatic controls shall be commissioned by the controls supplier.

Fault conditions shall be simulated and all alarms and safety devices shall function correctly. Such proving tests shall be carried out in the presence of the Consultant/Client and certificates shall be provided specifically detailing all check procedures, which have been carried out.

The Consultant/Client may ask for additional tests on site that are necessary to determine the works compliance with the specification, manufacturer’s guarantee/instructions or the applicable code of installation. The contractor shall carry out such additional test also.

3.1.26 SYSTEM ACCEPTANCE.

The ultimate condition for system acceptance is that the Consultant/Client have inspected the system and found it to be acceptable, and indicated this in writing.

Submit original copies of letters from manufacturers of all systems indicating that their technical representatives have inspected and tested the respective systems and are satisfied with the methods of installation, connections and operation.

Submit, "As built" drawings and operation and maintenance manuals.

Train HAL maintenance staff.

3.1.27 CORRECTION AFTER COMPLETION.

Remedy all work in accordance with the General Conditions of Contract during the Maintenance period.

Attend immediately to any and all the defects occurring during the period defined above and repair in a manner to prevent recurrence. This contractor is responsible for all work required by other trades necessary to repair the works of this section, or necessary to repair damage caused by the failure of any part of this section.

Instruct all Suppliers and Manufacturers that guarantees on equipment will commence when the completed work is accepted and not from the date the equipment is put into operation. In the event that this condition is omitted by the supplier, or if subsequent cost to the Client is involved, in such cases Contractor shall be liable for bearing such costs.
3.1.28 GUARANTEES

The Contractor will guarantee all material and workmanship for at least 12 months after successfully commissioning and take over by the Client. During which period any or all components found to be defective shall be replaced or repaired free of cost and any short coming found in the system as specified shall be removed at no extra cost. The contractor shall provide the necessary personnel and tools for fulfilling the above guarantee. If the defects are not removed within a reasonable time the owner may arrange to rectify the same at contractor risk and without prejudice to any other right.

Also party has to submit all guaranty certificates of the HVAC equipments.

All guarantees from equipment suppliers will be vested in the Client, regardless of whether the Contractor who supplied the equipment is still associated with the project or not.

Guarantees will be full guarantees and will include all overhead, profit, incidental charges and sundries.

Where damage is caused to any other item by any failure of the item guaranteed, then the guarantee shall also include the costs incurred in rectifying that damage.

3.1.29 MAINTENANCE.

Maintenance is defined as the Contractual Liability to maintain the equipment in working condition, PLUS the regular checks and servicing of equipment during the maintenance period, including all the consumables and spare parts to keep the equipment in best working order.

Regular maintenance shall be as necessary, but in any event not less frequently than monthly. Breakdown calls shall be attended immediately.

3.1.30 SAMPLES

The contractor should submit two set of samples of accessories or apparatus that are proposed to use for consultants/client for approval.

3.1.31 GENERAL TERMS AND CONDITIONS

(a) All tools, tacks and returnable items should be brought by the contractor within the premises of HAL on the contractor’s delivery challan. It will be contractor’s responsibility to take coordination from HAL security on the Delivery challan while bringing the items inside the premises of HAL. The contractor also required to preserve all the challan in separate files.

(b) The party /contractor may take his returnable material out of the HAL premises for repair or replacement or on permanent basis after completion of the work. Necessary Non-returnable gate pass will be issued by the concerned engineer-In charge of HAL on the basis of the material incoming delivery challan against which the material was brought inside the factory.

(c) The Contractor will be fully responsible for the quality of all material incorporated or brought for incorporation in the work.

(d) Contractor will be fully responsible for the safety of their personnel employed for execution of HVAC works.

(e) Contractor should follow all relevant codes and IS standards for HVAC equipments.

(f) For the material supplied like HVAC equipment, contractor should supply test certificates, from the OEM and conformance to tenders specifications.

(g) In case of major items the contractor should offer the same for Pre dispatch Inspection. However the cost incurred on PDI in respect of the HAL team deputed for PDI shall be borne by HAL.

(h) The contractor should intimate in advance the readiness of the item for PDI along with following relevant details: a) Item to be inspected b) Place of Inspection. Subsequent on receipt of intimation of PDI, either the PDI will be carried out or based on the testing reports and standard document submitted before PDI, the same may be waived off. The decision of waive off PDI rests with HAL.

(i) All test certificate, manual and catalogued & all the testing /commissioning report of the same should be persevered by the contractor in separate files. The same should be produced as and when required by the monitoring in charge during the execution of the work and finally submitted at the
(j) The contractor has to supply various HVAC materials in suitable lots commensurate with the planned phase wise execution of the work so as to ensure optimum utilization of supplied material.

(k) Contractor has to co-ordinate with other division in advance for HVAC related civil & electrical works.

(l) A name board of the installation showing all details of the plant to be made and installed in the plant room by the contractor free of charges.

(m) The contractor shall also furnish all necessary consumables like anchor bolts and nut, crawl plugs, hockshop blades, taps, dies, files, wire brushes, necessary pipe scaffolding, ladders, wooden and consumable material like oxygen, greases, nitrogen, fasteners, gasket, refrigerator gas, supports, cotton wast and other miscellaneous supplies of every kind required for carrying out the work under the contract.

(n) The contractor shall not dispose off transport or withdraw tools, tackles, equipment and material provided by him for the contract without taking prior written approval from consultant/Client. Consultant/Client at all times shall have right to refuse permission for disposal, transport or withdrawal of tools, tackles, equipment and material if in this opinion, the same will adversely affect the efficient and expeditious completion of the project.

(o) The contractor should furnish the details of all tools like welding & brazing equipments, testing equipments, test connection and kits etc, required for complete installation, testing and commissioning of the items included in the contract.

(p) The contractor should co-operate with other contractors at site in all matters of common interest through the consultant/Client/Engineer-in-charge, so that there should not be any obstruction to others and to ensure the safety of all personnel and works covered under this specification.

(q) The work should be carried out strictly as per the technical specification and execution drawing. In case of any doubt/misunderstanding as to correct interpretation of the drawing or specifications, necessary clarifications shall be obtained from consultant/Client. The contractor shall be made responsible for any damage to the equipment consequent to not following manufacturer’s instructions correctly. All necessary drawing, manufacturer’s manuals shall be furnished to Client and a copy to consultant.

(r) Any mis-handling or loosing of equipments/component parts, after taken over by the contractor from client/manufacture till the complete installation/inspection shall be contractor responsibly only.

(s) The contractor shall not touch-up painting on any equipment indicated by the client/consultant, if the finish paint on the equipment soiled or marred during installation or handling.

(t) The contractor should verify the exact quantities of materials/equipments required after site measurements as per execution drawings by the engineer before procuring the same.

Please note excess quantities of material supplied without prior approval from Consultant/Client are at contractor risk and Client will not be responsible for taking back material.

3.1.32 HANDLING OVER AND TAKING OVER OF WORK/EQUIPMENT/SYSTEM

The contractor should hand over the works/equipments/system covered under this contract only after they have been completely installed, tested and commissioned in all respect by the Contractor to the entire satisfaction of the Client/Consultant and all relevant test forms/certificate operation and maintenance manual’s as built drawing etc.shall be forwarded to the consultant/Client. Any incomplete/partly commissioned works/equipments/system will not be taken over by the Client. In this regard, the decision of the consultant/Client will be final and binding on the contractor.

3.1.33 SAFE CUSTODY AND STORAGE

Safe custody of all equipment supplied by the Contractor shall be his own responsibility till the final taking over by the owner. He shall therefore, employ sufficient staff for watch and ward at his own expanse. The owner however, allows the contractor to use the plant room.weather maker room, etc for temporary storage of equipments if such space is ready and available.

3.1.34 REJECTION OF DEFECTIVE PLANT

If on test run or commissioning of any portion of the system, equipment or components are found to be defective or not fulfilling the intent or the meaning of specifications, the same shall be replaced or repaired to the entire satisfaction of Client.
In case the contractor fails to remove the defects, within a period considered reasonable, the owner reserve the right to take necessary remedial measures through other agencies and all expenses thus incurred would be recovered from Contractor.

3.1.35 Extra Item:

If any need arises for any additional item during the execution of work as per the site condition and not covered in the Bill of Quantities, the rate shall either be derived from the tenders items or substantiated by a rate analysis.

3.1.36 SCOPE OF WORK

Scope of work under this package covers the manufacture, inspection, supply, installation, testing, balancing, commissioning, handing over, testing (including performance testing at contractors works and / or his subcontractors works), delivery to site, storing and handling at site, carrying out acceptance test, completion of validation procedures as Installation Quality, Assurance (IQA) and Installation Quality Control (IQC) standards at site for the entire HVAC system as per BOQ and as described in the tender technical specifications to the complete satisfaction of the client.

It is not the intent to specify completely herein, all the details of design and construction of the equipment and system. However, the equipment and system shall conform, in all respects, to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation in a manner acceptable to the Project Consultant / Client, who will interpret the meaning of drawings and specifications, and shall have the power to reject any work or materials, which, in his judgment, are not in full accordance therewith.

Quantities, sizes and capacities of various equipment/material mentioned in this specification and enclosed drawings are for contractor’s guidance only. Contractor shall carefully check the above-mentioned details while selecting and offering the equipment, System components complete.

The extent of supply under this contract includes all items shown in the bid drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification or schedules, notwithstanding the fact such items may have been omitted in the drawings. Also such of those items not specifically included in the specifications and drawings, but which are required to complete the intent of the contract shall also be deemed to be within the scope of supply of the Contractor.

Such other works which are not included in the aforesaid Bill Of Quantities are generally intended to be executed through a separate agency. Notwithstanding the above, the clients reserve the right to order additional works under the same contract. The clients also reserve right to omit any item of work included in the aforesaid Bill of Quantities and award the same to any other contractor or not perform it at all at their discretion and the Contractor shall not have any claim because of the same. This specification covers only the broad outline of the HVAC facility, Electrical and Mechanical system to be provided. It is the contractor’s responsibility to check and satisfy himself that the requirements / capacities of the equipment / system wherever indicated in this specification are adequate to meet the stated design. The contractor for this work shall be required to work in co-operation with other agencies on site and give them all reasonable assistance and help for execution of the work in an efficient manner.

3.1.37 GENERAL

The general character and the scope of work to be carried out under this contract are illustrated in Drawings, Specifications and Bill of Quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Project Consultant / Client.

3.1.38 ASSOCIATED WORKS

CIVIL & ELECTRICAL WORKS
Civil works like plant room, foundation of HVAC equipments, false ceiling with opening for grills and diffusers along with wooden frame work, wall opening for intakes, supply & return air duct, dampers, fire dampers, pipes and cables and then making good these opening by sealing them and finishing the same with P.O.P. Water supply required for AHU unit with piping and valves. HVAC contractor has to indicate in advance on civil contractor drawing before execution of works. Main incoming power cabling including earthing and termination to main panel of AHU, ventilation fan and split type A/c shall be done by electrical contractor. HVAC contractor has to indicate in advance on electrical contractor drawing before execution of works.

SECTION 2

HVAC EQUIPMENT

1.0 SCOPE OF WORKS.

1.1 The Scope of this section comprises supply, erection, testing, commissioning, balancing adjustment and setting to work of the following systems conforming of these specification and accordance with drawing and of the schedule of quantities:

- Air-conditioning system
- Ventilation system.

1.2 Contractor is to assume full responsibility for the correct functioning of the system and to carry any liability or other insurance or guarantee as may be necessary to protect all parties in this regard.

1.3 Contractor shall be responsible for coordination with other trades and services and shall provide all materials, labour and supervision, equipment, tools, appliances, services, etc. for carrying out the following items of work:

- Supply and install of air conditioning and ventilation plant and equipment.
- Insulated ductwork complete with air terminals, dampers, supports, etc.
- Electrical Controls and control panels.
- Motor control centres and starter panels complete with cabling and earthing from the panels to the respective equipment. Power supply upto the panel shall be the responsibility of the electrical contractor.
- Power supply to fan coil units, air handling units, Ventilation fans etc. Electrical power supply terminating in an isolating switch within 2 metres of the equipment shall be the responsibility of the electrical contractor.
- Insulated drain piping from each air handling unit/fan coil unit to the nearest drain point. The drainage contractor shall be responsible for provision of a floor drain in each mechanical room.

1.4 The contractor shall also include all overheads at office and site, labour, sundries, plant, appliances and consumable both for the works and for balancing, testing & commissioning, and during the maintenance period.

1.5 Air cooling, Exhaust and split A/c's shall be supplied and installed by other agency. Contractor has responsibility to coordinate with this agency for positioning of AHU installation with fitting of ducting and all associated related work and balancing of air flow rate as per the requirement for execution of entire work.

2.0 DESIGN PARAMETERS

Design, in general, shall be based on ASHRAE recommendation with the following particular requirements:
2.1 DESIGN TEMPERATURE CONDITIONS

a) External
   Summer - 108 °F DB & 75 °F WB.
   Monsoon - 101 °F DB & 83 °F WB.
   Winter - 50 °F DB & 43 °F WB

b) Internal - 72+/2 deg F & 60 % RH

c) Performance Base: - Nasik - Elevation level conditions.

2.2 VENTILATION REQUIREMENTS

As shown on ventilation plans.

2.3 NOISE LEVELS – As per ASHRAE stds for various applications

2.4 Air Distribution

Duct Velocity, supply : 1250 – 1400 FPM
Duct velocity, return : 1100 – 1250 FPM

2.5 PRESSURIZATION PHILOSOPHY

Fresh air requirements to each zone shall be generally determined by the level of dirty extract to that same zone, or to a value as required for the levels of occupancy in each zone.

Areas requiring no dirty extract shall be positively pressurized or maintained neutral as recommended by ASHRAE.

Areas requiring dirty extract shall be pressurized delta negative.

The whole building is positively pressurized to avoid any hot air infiltration.

2.6 FIRE PHILOSOPHY AND SMOKE MANAGEMENT

Also, fire dampers shall be positioned in all air ductwork crossing fire walls/slabs as shown in the drawings. They shall be triggered from a fusible link connection sited in the damper.

2.7 AIR INTAKE SYSTEM

Galvanised sheet steel Fresh air intake louvers with bird screens; filters and damper shall be provided in the clear openings in masonry wall is thru infiltration and Fresh air package wherever specified on the drawings. Air intake louvers shall in general be located as far away as possible from extract louvers and drainage vent stacks to avoid short circuiting of dirty air.

3.0 Exhaust Air units:

The SISW centrifugal fans shall be high efficiency non-overloading backward curved impellers. The fans shall be suitable for Exhaust application in industrial application. The fan shall be design to comply with AMCA class I standards

The fan shall be SISW spark resistant fan complete with dampers, cowl & bird screen, mesh, prefilter (20micron) section with filters, Fan section with IP 55, class F, TEFC fan motor suitable for 415V, 3ph, 50Hz. Drive to fan shall be provided through belt with adjustable motor. Drive package section with belts pulley and belt guard. The motor shall be design for quiet operation and motor speed shall not exceed 1440 RPM. The fan motor shall be flameproof & weatherproof design. Direction of discharge and rotation position shall be as per the job requirements. Details capacity of fan is mentioned in the tender B.O.Q

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The impeller and shaft of the fan shall be both totally statically and dynamically balanced. The shaft of fan shall be EN-8 standard. Similarly, the fan pulley as well as the motor pulleys shall also be dynamically balanced. Bearing shall be mounted directly on the fan housing. Bearing shall be designed especially for quiet operation. The contractor shall furnish certificates to the effect that such dynamic balancing so carried out shall also be furnished in the certificates.

The fan and motor shall be assembled together on a common base frame, which shall be mounted on framework, cushy foot mounts with anti vibration isolators pads. The entire unit shall be of sturdy construction to ensure freedom from vibration during running.

CONSTRUCTION

"Pittsburg lock" form housing manufactured in galvanised sheet steel for all sizes except 1250 and above, in mild steel finished with polyester powder coating. The wheel having forward/backward curved blade is made of galvanised sheet steel.

TESTING

The Fans shall be tested for the capacity, power consumption and noise level. Test Certificate and commissioning report shall be furnished during execution of work.

Both air and sound performance ratings are based on test to AMCA210 and AMCA300 Standards.

All wheels are statically and dynamically balanced to ISO1940 and AMCA204 - G2.5 Standards.

4.0 CEILING SUSPENDED DUCTED DX INDOOR UNIT

GENERAL

The Indoor Unit will be ceiling suspended type and the depth of unit not to exceed 450mm. Indoor unit can be accommodated above false ceiling due to low height. The Air Handling Unit should be factory fabricated and assembled, consisting of DIDW forward-curved fan section with centrifugal blower and motor, DX coil, cleanable filters & electrical control box. The unit should be ready to operate when piped to a suitable condensing unit, connected to power/controls and air ducts or plenums. The mounting components like fans, blower compressor, and motor shall be dynamically balanced to ensure smooth and low-noise operation. The unit shall be operated at 415V, 50 Hz, 3-phase AC power supply.

The indoor and outdoor units are made of galvanized steel construction and attractively finished in polyester powder coat to provide resistance against corrosion.

UNIT ENCLOSURE

Casing panels must be of heavy gauge (G-90) galvanized steel. Removable access panels to be provided for inspection and access to all internal parts. These panels to be insulated with ½” thick TUFF-SKIN fiberglass or eqvt insulation to prevent condensation from forming on the unit casing. An insulated drain tray with drain connection shall be provided below the fan coil section so as to avoid dripping over the equipment installed in the lower portion of cabinet. Insulation to meet the requirements of NFPA 90A and is protected against deterioration and erosion from air currents. Steel sheet to be zinc-coated, galvanized by the hot dip process of lock forming quality conforming to ASTM A 653 commercial weight G-90, followed by baked-on electrostatic polyester dry powder coat.

COILS

DX Coils are of the corrugated fin-and-tube-type, constructed of seamless copper tubes of minimum thickness 0.014 inches (0.356 mm), mechanically bonded to aluminum fins. The fins shall be 4 to 5 per cm of tubes. Coil shall be fitted with equalize copper distributor to ensure that each circuit
receives equal amount of refrigerant. End plates and tube support sheets are 18 gauge-galvanized steel formed to provide structural strength. The coil shall be thoroughly evacuated, dried and each coil to be pressure tested in the factory at not less than 300 psi air pressure. Coils conform to ARI 410. The insulation of suction line shall be as per manufacturers standards.

**DRAIN PANS & PIPES:**

Drain pans provided under cooling coil section are made of G-90 galvanized steel with mastic coated liner for additional corrosion protection. Drain outlets on both sides of the unit for connection as per field requirements.

The drainpipes should be of PVC material properly fitted from indoor unit to the nearest drainage line.

**EVAPORATOR FAN**

Evaporator fan shall be of DIDW centrifugal forward-curved blade designed for quiet operation and sized to meet system airflow/pressure and shall be suitable to operate to ensure smooth airflow into the fan at a minimum SP 45 mm to overcome the pressure drop through the cooling coil, filters, supply air ducting & grills/diffusers. Fan motor must be mounted on an adjustable base and secured by a locking device. Fan drive is through adjustable motor pitch pulley and belt driven. Fan shafts are designed to operate at less than 2/3rds of the first critical speed when the unit comes up to rated revolutions per minute (RPM). Units have sealed permanently lubricated ball or sleeve fan bearing and are statically/dynamically balanced in the fan housing during final assembly. Fan motors shall be mounted within cabinet. This shall be of TEFC enclosure, squirrel cage induction motor of suitable HP for the relevant class of duty. Fan motor are of the open drip proof type and conform to NEMA MG-1 & MG-2. Motor starters are magnetic contactor, across-the-line type.

**ELECTRONIC CONTROL BOARD**

The Air Handling Units should have the following unique features, which have been engineered with innovations that guaranteed years of performance and customer satisfaction.

Microprocessor Based Electronic Control Board

Compressor Lockout If any of the unit’s safety controls trips due to abnormal conditions the electronic controls lockout the compressor, preventing restart, unless attended by service personnel. The unit can be re-started only by resetting of thermostat after ensuring safe system condition.

Lead / lag of compressor. To programmed selectable automatic timing between compressors during start to equalize operating hours.

Built-in selectable anti-recycle timer for compressor safety in case of accidental manual reset or immediate recycling of thermostat due to load demand.

To aid the service personnel each board has a built-in tiny but bright status/fault indication lights.

**AIR COOLED CONDENSER**

The Condenser units to incorporate the latest innovative grooved coil technology to provide efficient and reliable performance. The large wrap-around condenser coil is preferred for the aesthetical appeal to be of corrugated fin and tube type, constructed of seamless copper tubes with wall thickness of 0.014” (0.356mm), and mechanically bonded to aluminum fins. All copper tube return bends have 0.022” (0.56mm) wall thickness. Tube support sheets are of galvanized steel, formed to provide structural strength. Tubes to be circuited to ensure minimum pressure drop and maximum heat transfer. Each coil is completely dehydrated, charged and sealed at the factory upon completion of pressure tests. Condenser should be effective to give optimum heat transfer efficiency.

Units to be equipped with totally enclosed fan motors for greater reliability and dependable performance.
for many years. Inherent thermal protection is automatic reset type.

Access panels to provide access to the compressor, fan motor and to the electrical control box are required. These units can be installed on a rooftop/ground level on an MS framework platform. Their capacity shall match the indoor unit. Condenser shall be complete with propeller fan and weatherproof totally enclosed motor and other accessories as required. Panels must be heavy gauge (G-90) galvanized steel sheet and completely weatherized for outdoor installation. Steel sheet panels to be zinc coated and galvanized by the hot dip process of lock-forming quality conforming to ASTM A 653 commercial weight G-90, followed by baked on electrostatic polyester dry powder coat.

First charge of refrigerant gas and oil, expansion & solenoid valve, filter driers, sight glass, and adjustable HP/LP switches. The fans are propeller type and direct-driven, upward discharge or Horizontal discharge provided with fan grille. Motor should be IP55 protection and weatherproof. Units to be equipped with totally enclosed fan motors for greater reliability and dependable performance for many years. Inherent thermal protection is automatic reset type.

This AHU to function in conjunction with matching capacity outdoor condensing units.

**COMPRESSOR**

The scroll compressor shall be hermetically sealed in design suitable for eco-friendly R-gas. It shall be fitted with suction and discharge stop valves to facilitate servicing, safety controls, filters, release valves, control valves and standard accessories for efficient operation. The compressor shall be direct shaft mounting of the refrigerant cooled hermetic motor and it should mounted on ant vibration resilient material to ensure minimum noise and vibration during operation. The compressor housing shall be made of gas tight steel shell, which is made up of two shells; these shells are welded together to form a Hermetic (Airtight) seal. One shell is fitted with a suction tube and a Glass –matic terminal used for supplying power to the motor, fitted inside the compressor shell and the other is fitted with a discharge tube. The shell also acts as an oil sump. The internal parts shall be accurately machined for installation of the required parts. The Impellers, valve plate and connecting shaft shall all be made of aluminum alloy having high compressive strength. The oil pump formed by drilling number of holes on the surface shall do the lubrication of the bearing. One end of the crankshaft shall be always dipped in the oil. The compressors to have all standard controls for proper and safe operation.

**MOTORS**

Motors to be either ODP or permanent split capacitor type with three speed-tapped windings and shall be suction cooled. The bearings shall be of sleeve type. Service ValvesBoth suction and liquid service valves to be back seating type with sweat connections. Valves to be externally located so refrigerant tube connections can be made quickly and easily. Each valve to have a gauge pressure port for ease of checking refrigerant operating pressures.

**SERVICE VALVES**

Both suction and liquid service valves to be back seating type with sweat connections. Valves to be externally located so refrigerant tube connections can be made quickly and easily. Each valve to have a gauge pressure port for ease of checking refrigerant operating pressures.

**CONTROL PANEL**

A complete factory-wired control panel with all necessary safety and electrical control devices to ensure safe and proper operation.

The control panel design must be equivalent to NEMA construction for easy access ensuring dust and weatherproof construction with isolators. Internal power and control wiring to be factory done neatly and routed properly anchored and all wires identified with cable markers as per standard applicable to HVAC units. A complete factory-wired control panel with all necessary safety and electrical control devices to ensure safe and proper operation.
The electrical controls used in the control panel to be UL approved, which are reliable in operation at high ambient conditions for a long period. The electrical circuit must be carefully designed with all necessary protection and circuit elements for safe operation of the unit. The unit electrical control panel shall also include necessary push button, starters, switches, OL relays, single phase preventer, time delay switches, fuses, contractor, phase failure, ON/OFF and trip indicating lamps, single phase preventers, sensor & thermostat control. Power cabling & earthing with G.I strips with complete cabling & saddling all suitable for proper functioning. In addition to the above the package A.C units shall be equipped with Electronics microprocessor based controller with panel, which has the following features:

- Programming start/stop times.
- Operator free operation
- Setting of temperature and its differential, start delay in case of multiple units and real time clock setting, protected by two passwords.
- Automatic/semi automatic/manual modes. In automatic mode, the unit starts and stops as per the preset times along with the sequencing of blower and Compressor/condenser fans.

- Auto restart after power failure, built in time delay
- Fault diagnostics

LED display for ON/OFF status of compressor, blower motor and cool/dry/fan mode

ON/OFF timer

- The following compressor trip messages should be indicated

On High/low pressure
Motor overload
Internal overload
Evaporator fan off
External interlock (e.g. return air temperature sensor fault indications)
Diagnostic display features.
Optimum starts/stop features which starts/stop the unit in advance of area occupancy based on return air temperature and prior 30 days history of time taken to cool the area

Low pressure Switch

Auto reset SPST switch activated by refrigerant pressure-lock out the compressor, if the refrigerant pressure falls below 25 PSIG. Also provides additional protection against evaporator freeze up due to loss of indoor airflow.

High Pressure Switch:

Auto reset SPST switch activated by refrigerant pressure – locks out the compressor, if the refrigerant pressure rises above 450 PSIG. Also provides additional protection against compressor damage due to loss of outdoor airflow.

SAFEFTY DEVICES

The Condensing units shall be provided with all necessary safety devices, which are essential for proper operation of the equipment. These shall not be limited to the scope of this specification and shall have all safety devices required for optimum operation of the unit.

The following minimum safety devices are suggested:

a. In-built internal overload
b. Low pressure cutout
c. Low evaporating cutout
d. High condensing pressure cutout
e. High oil/discharge temperature cutout
f. Pressure relief valve.
g. Motor overload trip/protection.
h. Pump down solenoid valve
i. Under voltage monitor
REFRIGERANT PIPING AND DRAIN PIPE.

The refrigerant piping interconnecting all the condensing unit & the ceiling suspended AHU shall be hard drawn Seamless copper with tube diameter as required and having a wall thickness of minimum 2mm and able to withstand pressure upto 500PSI. Expansion valve shall be provided with remote bulb external equalizer port and external super heat adjustment. Each set of refrigerant piping to be provided with all accessories like filter drier, liquid line solenoid valve, sight glass in piping preceding the expansion valve. The entire Refrigerant pipeline shall be insulated and painted as per ASHRE standard color code.

Drainpipe should be PVC material connected from indoor unit to the nearest drainage line with properly supporting and fitting arrangements.

MISCELLANEOUS

1) Each unit shall include suitably designed housing in heavy gauge sheet steel and angle framework treated for rust prevention and painted, to mount the components.
2) Full charge of refrigerant gas, as required to obtain and maintain design conditions and the required quantity of suitable grade lubrication oil.
3) Sheet steel control panel for housing the controls and other operated items.
4) Rubber vibration isolator pads or springs of 90% efficiency in preventing transmissions of vibration.
5) Each unit shall include but not be limited to all the items listed in foregoing paragraphs and shall be complete as required.
6) The refrigerant copper piping of the split unit shall be insulated with closed cell insulation (tubular type).
7) The Package units for all areas shall be equipped with electronic thermostat having tolerance of ± 1 Deg C.
8) Filter shall be washable of 20 micron to be provided.

5.0 PARTICULAR FAN

5.1 ROOF MOUNTED FANS

Description

Roof Fans to be centrifugal belt / direct drive type. These fans are specifically designed for roof mounted applications exhausting relatively clean air. Fans shall be suitable for outdoor application and weatherproof design. Fan wheels shall be backward inclined and constructed of aluminum. Adjustable motor pulleys in case of belt driven fans to allow for final system balancing. Performance capabilities to meet the details in the BOQ.

Specifications

The fan shall be centrifugal type. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. The fan shroud shall have a rolled bead for added strength. The Fan weatherproof hood can be out of rigid heavy-duty epoxy coated FRP construction, totally weatherproof as an alternate. Galvanized rigid wire to protects the fan's discharge from birds or small objects. The fans shall have inbuilt protection against rain and for drainage of the rainwater.

Motors shall be heavy-duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motors and drives shall be designed for vibration free operation and of low noise. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance. Motors to be TEFC, IP 54 protection and Class F insulation to withstand ambient temperatures. Electrical connections to the motors shall be in a totally enclosed terminal box secured to the exterior of the
casing. Wiring within the fans shall be suitable for the conditions within the casings. In case of belt driven fan the Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150 percent of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing.

Impellers shall be die cast in Aluminium alloy and X rayed during manufacture.

In case of direct driven fans, the impellers shall be capable of running continuously at 20% in excess of the rated speed. The impeller shall be keyed and locked onto the shaft, which shall be statically and dynamically balanced and tested at overspeed before dispatch from the Manufacturer's works. Easy serviceable access to be provided on the casings of all fans. Casings shall cover both impeller and motor so that fans can be removed. The bearings are to be truly aligned and rigidly mounted on to the casing.

Graphs of the performance curve of each fan are to be forwarded to the Consultant together with a test report on the sound level at three diameters in a free field condition prior to the order being confirmed. Blade angle shall be adjustable over at least a 30 degree range, with markings at the root to indicate the blade angle.

The fans to be suitable for mounting on corrugated Sheet metal roofing. It is the prime responsibility of the Fan manufacturer to supply all accessories and ensure installation of the fan on the roof as per the recommended practices with proper flashing and sealants. The manufacturer to supply all accessories related to proper fixing of the fans on the roof top including roof curb, roof GI adaptors, flashing sheets and sealants. The contractor to fix Roof curb assemblies and accessories and finish the Double flashing works with frames and sealant application to ensure LEAK PROOF installation.

A fan conduit chase shall be provided through the curb cap to the motor compartment for ease of installation. Each fan shall be designed for easy service and maintenance of the motor and accessories.

All fans shall bear the AMCA Certified Ratings Seal for sound and air performance. Vibration and noise level during the operation of unit should be within permissible limits.

Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

### 5.2 WALL MOUNTED PROPELLAR EXHAUST FANS

The unit shall be suitable in all respects for operation in ambient air conditions of 40°C and 95% RH. The fan shall not require periodic lubrication. Fan shall be of the broad type, ring diaphragm mounted and of the capacity shown in the schedule of equipment.

**Construction**

The propeller fan shall be axial fan with sturdy Ms steel frame with rubber cushy and bolts for wall mounted installation complete with mounting brackets, gravity louvers, safety grill on suction side and bird screen on discharge side. The Fan blades are Aluminum in construction, Motor is PSC IP 44 protection, and single phase 220/1/50. The fan shall be fully balanced after assembly. The blades shall be enclosed by a high quality chromium plated metal wire-mesh metal guard.

**TESTING**

Fans shall be tested for the capacity, power consumption; noise level and vibration isolation and result shall conform to the approved data furnished by the Contractor.
On completion of the erection and testing, the assembly shall be painted with two coats of an appropriate paint of approved make and colour.

6.0 ELECTRIC MOTORS

Unless otherwise specified in the equipment specifications, all motors supplied and installed as a part of mechanical works shall conform to the following requirements:

Motors shall be of high efficiency, and shall be constructed and type. These shall be of totally enclosed fan cooled (TEFC) type to IP55 either with foot-mounting or flange-mounting suitable for its application. Unless otherwise specified, motors shall be designed for continuous running duty type S1 for operation during 3 years without maintenance. They shall be of such size as to drive adequately their associated equipment under the range of operating conditions, without overloading.

Windings shall be insulated with Class F insulation material to BS. 2757, and temperature rise of windings shall be class B (i.e. maximum of 80 deg.C. as measured by resistance method). Electric motors up to and including 0.37 Kw shall be suitable for operation at 240 volts single phase. Motors rated above 0.37 Kw shall be of the 3 phase squirrel cage induction type with drip proof housing. Motors located directly in air streams shall be totally enclosed, fan cooled.

All the motors shall be provided with a substantial earthing terminal tapped into the frame or clamping device located on the cable end box side of the motor.

Terminal connections shall be constructed in such a way that direct contact between screws, bolts or nuts and the conductor is avoided.

The terminal box shall be of sturdy construction with ample space for connecting cables. An earthing bolt of adequate size shall be provided inside the terminal box for connecting to the cable earthing. This will be in addition to the earthing bolt provided in the motor enclosure. The terminal box shall be adequately weather proofed with a suitable non sticking reusable non-hygrosopic gasket material. These terminal boxes also shall be provided with suitable cable sealing end boxes or cable glands.

In addition to these items the following information shall be indicated:

a) Type of enclosure

b) Locked rotor torque on % of rated torque
   Locked rotor current in % of rated torque

c) Allowable running-up time in seconds (ART) bearing type, size, fit, re-greasing period and type of grease.

d) Net weight.

e) Purchase order number.

All motor shafts shall be provided with a key way unless the motor is of the flange mounted type in which case they shall be complete with adjustable rails.

The frame shall be painted in accordance with manufacturer's standards. However, the painting shall at least consist of one coat of primer and two coats of oil-resistant finishing paint.

7.0 MOTOR STARTERS, CONTROLS SWITCHGEAR

All starters and other control components shall be supplied and installed under this section but the contractor shall ensure that all components supplied shall comply with the requirements of the relevant sections of the electric specifications.
8.0 PANEL BOARDS AND MOTOR CONTROL CENTRE.

Construction of all panel board, motor control centres, control panels etc. shall comply with the relevant sections of the electrical specifications.

Air handling unit starter panels:

Each air handling unit shall be supplied with a starter cubicle including the following:

a) A door interlocked isolator handle.
b) A three position HAND/OFF/AUTO control switch.
c) A "motor run" lamp (green).
d) A "motor trip" lamp (red).
e) Motor speed selector switch
f) Motor starter assembly.
g) Control fuse.
h) Filter pressure drop (filter clog indication)
j) Inter-connection with fire alarm system and extract fans.
k) Power fuses with carriers and bases.
l) Moisture elimination heating coil.
m) Heating element contactors and controls.
n) Heating element 'energized' lamp (Green)
o) Heating element 'tripped' lamp (Red)

Note:

Control switch "Off" - Motor shall not run.
Control switch "Test" - Motor shall run except for local lock-off stop buttons.
Control switch "Auto" - Motor shall start and stop under dictation from remote control circuit.

Starter panels, where installed outdoor, shall be of the weatherproof type enclosure.

Fan Coil Unit Control Enclosure

Control components of each fan coil unit like contactors, transformers, controllers, etc. shall be housed within an enclosure located besides the unit within the ceiling void.

Motor Control Centre

Motor control centre shall be of the cubicle type, floor mounted and shall contain the following:

- Incoming as shown on the schematic diagram.

- Busbars for each phase, neutral and earth.

- Outgoing as shown on the schematic diagram.

- Starter as indicated on the schematic diagram.
- Pilot light for each phase.
- Pilot light for each motor in the plant room.
- On-off switch for each chiller control panel.
- Push button (start-stop) for each motor and plant room.
- One ammeter with selector switch for each motor in plant room.
- One ammeter for each phase for the incoming power supply.
- Volt meter with selector switch.
- All required interlock wiring.
- Motor duty selector switch.
- Phase monitor relay for each motor.
- Low voltage protection device.
- Bank of capacitors for power factor improvement.
- Chiller sequence controls

Where motor control centres are installed outdoors, the panel shall be of the weatherproof type.

Motor control centre construction and components shall comply with the requirements as set out in the relevant sections of the electrical specifications.

9.0 SUBMISSIONS.

Initial technical submissions are to accompany the bid including full technical details of every item of equipment proposed for the project, with the appropriate figures and details highlighted in marker pen or similar in standard manufacturer's catalogues.

After final checking of sizing after award of contract, resubmission will be made with any changes specifically noted.

Technical submissions for the following are particularly required to be submitted:

- Ductable Airconditioner
- Exhaust unit
- Motor Control Centre.
- Fans.

In the event that the Consultant/Client requires further information on any of the proposed items the Contractor shall arrange visits to similar units, which he has installed. In any event, all equipment proposed for the project shall be currently installed and working satisfactorily locally. The Contractor must be able to provide references of at least three satisfied Owners and Consultant with equipment of the particular size and model proposed.

SECTION 3

DUCTWORK AND AIRSIDE EQUIPMENT

1.0 DUCTWORK MATERIAL.

1.1 Make all ductwork, unless specifically noted otherwise, of galvanized sheet steel conforming to ASTM A 525 or ASTM A 527, galvanized steel sheet, lock-forming quality, having zinc coating of 12.25 ounces per square foot for each side in conformance with ASTM A 90. The galvanizing shall be
carefully done and the sheets shall be of such quality that they may be bent flat on themselves with no fracture to the coating or the base metal. All duct work, dampers and accessories shall be fabricated out of galvanized steel sheet manufactured to ISS: 277:2003. Duct shall be installed in a workman like manner, conforming to IS: 655-1963

1.2 All supports, stiffeners, flanges etc. used in ductwork construction and installation shall be hot dip galvanized. Ductwork guarantee shall cover workmanship, noise, chatter, whistling or vibration. Ductwork shall be free from pulsation under all conditions of operation.

2.0 DUCTWORK SPECIFICATION.

2.1 Ductwork fabrication / sheet metal ductwork material and installation shall comply with the latest edition of SMACNA Low Pressure Duct Construction Standards. Medium pressure round/oval double wall sheet metal ductwork shall comply with the latest edition of SMACNA High Pressure Duct Construction Standards. All air distribution devices (such as dampers) included in this specification shall comply with the latest applicable SMACNA manual and hanging methods shall be as described in the latest edition, and/or current edition of applicable manuals published by the Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA), where methods described in these volumes are not at variance with the requirements of any authority having jurisdiction, or do not conflict with methods described hereafter.

2.2 DEFINITIONS

A. Duct Size. The ducts sizes shown are inside clear dimension and do not include proper allowances for 1-inch acoustical lining, if required, and/or unless otherwise indicated.

B. Low Pressure Systems. Less than 3-inches w.g. to +3-inches w.g. positive static pressure and velocity less than 2500 fpm.

C. Medium Pressure System. 3 inches through 6 inches w.g. positive static pressure and velocities greater than 2000 fpm. (10.2 m/sec).

3.0 DUCTWORK GENERAL.

3.1 All dimensions shall be checked on site before ductwork manufacture is commenced.

3.2 Submit ductwork shop drawings and product data. Indicate duct fittings, particulars such as gauges, sizes, weld and configuration prior to start of work for low, medium and high pressure and exhaust systems.

3.3 Erect all ducts in the general locations shown on the drawing(s), but conform to all structural and finish conditions of the building. Before fabricating any ductwork, Contractor shall check the physical conditions at the job site and make all necessary changes in cross sections, offsets and similar items, whether they are specifically indicated on drawings or not. Contractor to coordinate with all other services while installation of the ducting.

3.4. The whole of the ductwork installation shall be carried out by an approved specialist in ductwork manufacture and installation. No ductwork shall touch the building structure or building finishes direct, but shall be isolated with insulating spacer.

3.5. The fabrication shall be carried out in a neat and workmanlike manner with all ductwork true in size and cross-section braced and stiffened as specified and with all internal and external surfaces free from projections and sharp edges.

3.6 At each main branch in ductwork and at each fan discharge and suction, provide sufficient number of Pitot tube test holes for balancing systems. Also provide test holes for traverse fan discharge and at all equipments. Test holes shall be located within easy reach of catwalks or ladder. Each test hole shall have 20 mm clear opening, provided with a metal ring plate with a threaded hole in the boss, and matching screwed head plug. Where these plugs are installed in insulated ductwork, provide an extension collar against which the insulation can be finished.
3.7 Ductwork shall be rigidly suspended or supported from building structure. Expansion type concrete inserts shall be placed so that the fastener is in shear rather than tension. Provide necessary steel angle iron required for bracing of ductwork or equipment, and for supporting ductwork from building structure. All supports shall be hot dip galvanized and painted.

3.8 Increase in duct size shall be gradual. Where width or largest dimension of a duct is over 450 mm, duct shall be stiffened by bending in a break across corners in both directions. Ducts shall be self-supporting and complete in themselves. Visible internal portions of duct outlets to grilles and registers shall be painted in dull black.

3.9 All necessary allowances and provisions shall be made in the installation of the ducts for the structural framing of the building and when changes or offsets are necessary, the required cross-sectional areas shall be maintained. All of these changes however, shall be approved, and installed as directed at the time.

3.10 During installation the open ends of ducts shall be protected with blank, flanged sheet metal baffles, securely attached to prevent debris and dirt from entering.

3.11 Where ducts are shown connecting to masonry openings and/or along the edges of all plenums at floors, walls, etc., provide a continuous 30 x 30 x 4 mm galvanized angle iron which shall be bolted to the structure and made airtight to same by applying caulking compound on the angles before they are drawn down tight. The sheet metal at these locations shall be bolted to the angle iron framing.

3.12 All air ducts, casings, plenums etc., shall be constructed of lock forming quality prime galvanized steel sheets, which are free from blisters, slivers, pits, imperfectly coated spots etc. No second quality sheet metal allowed.

Where damage (or rusting) has occurred on galvanized duct work the affected section shall be made good by painting with two coats of zinc-rich paint and approved finishing paint, or where the damage in the Consultant's opinion cannot be made good, then a new section of ductwork shall be provided at no cost to the contract.

3.13 Duct shall be constructed using double or Pittsburgh lock corner seams. All seams shall be hammered down and made airtight by applying sealant before hammering down.

3.14 Support the vertical ducts installed in the various shafts at each floor level with galvanized supporting irons of approved size. Install these angles across the width of the shaft, with their ends attached to angle irons securely anchored into the masonry walls of the shaft, or attached to the framing of the floor openings. The ducts shall be bolted to these supporting angle irons.

3.15 Ensure that all openings required through floors, walls, partitions etc., for the duct system are provided in the exact location required.

3.16 Each piece of ductwork shall be wiped inside and out before installation and all open ends shall be capped and sealed to prevent entrance of dirt during construction. Ensure that ductwork systems are clean and free from dirt, dust, grime, debris etc., before initial operation of fans. Fans shall not be operated until the filters are installed and approval from the Consultant has been obtained.

3.17 All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees or angles of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

4.0 LOW PRESSURE DUCTWORK.

4.1 This applies to ductwork with mean velocities less than 2,000 fpm (10 M/Sec) and static pressures of 2 inches water gauge, (500 pascals) or less.

4.2 Rectangular low-pressure ductwork shall be fabricated from prime quality, re-squared, tight coat galvanized steel sheets of the following gauges.

<table>
<thead>
<tr>
<th>Size of Duct (Milli metres)</th>
<th>Thickness</th>
<th>Bracing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GI Sheet Metal.

<table>
<thead>
<tr>
<th>Width/Depth</th>
<th>Thickness (mm)</th>
<th>(SWG)</th>
<th>Angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 mm less in width/depth</td>
<td>0.63 mm</td>
<td>24 SWG</td>
<td>None</td>
</tr>
<tr>
<td>401 to 750 mm width/depth</td>
<td>0.63 mm</td>
<td>24 SWG</td>
<td>25x25x3mm angles 1.2m from joint</td>
</tr>
<tr>
<td>751 to 904 mm width/depth</td>
<td>0.80 mm</td>
<td>22 SWG</td>
<td>25x25x3 &amp; 40x40x3mm 1.2m from joint</td>
</tr>
<tr>
<td>905 to 1524 mm width/depth</td>
<td>0.80 mm</td>
<td>22 SWG</td>
<td>38x38x3.2mmdiagonal angles 1.2m from joint</td>
</tr>
<tr>
<td>1525 to 2250 mm</td>
<td>1.00 mm</td>
<td>20 SWG</td>
<td>38x38x3.2mmdiagonal angles</td>
</tr>
<tr>
<td>2250 mm and over</td>
<td>1.25 mm</td>
<td>18 SWG</td>
<td>40x40x3mm diagonal angles</td>
</tr>
</tbody>
</table>

4.3 Low pressure suction and discharge plenum chambers shall be fabricated from 1.25 mm (18 gauge) galvanized steel with galvanized angle iron framework and bracing.

4.4 Construct tees, bends and elbows with radius of not less than 1-1/2 times the width of duct on centerline. Rectangular 90-degree elbows shall be constructed with double-wall, airfoil, and galvanized sheet metal turning vanes. The turning vanes shall be fabricated in accordance with SMACNA HVAC Duct Construction Standards. Same applies to square elbows. Vanes shall be tack welded to vane rail. For vane lengths over 1000 mm, tack weld vanes to 10 mm tie-rod at mid-span.

4.5 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

5.0 ACCESS PANELS

5.1 Duct access panels shall be minimum 450 x 300 mm size. unless restricted by duct dimensions. All access panels shall be constructed from galvanized steel sheets, with necessary reinforcing inside for rigidity, with space filled with glass fiber insulation. Panels shall be made airtight with a continuous neoprene rubber gasket.

5.2 Apparatus access doors shall be minimum 600 x 1500 mm with angle or channel frame. Provide two 75 mm strap hinges with brass pins; and two handles minimum, operable from inside and outside. All access panels shall be constructed from double thickness 18 gauge (1.3 mm) galvanized steel, with 25 mm insulation between sides with necessary reinforcing for rigidity.

5.3 Provide access panels where shown, required and directed and in the following locations:

- Bottom of all duct risers.
- Next to outside air intakes and outlets.
- At each fire damper.
- Into apparatus casings to facilitate maintenance and cleaning of all components.

6.0 BALANCING DAMPERS. (VCD)

6.1 Install volume control dampers in accessible locations at all branch connections and wherever necessary to adjust the flow of air to secure correct distribution. Casing and blades shall be made of galvanized sheet metal, and shall be equipped with an approved device for fastening in any desired position. This device shall be such that the damper cannot move or rattle and pointer shall indicate the position of the damper from the outside of the finished duct insulation.

6.2 Volume control dampers of 1.2mm thick GSS blades, extended linkage rods for motorized operation, channels, and flanges suitable for duct mounting and with a manual-operating handle. Dampers shall be aerofoil multileaf opposed blade with blade height not more than 180 mm.

6.3 All blades shall be operated by a single operating with suitable link, levers and quadrant with gears.
and links as necessary. For their proper operating, control or setting devices shall be made robust, easy to operate and accessible.

6.4 The whole damper assembly shall be mounted in a galvanized frame with flanges.

6.5 Dampers shall be UL listed or certified by an equal regulatory authority.

7.0 VIBRATION ISOLATION (For all sections)

7.1 All plant and equipment shall be isolated from the building structure in such a manner that noise and vibration is not transmitted through the structure.

Anti-vibration equipment will be manufactured by a specialist company acceptable to the Consultant, and with standard ratings information available.

The following requirements are minimum requirements and must be confirmed by the specialist manufacturer's representative as being adequate for the particular equipment proposed by the Contractor.

7.2 In addition, Flexible connection shall be included at inlet and outlet to all items of equipment.

Flexible connections will be of full line size and will be flanged with gaskets and mating flanges.

Connectors shall be twin sphere manufactured with multiple ply's of nylon tire cord fabric and neoprene in hydraulic rubber presses and vulcanized.

8.0 DIFFUSERS AND_registers

8.1 Supply and return air diffusers shall be shown on the drawing and indicated in schedule of quantities. Supply air Registers and diffusers to be of high quality Extruded Aluminum profiles, double deflection aerofoil blades with Aluminum profile with 20mm min spacing, nylon bushing and the damper frames and blades shall be high quality extruded Aluminum profile with natural aluminum finish. The supply air diffuser shall be provided with removal key operative volume control dampers. Diffusers, registers and grilles shall be arranged for flush mounting in lay-in type ceilings and over lap mounting in plaster, mineral tile and similar ceilings, with concealed fixings unless otherwise directed.

8.2 Grills shall be extruded aluminum construction. Grilles, register and diffuser locations shall be adjusted to suit reflected ceiling drawings, or Consultant's site instructions. All grilles, registers, diffusers, louvers shall be from one manufacturer.

8.3 Provide plaster frame for grilles, and diffusers installed in plaster ceilings.

8.4 All diffusers, grilles and registers shall be supplied completely factory powder coated. Finish colour shall be to the approval of the Architect. The interior of all grilles and diffusers is to be factory painted matt black.

8.5 All supply grilles and diffusers will have opposed blade-balancing dampers. All will have foam rubber sealing band around the edge to seal to the structure.

3.16 Unless otherwise specified basic grilles and diffuser materials shall be Aluminum extruded sections. Sections in the airstreams shall be carefully selected to minimize turbulence.

8.7 All grilles and diffusers supplied on this project shall be tested and rated in accordance with ASHRAE Standard 70-72, ADC Test Code 1062-GRD and ISO 3741.

8.8 Ceiling Diffusers shall be multicone giving 4 way horizontal discharge

The three centre cones of the diffuser shall be manufactured from pressed aluminum, with the remaining cones and the outer frame fabricated from extruded aluminum welded at the corners to give
near invisible joints.

4 way pattern cores shall be used as indicated on schedules. All cores shall be interchangeable.

The core shall be removable without the use of special tools, but for safety, shall be fixed to the outer frame by a small length of chain.

The diffuser shall be complete with an opposed blade damper painted matt black. Wherever the air volume of supply / return air diffuser is not in proportion with the Standard size of the diffuser the overall size shall remain suitable for the longer airflow rate during the fabrication of diffusers. For lesser flow rate internal core / cores shall be blocked to achieve the require airflow with adequate throw and specified noise levels.

All such alterations shall be carried out by the manufacturer in the factory in such a way that specified air volume is maintained all the time without effecting the required throw for that particular diffuser. Noise levels shall not exceed specified limits in any case.

In general, sizes and air volume of all diffusers as shown on design drawings shall be maintained by achieving required throw and specified noise levels without effecting uniform air diffusion pattern.

Where a 4-way throw diffusers are installed very close to wall or obstruction, the diffuser shall be 4 ways, but with internally blocked in the area of obstruction.

8.9 Swirl and drum type diffusers shall be provided in each supply air duct outlets as per the ducting drawings.

9.0 SAND TRAP LOUVER FOR AIR INTAKE

9.1 Sand trap louvers shall have a double deflection inlet passage to separate sand from incoming air by means of centrifugal forces.

9.2 Separation efficiency particle size 350-700 shall not be less than 90% at a face velocity of 1M/Sec and not less than 70% at a face velocity of 2M/sec.

9.3 Sand trap louver shall be of aluminum construction, self-cleaning and maintenance free. The base of the louver shall have self-emptying sand holes.

9.4 Pressure drop at 2 M/Sec average face velocity shall not exceed 120 pascals.

9.5 Insect mesh shall be included.

9.6 Sand louvers shall be provided with powder-coated finish to the approval of the Architect.

10.0 FILTERS

10.1 Pre filters

Filter Media shall be of the non-woven cotton fabric type. The filter media shall have an average efficiency of 25-30% on ASHRAE Test Standard 52-76. It shall have an average arrestance of 90-92% in accordance with that test standard.

Media support Grid shall be a welded wire grid with an effective open area of not less than 96%. The welded wire grid shall be bonded to the filter media to eliminate the possibility of media oscillation and media pull away.

The media support grid shall be formed in such a manner that it affects a radial pleat design, allowing total use of filter media.

Enclosing frame shall be constructed of a rigid, heavy duty, high wet strength beverage board, with diagonal support members bonded to the air entering and air exiting side of each pleat, to ensure pleat
stability. The inside periphery of the enclosing frame shall be bonded to the filter pack, thus, eliminating the possibility of air bypass.

11.0 SUBMISSIONS

11.1 Technical Submissions

For any minor revisions in architectural layouts, contractor shall be responsible to carry out part redesign for such area and submit necessary calculations for Engineer's approval before proceeding with the shop drawings.

11.2 The Contractor will prepare full shop drawings, including sections, of distribution systems and equipment.

11.3 Hardware Submissions.

The Contractor will submit catalogue information for all distribution equipment including, but not limited to:
- Ductwork - Low pressure.
- Flexible ductwork - Low pressure
- Flexible connections.
- Access panels.
- Balancing dampers.
- Vibration isolators.
- Diffusers, grilles and registers.
- Louvers, Sand louvers.
- Filters.

11.4 The Contractor will submit samples for any or all of the above as requested by the Consultant after receipt of the catalogues.

11.5 Samples will definitely be required of these items, which are exposed, such as diffusers, grilles and louvers. The samples must be of size, specification and finish to be relevant to the project.

11.6 Where a Country of Origin is given, this refers to the Head Office in the case of International Corporations. However, for each product not manufactured in that Country, separate approval must be obtained from the Consultant/Client.

12. EXECUTION

12.01 INSTALLATION - SHEET METAL DUCTWORK: Duct shall be installed generally as per the drawing and in strict accordance with approved shop drawings to be approved by the contractor.

1. Construction Standards. Use construction methods, which follow the requirements outlined in SMACNA Balancing and Adjusting publications, unless indicated otherwise in these specifications or accompanying drawings.

2. Reinforcement. Reinforce ducts having one side equal to 25 inches or more in accordance with recommended construction practice of SMACNA.

3. Plenum Construction. Construct single-wall and 2” (thick insulation double-wall) plenum chambers of 18G sheet metal reinforced with galvanized structural angles.

4. Cross Breaking or Beading. Cross break or bead sheet metal for rigidity, except ducts which are 12 inches or less in the longest dimension.

5. Wall Penetrations. Where ducts pass through walls in exposed areas, install suitable escutcheons made of sheet metal angles as closers. Support ducts where passing through floors with steel structural angles of adequate bearing surface, galvanized after fabrication and resting on top of the sleeve.
6. **Interior Painting.** Paint flat black, the interior of metal ductwork exposed to view through grilles, registers, and other openings. Do not install grilles, registers, or similar items until painting is complete.

7. **Ductwork Openings.** Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

8. **Ductwork Location.** Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

9. **Sealant.** The entire duct system shall be sealed. Nonhardening, water resistant, fire resistant, compatible with mating materials; liquid used along or with tape, or heavy mastic. Duct shall be thoroughly cleaned prior to application of sealant. All transverse joints, longitudinal seams and duct wall penetrations shall be sealed. All ductwork shall be sealed as per seal Class A irrespective of the duct pressure classifications.

10. **Hangar Rod.** Galvanized steel, threaded continuously. (Refer Table)

11. Duct shall be straight be smooth on the inside neatly finished joints. All joints shall be made airtight.

12. **Change in dimension and shape of ducts shall be gradual, cuved elbows, unless otherwise indicated, shall have a centerline radius equal to one and a half times the width of the duct. Air turns shall be installed in all vanes, arranged to permit the air to make the turn without appreciable turbulence. Suitable vanes shall be provided in duct collar to have uniform/proper air distribution.**

13. **Duct shall be fabricated as per details shown on drawing. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees or angles pf sample size to keep the ducts true shale and prevent hulking, vibration or breathing.**

### 12.02 LOW PRESSURE DUCTWORK

1. **Construction.** Construct rectangular ducts in accordance with the SMACNA Duct Manual.

2. **Controls.** For control devices concealed by ceilings, furring, or in other inaccessible locations, furnish extension rods and appropriate recessed-type regulators, mounted on the surface of the ceiling or the furring, unless specified, or shown otherwise. For ducts which are not concealed, or ducts that are above lay-in ceiling but accessible, provide heavy-duty, quadrant-type, adjustable regulators having wing nuts for locking in position. Sawmark the ends of all operating rods for dampers and air control devices to indicate damper position.

3. **Obstruction.** Install streamlines deflectors at any point where dividing a sheet metal duct around piping or where other such obstruction is permitted. Where such obstructions occur in insulated ducts, fill space inside streamliner and around obstructions with glass fiber insulation.

4. **Low Pressure Duct Supports.**

   Horizontal Ducts Up to 40 Inch. Support horizontal ducts up to and including 40 inches in their greater dimension by means of No. 18 U.S. gage band iron hangers attached to the ducts by means of screws, rivets or clamps, and fastened to inserts with toggle bolts, beam clamps or other approved means. Place supports on at least 8'-0" centers. Use clamps to fasten hangers to reinforcing on sealed ducts.

   Horizontal Ducts Larger Than 40 Inch. Support horizontal ducts larger than 40 inches in their greatest dimension by means of hanger rods bolted to angle iron trapeze hangers. Use double nuts
and lock washers on threaded rod supports. Place supports on at least 8'-0" centers according to the following:

<table>
<thead>
<tr>
<th>Angle Length</th>
<th>Angle</th>
<th>Rod Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feet</td>
<td>Inches</td>
<td>Inch</td>
</tr>
<tr>
<td>4'-0&quot;</td>
<td>1-1/2&quot;x1-1/2&quot;x1/8&quot;</td>
<td>1/4&quot;</td>
</tr>
<tr>
<td>6'-0&quot;</td>
<td>1-1/2&quot;x1-1/2&quot;x1/8&quot;</td>
<td>1/4&quot;</td>
</tr>
<tr>
<td>8'-0&quot;</td>
<td>2&quot;x2&quot;x3/16&quot;</td>
<td>5/16&quot;</td>
</tr>
<tr>
<td>10'-0&quot;</td>
<td>2&quot;x2&quot;x3/16&quot;</td>
<td>3/8&quot;</td>
</tr>
</tbody>
</table>

Vertical Ducts. Support vertical ducts where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to 60 inches. Above 60 inches, the angles must be increased in strength and sized on an individual basis considering space requirements.

5. MEDIUM PRESSURE DUCT SUPPORT SCHEDULE:
All horizontal rectangular ducts shall have duct hanger requirements as follows:

<table>
<thead>
<tr>
<th>Max. Duct Dimen.</th>
<th>Steel Rod</th>
<th>Galv. Steel Strap Width</th>
<th>Max. Spacing</th>
<th>Min.# Hngrs</th>
<th>Trapeze Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 thru 18&quot;</td>
<td>--</td>
<td>1&quot; x 16 ga.</td>
<td>10'</td>
<td>2</td>
<td>--</td>
</tr>
<tr>
<td>19&quot; thru 36&quot;</td>
<td>--</td>
<td>1&quot; x 16 ga.</td>
<td>10'</td>
<td>2</td>
<td>--</td>
</tr>
<tr>
<td>37&quot; thru 60&quot;</td>
<td>3/8&quot;</td>
<td>1&quot; x 16 ga.</td>
<td>8'</td>
<td>2</td>
<td>2&quot; x 2&quot; x 1/4&quot;</td>
</tr>
<tr>
<td>61&quot; thru 120&quot;</td>
<td>3/8&quot;</td>
<td>1-1/2&quot; x 12 ga.</td>
<td>8'</td>
<td>2</td>
<td>2&quot; x 2&quot; x 1/4&quot;</td>
</tr>
<tr>
<td>121&quot; thru 240&quot;</td>
<td>3/8&quot;</td>
<td>--</td>
<td>4'</td>
<td>3</td>
<td>2-1/2&quot; x 2-1/2&quot;x 3/16&quot;</td>
</tr>
</tbody>
</table>

6. DUCT HANGERS - GENERAL NOTES (all pressures)

Hanger straps on duct width of 60 inches and under shall lap under the duct a minimum of 1 inch and have minimum of one fastening screw on the bottom and two on the side.

Hanger straps on duct widths over 60 inches shall be bolted to duct reinforcing with 3/8" bolts minimum.
Use 3/8" minimum bolts for securing duct hanger to band straps.

12.03 OPENING IN DUCTWORK

Provide opening in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

12.04 FLASHING

Where ducts pass through roofs or exterior walls, provide suitable flashing to prevent rain or air currents from entering the building. Provide flashing not less than No. 26 gage stainless steel or 16-ounce (450 g) copper.

12.05 DUCT LINING (LOW PRESSURE - RECTANGULAR)
Install glass fiber acoustical lining in all rectangular (except exhaust) ductwork shown on drawings. Provide acoustic line inside the ducts up to the initial 5 m of the supply ducts for air conditioning applications. Secure to duct surfaces with Foster 85-22 adhesive and sheet metal fasteners on 12-inch centers. Omit lining as necessary to permit satisfactory operation of air control devices. Coat all exposed edges and leading edges of cross joints with adhesive. Insulation shall not breed or promote fungi or bacteria, shall resist mold growth, shall not rot or sustain vermin.

12.06 TESTS

Allowable Leakage. Test ductwork for leaks before concealing. Permissible duct leakage shall not be more than 3% percent of total flow.

All the duct shall be clean after installation but before completion of false ceiling.

Equipment. Provide equipment necessary for performing tests, including rotary blower, orifice section and U-tube gage board complete with cocks and rubber tubing.

Risers and Branch. Test duct riser or branch duct including flexible duct runouts in accordance with SMACNA manual.

Mains: Test mains after risers and branches are tied in and all equipment set. Close runout connections and place fan in operation. Provide pressure in mains above design pressure. Visually inspect joints. Repair leaks detected by sound or touch. Release mains for completion after joints are tight.

12.07 ADJUSTING AND CLEANING

Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment, which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

SECTION 4

DUCT INSULATION

1.0 INSULATION GENERAL.

1.1 The whole of the insulation work shall be carried out by an approved specialist insulation Contractor.

1.2 All allowances shall be included for informing the specialist contractor of all details of the building structure, programme arrangements, and other relevant details at the time of tender and for all necessary visits to site by the contractor or his workers.

1.3 The insulation material shall be elastomeric closed cell self adhesive nitrile rubber insulation (ARMAFLEX / K-FLEX/SUPREME) with the following properties:

   a) Density – 40 Kg / cum
   b) Temperature Range: – 60 deg C to 105 Deg C
   c) Ozone friendly ; no cracking; ASTM D 1171
   d) Color : Grey / Black
   e) Reaction to fire: Self Extinguishing
   g) Health Resistance: Dust and Fibre free
   h) Thermal conductivity (□) ASTM C 177
      - Not greater than 0.036 W / mK at a mean temperature of 10° C
   i) Vapour permeability
1.4 All material delivered to site shall be new and fully dried out and so maintained throughout the progress of the works.

All insulating materials shall be stored in storage sheds, and in accordance with the Manufacturer's recommendations.

1.5 In order to ensure that the insulation applied is in all respects in accordance with the specification, sections shall, as required by the Consultant/Client, be cut from the finished insulation. If, however, defects are revealed, further sections shall be cut out for inspection, and all cutout sections shall be replaced at no cost to the Contract.

If further defects are revealed then the Consultant/Client shall have the right, when in his opinion it is necessary, to issue instructions for any part or the whole of the insulation to be removed and replaced. The replacement with new insulation shall be to the satisfaction of the Consultant and the cutting out and replacing shall be at no cost to the Contract.

1.6 Particular attention shall be paid to the finished appearance of all thermal insulation which must present a neat and symmetrical appearance running true in line with pipe layouts, etc.

1.7 Any rough, irregular and badly finished surfaces shall be stripped down and re-insulated to the Consultant's/Client satisfaction.

1.8 All systems are to have been tested and approved by the Consultant/Client prior to installation of insulation.

2.0 CONCEALED COLD AIR DUCTS.

2.1 Unless otherwise indicated insulate all ductwork (supply return, fresh air and extract) with elastomeric closed cell self-adhesive nitrile rubber insulation sheets. Cover the sections with vapour barrier of polythene sheet with minimum overlap of 75mm near the joints. The insulation material to confirm to ASTM E 84.

3.0 EXPOSED COLD AIR DUCTS.

For ducts exposed in non air conditioned areas, insulate using the method described for concealed ducts, but using insulation with a electrophoretic closed cell self adhesive nitrile rubber insulation and the finishes to be as mentioned in clause 2.1. Finally cover with 28 gauge aluminium sheet cladding.

Where ducts penetrate the building shell, the duct shall be flashed and waterproofed before any insulation is applied.

4.0 Condensate Drain Pipes and exposed cold water pipes on roof:

The pipework shall be insulated with 9mm thick elastomeric closed cell self-adhesive nitrile rubber.

5.0 LAGGING ADHESIVE

5.1 Adhesive shall be a flexible, fire resistive compound suitable for vapour sealing insulated ducts and pipes.

5.2 Adhesive shall be suitable for indoor and outdoor use and in high humidity environments.

6.0 ACOUSTIC INSULATION
6.1 All low-pressure ductwork shall be lined with acoustic insulation up to the first take off point, or 5 meters from the AHU outlet whichever is greater.

6.2 Duct acoustic lining shall be 10 mm thick, fiberglass, and 24 Kg/cum density with a thermal conductivity of 0.035 Watts/ M/ deg C with approved coating on inside.

6.3 Liner will be attached by a fire resistant adhesive such as Benjamin Foster 81-99, or equivalent. In addition mechanical fasteners shall be used on 400 mm centres on top and side sections. These fasteners must be spot-welded to the inside of the duct and must not perforate the duct. The insulation material shall be covered with 24 G perforated aluminium sheet.

7.0 ALUMINIUM CLADDING – FOR EXPOSED SURFACES

7.1 Aluminium cladding shall be provided to ducts with neat 90 degree joints and finish. Material shall be with stone finish.

7.2 In pipework the longitudinal joints shall be cleated or held in position with stainless steel bands and clips. Elbows and other fittings shall be made with mitred section and riveted. All valves strainers, flexible connection etc. shall have easy removable boxes with stainless steel aluminium toggle clips.

7.3 In ductwork the joints shall be riveted or banded with stainless steel band and clips to avoid sagging. Boxes to be made around duct traverse joints.

7.4 All gaps shall be to a minimum and shall be sealed with silicon mastic suitable for outdoor.

8.0 SAMPLES

8.1 Submit samples of all types of insulation for approval.

8.2 Submit with samples, the full technical brochures.

8.3 Where the specification calls for additional treatments, such as wrapping and waterproofing, submit also a completed sample of similar size.

8.4 All samples after approval are to be retained on site to be a reference for future work.

REFERENCES

A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.


C. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.

D. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

E. ASTM E84 - Surface Burning Characteristics of Building Materials.


H. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

I. UL 723 - Surface Burning Characteristics of Building Materials.

SUBMITTALS
A. Product Data: Provide product description, list of materials and thickness for each service, and locations.

C. Samples: Submit two samples of any representative size illustrating each insulation type.

D. Manufacturer's Installation Instructions: Indicate procedures, which ensure acceptable workmanship and installation standards will be achieved.

QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with NFPA 255.

QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site in proper conditions as stated in Section 1.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

EXECUTION:

EXAMINATION

A. Verify that ductwork has been tested and cleaned before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

INSTALLATION

Install materials in accordance with manufacturer's instructions.

All insulation shall be applied by mechanics skilled in this particular work and regularly engaged in such occupation. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy work will not be acceptable, and all such work shall be removed and replaced as many times as necessary to achieve an acceptable installation.

All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application, and is stated as an exception to this requirement. Certificates to this effect shall be submitted along with Contractor's submittal data for this section of the Specifications. No material may be
used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.

All surfaces to be insulated shall be clean and dry before applying the insulation. All sections of duct/pipe covering shall be firmly butted together. Where an insulation covering is applied, it shall lap the adjoining section of insulation by at least three inches (3”). Where insulation terminates, it shall be neatly beveled and finished. No insulation shall be applied until the pipe, duct, etc., have been pressure tested and found tight. Piping, flexible connections, flanges, valves, stirrers, and unions shall be covered unless specifically noted otherwise. Flexible connections on duct shall not be covered. All materials used shall be fire retardant or nonflammable. Refer to Section 15A. Extreme care shall be taken in covering high and medium pressure (high and medium pressure ductwork shall be all ductwork between the fan discharge and all mixing boxes) ductwork to insure the duct is not pierced with sheet metal screws or other fasteners. All high and medium pressure ducts in these specifications are classified as high velocity ductwork. Where specified, aluminum bands shall be used on piping insulation. The bands shall be applied three (3) to a section of pipe. Fittings, valves, etc., shall have bands on each side.

For purpose of definition in this Specification: "concealed" areas are those areas which cannot be seen by the building occupants, and "exposed" areas are all areas which are exposed to view by the building occupants, including under counter and inside cabinet areas, plus all mechanical rooms.

The handling and installation of all insulation materials shall be performed in strict accordance with the manufacturer’s recommendations.

TOLERANCE

Substituted insulation materials shall provide thermal resistance within 5-10 percent at normal conditions, as materials indicated.

SECTION 5

FIRE DAMPER

A. Combination Fire/Smoke Dampers

1. Furnish and install where shown on the Drawings, or as required by the Specifications or BOQ combination fire/smoke dampers meeting the following requirements.

2. Each combination fire/smoke damper shall be 1 1/2 hour fire rated under UL Standard 555, 4th Edition, and shall be further classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of ANSI-UL 555, 1985. The damper manufacturer shall have tested as per UL, a complete range of damper sizes covering all dampers required by this Specification. The leakage rating under UL555S shall be no higher than Leakage Class I (4 cfm per square foot at one inch water gage pressure and 8 cfm per square foot at 4 inches water gage pressure). The maximum air pressure drop through each combination fire/smoke damper shall not exceed 0.10 inch water gage at the design air quantity. (Note that this may require a larger damper than the connected duct size.)

3. The damper frame shall be a minimum of 20 gauge galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non-electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in an extruded hole in the frame or an extruded frame raceway. The dampers may be either parallel or opposed blade type. The blades shall be constructed with a minimum of 14 gauge equivalent thicknesses. The blade edge seal material shall be able to withstand 450 degrees F. The jam seals shall be flexible stainless steel compression type or lap seal type.
4. In addition to the leakage ratings specified herein, the combination fire/smoke dampers and their operators shall be qualified under UL555S to an elevated temperature of 250 degrees F. Electric operators shall be installed by the damper manufacturer at the time of damper fabrication. The damper and operator shall be supplied as a single entity, which meets all applicable UL555 and UL555S qualifications for both dampers and operators. The manufacturer shall provide a factory assembled sleeve. The sleeve shall be a minimum of either 20 gauge for dampers where neither width nor height exceeds 48 inches or 16 gauge where either dimension equals or exceeds 48 inches.

5. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4 inches water gage in the closed position, and 2500 fpm air velocity in the open position.

6. Each combination fire/smoke damper shall be equipped with a UL Classified Firestat/releasing device. The firestat/releasing device shall electrically and mechanically lock the damper in a closed position when the duct temperatures exceed 165 degrees F and still allow the appropriate authority to operate the damper as may be required for smoke control functions. The damper must be operable while the temperature is above 250 degrees F. The actuator/operator package shall include two damper position indicator switches linked directly to damper blade to provide capability of remotely indicating damper position. One switch shall close when the damper is fully open, and the other switch shall close when the damper is fully closed. The Firestat/releasing device and position indicator switches shall be capable of interfacing electrically with the smoke detectors, building fire alarm systems, and remote indicating/control stations.

7. The damper releasing device shall be mounted within the air stream. The device shall be activated and the damper shall close and lock when subjected to duct temperatures in excess of approximately 285 degrees F.

8. Motors for operation of smoke dampers shall be smoke system fail safe, spring return normally open supplies and normally closed returns, or as indicated in the plans, and shall be furnished and installed by the damper manufacturer as required by the U.L. rating mentioned above. Motors shall be electric or pneumatic to match the type of temperature control system specified elsewhere in this specification. All required relays, EP switches, wiring piping and other labor and material necessary to completely interconnect the smoke detector system shall be furnished by the Contractor.

9. Each damper shall be furnished in a square or rectangular configuration. The Contractor shall furnish and install sleeves manufactured by the approved damper manufacturer for each damper. The sleeves shall be constructed with square or rectangular to square, rectangular, round, or oval adapters as required. Dampers shall be installed in the sleeves in accordance with manufacturers U.L. installation instructions. The entire assembly, following installation, shall be capable of withstanding 6" W.G. static pressure.

10. All combination fire/smoke dampers shall comply with the specification as written above.

11. The contractor shall completely seal the assembly to the building components using Hardcast 1602 sealant tape so as to allow for expansion and contraction of the sleeve and damper assembly.

12. Dampers shall be UL labeled for use in dynamic systems. Closure reading shall be 110% of the maximum design air flow at the point of installation. The minimum closure pressure rating shall be 8" wg for air flow in either direction.

13. In case of fire, the signal from smoke detector, mounted in housing having air
sampling arrangement by means of air sampling tubes and filters, shall close the fire dampers as well as the Air handling unit.

B. **Submittal and Installation**

1. The air quantity and free area through each fire and combination fire and smoke damper has been noted on the drawing adjacent to the duct size or wall opening size where such damper is required.

2. Submittal(s) for fire and combination fire/smoke dampers shall include the following:
   a. Assign identification numbers for each damper with corresponding number noted on the drawings.
   b. Provide air quantity, size, free area of damper, pressure drop and proposed velocity through each damper.
   c. Provide manufacturer's data of damper and its accessories or options.

3. One sample 18'' x 12'' damper shall be furnished for the purpose of illustrating damper operation to the owner's operating and maintenance personnel.

4. Access doors as specified elsewhere shall be provided to make all parts of the damper accessible. Doors shall open not less than 90 degrees following installation and shall be insulated type where installed in insulated ducts.

5. Contractor shall install each damper square and true to the building. The installation shall not place pressure on the damper frame, but shall enclose the damper as required by UL555.

6. After each combination fire and smoke damper has been installed and sealed in their prescribed openings and prior to the installation of the ceilings, the Contractor shall, as directed by the Construction Inspector, activate part or all the dampers as required to verify "first-time" closure. Activation of the damper shall be accomplished by manually operating the resettable link, disconnecting the linkage at the fusible link of the fire damper, and manually operating the fire/smoke damper through the pneumatic or electronic controls as appropriate. Failure of the damper to close properly and smoothly on the first attempt will be cause to replace the entire damper assembly.

**SECTION 6**

**MEASUREMENTS**

The following procedure for measurement shall be followed for purpose of billing in case of items subject to variation in quantities.

1.0 Ducting:

1.1 Payment for ducting shall be on the basis of the external surface area of the ducting including all material and labour for installed duct.

1.2 The rate per square meter of the external surface shall include all wastage flanges, flanges, gaskets for joints, bolts and nuts, duct supports and hangers, vibration isolation pads or suspenders, flexible connections, inspection doors, dampers, turning vanes, straightening vanes, and any other item which will be required to complete the duct installation except external insulation and finish thereon.
1.3 The external area shall be calculated by measuring the overall width and depth (including the corner joints) in the center of the duct section and overall length of each duct section from flange face to flange face in case of duct lengths with uniform cross section. Total area will be arrived at by adding up the areas of all duct sections.

1.4 In case of taper pieces average width and depth will be worked out as follows

\[
\begin{align*}
W_1 &= \text{Width of small cross section} \\
W_2 &= \text{Width of large cross section} \\
D_1 &= \text{Depth of small cross section} \\
D_2 &= \text{Depth of large cross section} \\
\text{Average Width} &= \frac{W_1 + W_2}{2} \\
\text{Average Depth} &= \frac{D_1 + D_2}{2}
\end{align*}
\]

Width and depth in the case of taper pieces shall be measured at the edge of the collar of the flange for duct/sections fitted with angle iron flanges; otherwise at the bottom of the flange where the flanges are of GSS. Face to face length for taper piece shall be the mean of the lengths measured face to face from the center of width and depth flanges.

1.5 For Circular pieces the diameter of the section midway between large and small diameter shall be measured and adopted as the mean diameter for calculating the surface area off the taper piece. Duct measurement for calculation of area shall be taken before application of insulation.

1.6 For special pieces like bends, branches, and tees, etc., the same principal of area measurement as for linear lengths shall be adopted, except for bends and elbows, the length of which shall be the average of the lengths of inner and outer periphery along the curvature of angle of the piece.

2 Grill/Diffuser:

Payment for grill/diffuser shall be on the basis of internal (effective) surface area of the grill/diffuser including all material and labour for installed grill/diffuser.

The rate per Sq. meter of surface shall include all flanges, gaskets, bolts and nuts etc. The internal area shall be calculated by measuring the liner width and depth of the grill.

3 Piping

Piping shall be measured in unit of length along the center line of installed pipe including all pipe fitting, flanges (with gasket and nut and bolts for jointing), union bends, elbows, tees, concentric and eccentric reducers, inspection pieces expansion loop etc. The above accessories shall be measured as part of piping length along the center line of installed pipes and no special rates for these accessories shall be permitted.

The quoted rates for center line liner measurements of piping shall include all wastage, allowance, pipe supports including hanger, MS channel, vibration isolators’ suspension where specified or required.

4 Piping Insulation

Piping insulation shall be measured in unit length along the centerline of the installed pipe, strictly on the same basis as the piping measurements described above. The linear measurement shall be taken before the application of the insulation.

5 Duct insulation/Acoustic lining

- This item is provided separately for various thickness and shall be paid for in area basis of uninsulated duct. The area of the duct to be insulated shall be measured before application of insulation.
The Owners / Consultants shall have the right to reject all supplies, which do not conform to the samples so approved.

b. The insulation shall be applied as under.

i) Clean the duct surface to be insulated free from dust, grease & other dirt.

ii) Measure the size of the duct and cut the insulation sheet to the required size with a sharp knife and straight edge. Remove the sheet from the role and fix it to the duct and apply slight pressure so that it bonds will. Ensure that is in desired position before the adhesive of the sheet make contact with the sheet metal duct.

iii) Seat the joints using black adhesive tapes as per recommendations of the manufacture.

SECTION 7

TESTING, ADJUSTING AND BALANCING
(T A B)

1.01 SUMMARY

A. Perform all work required to prepare the building HVAC systems for testing, adjusting and balancing indicated by the Contract Documents as follows:

1. Responsibilities of project contractor.

2. Preparation for balancing of air systems.

B. The scope of the TAB work is responsibility of the HVAC Contractor to satisfactorily execute the TAB work as per ASHRAE/ SMCNA. The Contractor in his original bid shall allow for the costs required to cover all work which may be required in the TAB phases as defined herein and as may be necessary for the completion of the TAB work as defined by the TAB firm.

1.02 SCOPE OF WORK

A. Testing, adjusting, and balancing (TAB) of the air conditioning and ventilation systems and related ancillary equipment will be performed.

B. As a part of this project Construction Contract, the Contractor shall make any changes or replacements to the sheaves, belts, dampers, valves, etc. required for correct balance as advised by the TAB firm, at no additional cost to the Owner.

C. The Contractor shall provide and coordinate the services of qualified, responsible Subcontractors, suppliers and personnel as required to correct, repair, and/or replace any and all deficient items or conditions found during the course of this project, including the testing, adjusting and balancing period.

D. In order that all systems may be properly tested, balanced, and adjusted as required herein by these Specifications, the Contractor shall operate said systems at his expense for the length of time necessary to properly verify their completion and readiness for TAB. This length of time shall be subject to the approval of the Construction Inspector.

E. Project Contract completion schedules shall allow for sufficient time to permit the completion of TAB services prior to Owner occupancy. The contractor shall allow adequate time for the testing and balancing activities of the owner provided services, during the construction period, and prior to Substantial Completion as defined in the Uniform General Conditions of this Construction Document.

F. The Drawings and Specifications indicate valves, dampers and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Contractor to install these devices in a manner that will leave them accessible and readily adjustable. Should any such device not be readily accessible, the Contractor shall provide access as requested by the TAB firm. Also, any malfunction encountered by TAB personnel and reported to the Contractor or the Construction Inspector shall be corrected by the Contractor immediately so that the balancing work can proceed with the minimum of delays.
G. The entire air distribution shall be adjusted and balanced for delivery of design air quantities as required for achieving design space conditions. All dampers after adjustment shall be set and locked in position.

1.03 RESPONSIBILITIES OF THE PROJECT CONTRACTOR:

A. The Contractor shall:

1. Have the HVAC systems in complete operational readiness for TAB work to begin.

2. Complete operational readiness of the air conditioning systems also requires that the following be accomplished:

   Air Distribution Systems:
   
   a. Verify installation for conformity to design. All supply, return and exhaust ducts terminated and pressure tested for leakage as required by the Specification.
   
   b. All volume, smoke and fire/smoke dampers are properly located and functional. Dampers serving requirements of minimum and maximum outside, return and relief air shall provide tight closure and full opening, smooth and free operation.
   
   c. All supply, return, exhaust and transfer grilles, registers, diffusers and terminal devices installed.
   
   d. Air handling systems, units and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc., shall be blanked and/or sealed to eliminate excessive bypass or leakage of air.
   
   e. All fans (supply, return and exhaust) operating and verified for freedom from vibration, proper fan rotation and belt tension; heater elements in motor starters to be of proper size and rating; record motor amperage and voltage on each phase at start-up and running, and verify they do not exceed nameplate ratings.

3. Water Circulating Systems:

   a. Check and verify pump alignment and rotation.
   
   b. Open all valves to their full open position, close bypass stop valves. Set mixing valves to full-flow through systems components. After the system is flushed and checked for proper operation, remove and clean all strainers. The Contractor shall repeat the operation until circulating water is clean.
   
   c. Record each pump motor amperage on each phase and voltage after reaching rated speed. Readings shall not exceed nameplate rating.
   
   d. Verify that the electrical heater elements are of the proper size and rating.
   
   e. In preparation of TAB all water circulating systems shall be full and free of air, expansion tanks shall be set for proper water level, and all air vents shall be installed at high points of systems and operating freely. Systems shall be cleaned and flushed. Chemicals shall be added to closed systems to treat piping and inhibit corrosion.
   
   f. Check and set operating parameters of the heat exchangers and control devices to the design requirements.
4. Automatic Controls:
   a. The Contractor shall establish the requirements and present the control scheme and check sequences of operation for correctness.
   b. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, dampers sequences, air and water resets, fire and freeze stats, high and low temperature thermostats, safety, etc.
   c. Verify that all controlling instruments are calibrated and set for design operating conditions with the exception of room thermostats or sensors, which shall be calibrated at the completion of TAB services with cooperation between the TAB firm and Control Contractor.

5. Tabulated Data: The motor amperages, voltages shall be recorded showing “actual” and “nameplate” voltage and amperage and submitted and actual RPM. This applies to each piece of electrically driven air conditioning equipment in the system including supply and exhaust fans, fans of fractional horsepower, pumps, etc.

6. Notification of System Readiness:
   After completion of the work, the Contractor shall notify the Owner in writing, certifying that the work has been accomplished and that the building HVAC systems are in operational readiness. A copy of the tabulated report data to be submitted to Owner.

SECTION- 8

ELECTRICAL WORKS

1.0 SCOPE

The scope of this section comprises of supply, erection, testing and commissioning of complete power distribution covering power distribution cum Motor Control Centre (MCC), Power cabling and earthing etc for HVAC system.

2.0 GENERAL

Work shall be carried out in accordance with the accompanying specifications and shall comply with the latest relevant Indian Standards and Electricity Rules and Regulations.

CPRI type tested design shall be adopted for the motor control centers. All equipments shall be suitable for operation on 3 phase/single phase 415/230 volts, 50 cycles power supply system with solidly earthed neutral.

3.0 CONSTRUCTIONAL FEATURES

The Motor Control Centre (MCC) cum power distribution board shall be fully compartmentalized fabricated out of CRCA sheet steel. Wherever specified the same shall be suitable for outdoor installation, dead front, floor mounting/wall mounting type. The control panel shall be totally enclosed, completely dust and vermin proof and shall have hinged doors with Neoprene gasket. Control panel shall be suitable for the climatic conditions as specified in Specifications. Steel sheets used in the construction of Control panel shall be 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to relevant Codes, approved standards.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or
provided with wing nuts. Self threading screws shall not be used in the construction of Control panels. A base channel of 75 mm x 75 mm x 5 mm thick shall be provided at the bottom for floor-mounted panels. Minimum clearance of 400 mm shall be provided between the floor of control panel and the lowest unit.

The panel shall be of adequate size with a provision of 25% spare space to accommodate possible future breakers. Breakers shall be arranged in multi-tier arrangement. Knockout holes of appropriate size and number shall be provided in the Motor Control Centre in conformity with the location of cable/conduit connections. Removable sheet steel plates shall be provided at the top to make holes for additional cable entry at site if required.

Every cabinet shall be provided with Trifoliate or engraved metal name plates. All panels shall be provided with circuit diagram mounted on inside of door shutter protected with Hylam sheet. All live accessible connections shall be shrouded and minimum clearance between phase and earth shall be 20 mm and phase-to-phase shall be 25 mm.

4.0 WIRING SYSTEM

All L T power cabling between MCC and motors shall be carried out with 1100 volts grade PVC insulated, overall PVC sheathed aluminium / copper conductor armoured cables, Cables shall be sized by applying proper derating factor. All control wiring shall be carried out by using PVC insulated copper conductor wires in conduits. Minimum size of control wiring shall be 1.5 sq mm of Stranded copper conductor. Minimum size of conductor for power wiring shall be of 4 sq. mm in case of Aluminium Conductor & 2.5 sqmm in case of Copper conductor.

5.0 CIRCUIT COMPARTMENT

Each circuit breaker, contactor and relay shall be housed in a separate compartment and shall have steel sheets on top and bottom of compartment. Sheet steel hinged lockable door shall be duly interlocked with the breaker-opening handle in the “ON” position. Safety interlocks shall be provided to prevent the breaker from being draw-out when the breaker is in ‘ON’ position. The door shall not form an integral part of the draw-out portion of the panel. Sheet steel barriers shall be provided between the tiers in a vertical section.

6.0 INSTRUMENT ACCOMMODATION

Adequate space shall be provided for accommodating instruments, indicating lamps, control contactors and control MCBs. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker and bus bar ‘ON’ lamps shall be provided on all outgoing feeders.

7.0 BUS BAR CONNECTIONS

Bus bar and interconnections shall be of high conductivity electrolytic copper or Aluminium as per specifications and of rectangular cross section suitable for carrying the rated full load current and short circuit current without overheating of phase and neutral bus bar and shall be extendable on either side. Bus bar and interconnections shall be insulated with heat shrinkable sleeve and shall be colour coded and shall be supported on glass fiber reinforced thermosetting plastic / DMC / SMC insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system. All bus bar shall be provided in a separate chamber and all connections shall be done by bolting. Additional cross sectional area shall be added to the bus bar to compensate for the holes. All connections between bus bar and breaker shall be through solid copper strips of proper size to carry full rated current as per approved for construction shop drawing and insulated with insulating sleeves. Bus bar shall be rated for current density of 1.00-amps/mm² cross-section area.

8.0 TEMPERATURE - RISE LIMIT

Unless otherwise specified, in the case of external surface of enclosures of bus bar trunking system which shall be accessible but do not need to be touched during normal operation, an increase in the temperature rise limits of 25° C above ambient temperature shall be permissible for metal
surface and of 15° C above ambient temperature for insulating surfaces as per relevant Codes, and approved standards.

9.0 CABLE COMPARTMENTS

Cable compartment of adequate size shall be provided in the panel for easy clamping of all incoming and outgoing cables entering from the top/bottom. Adequate supports shall be provided in cable compartment to support cables as per approved for construction shop drawing.

10.0 AIR CIRCUIT BREAKERS (ACB)

Air Circuit Breakers shall be sheet metal enclosed flush front, draw out type and shall be provided with a trip free manual operating mechanism or as indicated in drawings and bill of quantities with mechanical "ON" "OFF" "TRIP" indications.

The ACB shall be 3 pole with modular construction, drawout, manually operated and shall be capable of providing short circuit, overload and earth fault protection through micro processor based control unit sensing the true RMS value to ensure accurate measurement meeting the EMI/EMC requirement as per standard.

The circuit breakers shall be for continuous rating and service short Circuit Breaking capacity shall be as specified on the single line diagram and shall be equal to the short circuit withstand values.

Circuit breakers shall be designed to ‘close’ and ‘trip’ without opening the circuit breaker compartment door. The operating handle and the mechanical trip push button shall be at the front of the breakers panel and integral with the breaker.

The ACB shall be provided with a door interlock. The contacts shall be of silver plated copper with a feature of contact wear inspection, indicating the life of the contacts. The ACB shall have double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety and inaccessibility to live parts.

11.0 CRADLE

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. The movements shall be free from jerks, easy to operate and shall be on steel balls/rollers and not on flat surfaces.

There shall be 4 distinct and separate position of the circuit breaker on the cradle.

Service Position: Main Isolating contacts and control contacts of the breaker are engaged.

Test Position : Main Isolating contacts are isolated but control contacts are still engaged.

Isolated Position: Both main isolating and control contacts are isolated.

Maintenance: Circuit breaker fully outside the panel ready for maintenance after the cubicle door is opened.

There shall be provision for locking the breaker in any or all of the first three positions.

12.0 PROTECTIONS

a. The Microprocessor based release unit shall be provided on circuit breaker for short circuit, over current and earth fault protection with adjustable settings.

The release shall incorporate an 8-bit micro-computer to offer accurate and versatile protection with complete flexibility and shall offer complete overcorrect protection to the electrical system in...
the following four zones:

- Overload or long time protection.
- Short circuit or short time protection with intentional delay.
- Instantaneous protection with no intentional delay.
- Ground fault protection.
- True RMS sensing.

The release shall sample the current at the rate of 16 times per cycle to monitor the actual load current waveform flowing in the system and shall monitor the true RMS value of the load current. It shall take into account the effect of harmonics also.

b. Thermal Memory

When the breaker shall reclose after tripping on overload, then the thermal stresses caused by the overload if not dissipated completely, shall get stored in the memory of the release and this thermal memory shall ensure reduced tripping time in case of subsequent overloads. Realistic Hot/Cold curves shall take into account the integrated heating effects to offer closer protection to the system.

c. Defined time-current characteristics:

A variety of pick-up and time delay settings shall be available to define the current thresholds and the delays to be set independently for different protection zones thereby achieving a close-to-ideal protection curve. Available pick-up and time delay settings shall have flexibility for over two million different I-t characteristics to suit different applications.

d. Trip Indication

Electromechanical fault status indicators shall be provided to display the type of fault that caused a trip, without any auxiliary supply or battery, resulting in faster fault diagnosis and reduced system down time.

e. Test Facility

Test facility to test the operation of the release in different protection zones by simulating CT inputs externally through a testing kit.

f. Self powered

The release shall draw its power from the main breaker CTs and shall require no external power supply for its operation.

g. Tripping of the breaker

The release shall trip the breaker through a flux shift device which shall directly act on the breaker trip rod.

h. Zone Selective Interlocking

The release shall be suitable for communication between breakers to enable zone selective interlocking. This feature shall be provided for both short circuit and ground fault protection zones to offer intelligent discrimination between breakers. This feature enables faster clearance of fault conditions, thereby reducing the thermal and dynamic stresses produced during fault conditions and thus minimises the damage to the system.
II. The setting range of release shall be as follows:

<table>
<thead>
<tr>
<th>Type of Protection</th>
<th>PICK-UP CURRENT</th>
<th>TIME DELAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Time</td>
<td>0.5 to 1.0 times I₀ (Iₐ)</td>
<td>0.2 to 30 sec at 6 I₀</td>
</tr>
<tr>
<td>Steps: 0.50, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, and 1.00.</td>
<td>Steps 0.2, 0.5, 1.5, 2, 3, 5, 6, 12, 17 and 30 secs</td>
<td>Tolerance: Corresponding to ±10% of current.</td>
</tr>
<tr>
<td>Operating Limit : 1.05 to 1.2 times I₀</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Short Time</th>
<th>2 to 10 times I₀</th>
<th>20 ms to 600 ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steps: 2, 3, 4, 5, 6, 7, 8, 9, &amp; 10</td>
<td>Steps 20, 60, 100, 160, 200, 260, 300, 400, 500, and 600 ms</td>
<td>Tolerance: ±10% or 20 ms, whichever is higher</td>
</tr>
<tr>
<td>Tolerance: ±15%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instantaneous</th>
<th>2 to 16 times I_m</th>
<th>100 ms to 400 ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steps: 2, 3, 4, 6, 8, 10, 12, 14, 16, one position as infinity.</td>
<td>Steps: 100, 200, 300, 400 ms &amp; Infinity</td>
<td>Tolerance: ±10% or 20 ms, whichever is higher</td>
</tr>
<tr>
<td>Tolerance: ±15%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ground Fault</th>
<th>0.2 to 0.6 time I_m</th>
<th>100 ms to 400 ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steps: 0.2, 0.3, 0.4, 0.5, 0.6</td>
<td>Steps: 100, 200, 300, 400 ms &amp; Infinity</td>
<td>Tolerance: ±10% or 20 ms, whichever is higher</td>
</tr>
<tr>
<td>Tolerance: ±15%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Settings shall be by rotary switches having red knob for pick-up currents and blue knobs for time delays.

Factory Settings:

The release shall be set at the following values at the time of shipping:

LTP=0.5, LTD=2s, STP=9, STD=100 ms, IP=Infi, GFP=0.3, GFD=100 ms, Memory=OFF

II. Under voltage relay for voltage is less than 90% of the rated voltage (415 V) shall be provided in the incomer breaker only.

III. Over voltage relay for voltage more than 110% of the rated voltage (415 V) shall be provided in the incomer breaker only.

j. Minimum 6 NO and 6 NC auxiliary contacts shall be provided on each breaker. The contacts shall be rated 5 amps.

k. Rated insulation voltage shall be 1000 volts AC. The auxiliary contacts blocks shall be so located as to be accessible from the front. The auxiliary contacts in the trip circuits shall close before the main contacts have closed. All other contacts shall close simultaneously with the main contacts. The auxiliary contacts in the trip circuits shall open after the main contacts open.
All current carrying parts shall be silver-plated and suitable arcing contacts with proper arc chutes shall be provided to protect the main contacts. The heat generated in the contacts due to tripping under fault conditions shall be very nominal. All air circuit breakers shall be labelled.

13.0 SAFETY FEATURES

I. The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.

II. It shall not be possible to interchange two circuit breakers of two different thermal ratings.

III. There shall be provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism. Earthing bolts shall be provided on the cradle or body of fixed ACB.

IV. Arc Chute covers wherever necessary shall be provided.

V. The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, digital voltmeter and ammeter of size not less than 96 mm x 96 mm, selector switches, MCB for protection circuit and current transformers.

VI. It shall be possible to bolt the drawout frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.

14.0 MOULDED CASE CIRCUIT BREAKER (MCCB)

All MCCB’s shall be motor duty and Current Limiting type, and comprise of Quick Make - break switching mechanism, preferably Double Break Contact system, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCB’s shall be capable of defined Variable overload adjustment. All MCCB’s rated 200 Amps and above shall have adjustable Magnetic short circuit pick up.

The trip command shall override all other commands. MCCB shall employ maintenance free double break contact system to minimize the let thru’ energies and capable of achieving discrimination upto full short circuit capacity of downstream MCCB. The manufacturer shall provide both discrimination tables and let thru energy curves.

The breaking capacity of MCCB’s shall be asked for in the schedule of quantities. The breaking capacities specified will be ICU=ICS i.e type-2. Co-ordination as per relevant BIS and IEC Codes.

The MCCB’s shall be provided with rotary handle operating mechanism. The handle position shall give positive indication of ‘ON’, ‘OFF’ or ‘Tripped’ thus qualifying to Disconnection as per the IS/IEC indicating the true position of all the contacts. In case of 4 poles MCCB the neutral shall be defined and capable of offering protection.

15.0 MINIATURE CIRCUIT BREAKER (MCB)

Miniature Circuit Breaker shall comply with relevant BIS Codes and shall be quick make and break type for 230/415 VAC 50 Hz applications with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall have type ‘C’ characteristic. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values.

The housing shall be heat resistant and having high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP and TPN miniature circuit
breakers shall have a common trip bar independent to the external operating handle.

16.0 PAINTING

All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be as per relevant BIS code.

17.0 LABELS

Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the control panel shall be pasted on inside of the panel door and covered with transparent plastic sheet.

18.0 METERS

i. All voltmeters and indicating lamps shall be protected by MCB’s.

ii. Meters and indicating instruments shall be flush mounts type.

iii. CT ratio and burdens shall be as specified on the Single line diagram.

19.0 CURRENT TRANSFORMERS

Current transformers shall be provided for feeders rated 15 HP and above. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondaries for operation of associated metering.

The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block, which shall be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class I.

20.0 SELECTOR SWITCH

Selector switches where called for, selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

21.0 STARTERS

Each motor shall be provided with a starter of suitable rating. Starters shall be in accordance with relevant IS Codes. All Star Delta and ATS Starters shall be fully automatic. Each starter shall be provided with Motor Protective Circuit Breaker (MPCB) to suite the connected motor.

22.0 CONTACTOR

Contactor shall be built into a high strength thermoplastic body and shall be provided with an arc shield for quick arc extinguishing. Silver alloy tips shall be provided to ensure a high degree of reliability and endurance under continuous operation. The magnet system shall consist of laminated yoke and armature to ensure clean operation without hum or chatter.

Starters contactors shall have 3 main and 2 Nos. NO / NC auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters and 3 times the full load current of the motor in case of Star Delta and Reduced Voltage Starters. The insulation for contactor coils shall be of Class “E”.

Coil shall be tape wound vacuum impregnated and shall be housed in a thermostatic bobbin, suitable for tropical conditions and shall withstand voltage fluctuations. Coil shall be suitable for
220/415±10% volts AC, 50 cycles AC supply.

23 THERMAL OVERLOAD RELAY

Thermal over load relay shall have built in phase failure sensitive tripping mechanism to prevent against single phasing as well as on overloading. The relay shall operate on the differential system of protection to safeguard against three-phase overload, single phasing and unbalanced voltage conditions.

Auto-manual conversion facility shall be provided to convert from auto-reset mode to manual-reset mode and vice-versa at site. Ambient temperature compensation shall be provided for variation in ambient temperature from -5°C to +55°C.

All overload relays shall be of three element, positive acting ambient temperature compensated time lagged thermal overload relays with adjustable setting. Relays shall be directly connected for motors upto 30 HP capacity. C.T. Operated relays shall be provided for motors above 30 HP capacity. Heater circuit contactors may not be provided with overload relays.

24.0 TIME DELAY RELAYS

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one set of auxiliary contacts for indicating lamp connection.

25.0 INDICATING LAMP AND METERING

All meters and indicating lamps shall be in accordance with relevant BIS standards. The meters shall be flush mounted type. The indicating lamp shall be of LED type. Each MCC and control panel shall be provided with voltmeter 0-500 volts with three way and off selector switch, CT operated ammeter of suitable range with three nos. CTS of suitable ratio with three way and off selector switch, phase indicating lamps, and other indicating lamps as called for. All voltage circuits shall be protected by MCBs.

26.0 TOGGLE SWITCH

Toggle switches, where called for in Schedule of Quantities, shall be in conformity with relevant IS Codes and shall be of 5 amps rating.

27.0 PUSH BUTTON STATIONS

Push button stations shall be provided for manual starting and stopping of motors / equipment. Green and Red colour push buttons shall be provided for ‘Starting’ and ‘Stopping’ operations. ‘Start’ or ‘Stop’ indicating flaps shall be provided for push buttons. Push Buttons shall be suitable for panel mounting and accessible from front without opening door. Lock lever shall be provided for ‘Stop’ push buttons. The push button contacts shall be suitable for 6 amps current capacity.

28.0 CONDUITS

Conduits and Accessories shall conform to relevant Indian Standards. Wall thickness shall be 16-gauge upto 32 mm dia and 14 gauges above 32 mm dia conduit. Screwed G.I. conduits shall be used. Joints between conduits and accessories shall be securely made, to ensure earth continuity. All conduit accessories shall be threaded type only. All raw metal shall be painted with bitumastic paint.

Only approved make of conduits and accessories shall be used.

Conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

Maximum permissible number of 650/1100 volt grade PVC insulated wires that may be drawn into rigid non metallic or MS Conduits are given below:
### Size of wires Nominal Cross section Area (Sq. mm.)

<table>
<thead>
<tr>
<th>Size of wires Nominal Cross section Area (Sq. mm.)</th>
<th>Maximum number of wires within conduit size(mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>5 10 14 -- --</td>
</tr>
<tr>
<td>2.5</td>
<td>5 8 12 -- --</td>
</tr>
<tr>
<td>4</td>
<td>3 7 10 -- --</td>
</tr>
<tr>
<td>6</td>
<td>2 5 8 -- --</td>
</tr>
<tr>
<td>10</td>
<td>-- 3 5 6 --</td>
</tr>
<tr>
<td>16</td>
<td>-- 2 3 6 --</td>
</tr>
<tr>
<td>25</td>
<td>-- -- 2 4 6</td>
</tr>
<tr>
<td>35</td>
<td>-- -- -- 3 5</td>
</tr>
</tbody>
</table>

### 29.0 CABLES

M.V. Cables shall be PVC insulated aluminium conductor and armoured cables conforming to IS Codes. Cables shall be armoured and suitable for lying in trenches, ducts, and on cable trays as required. M.V. Cables shall be termite resistant. Cable glands shall be double compression glands. Control cables and indicating panel cables shall be multi core PVC insulated copper conductor and armoured cables.

### 30.0 CABLE LAYING

Cable shall be laid in accordance with IS code of Practice. Cables shall be laid on 14 gage factory fabricated perforated galvanized sheet steel cable trays, and cable drops / risers shall be fixed to ladder type cable trays factory fabricated out of galvanized steel angle. Access to all cables shall be provided to allow cable withdrawal / replacement in the future. Where more than one cable is running on a cable tray, one dia spacing shall be provided between cables to minimize the loss in current carrying capacity. Cables shall be suitably supported with Galvanized saddles when run on walls / trays. When buried, they shall be laid in 350 mm wide and 750 mm deep trench and shall be covered with 250 mm thick layer of soft sifted sand & protected with bricks/tiles. Special care shall be taken to ensure that the cables are not damaged at bends. The radius of bend of the cables when installed shall not be less than 12 times the diameter of cable.

### 31.0 WIRE AND WIRE SIZES

1100 volts grade PVC insulted copper conductor wires in conduit shall be used. For all single phase/ 3 phase wiring, 1100 volts grade PVC insulated copper conductor wires shall be used. The equipment inside plant room and AHU room shall be connected to the control panel by means of insulated copper conductor wires of adequate size in exposed conduits. Final connections to the equipment shall be through wiring enclosed in galvanized flexible conduits rigidly clamped at both ends and at regular intervals. An isolator shall be provided near each motor/equipment wherever the motor/equipment is separated from the supply panel through a partition barrier or through ceiling construction. PVC insulated copper conductor wires shall be used inside the control panel for connecting different components and all the wires inside the control panel shall be neatly dressed and plastic beads shall be provided at both the ends for easy identification of control wiring.

The minimum size of control wiring shall be 1.5 sq. mm PVC insulated stranded soft drawn copper conductor wires drawn through conduit to be provided for connecting equipment and control panels.

Power wiring, cabling shall be of the following sizes:

i. Upto 5 HP motors/ 5 KW heaters 3 x 4 sq. mm copper conductor.

ii. From 6 HP to 10 HP motors 3 x 6 sq. mm copper
From 12.5 HP to 15 HP motors with star delta starters

From 20 HP to 25 HP motor delta starters

From 30 HP to 35 HP Motors with star delta starters

From 40 HP to 50 HP Motors with star delta starters

From 60 HP to 75 HP motors

From 40 HP to 50 HP motors

100 HP motors

150 HP motor

250 HP motor

400 HP motor

600 HP motor

All the switches, contactors, push button stations, indicating lamps shall be distinctly marked with a small description of the service installed. The following capacity contactors and overload relays shall be provided for different capacity motors or as per manufacturer's recommendation.

<table>
<thead>
<tr>
<th>TYPE OF CONTACTOR</th>
<th>OVERLOAD RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor</td>
<td>CURRENT CAPACITY</td>
</tr>
<tr>
<td>5 HP Motors</td>
<td>16 amps</td>
</tr>
<tr>
<td>7.5 HP motors</td>
<td>16 amps</td>
</tr>
<tr>
<td>10 HP Motors</td>
<td>25 amps</td>
</tr>
<tr>
<td>12.5 HP Motors</td>
<td>16 amps</td>
</tr>
<tr>
<td>15 HP Motors</td>
<td>25 amps</td>
</tr>
<tr>
<td>20 HP Motors</td>
<td>32 amps</td>
</tr>
<tr>
<td>25 HP Motors</td>
<td>32 amps</td>
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<td>HP Motors</td>
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<td>30 HP Motors</td>
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<td>40 HP Motors</td>
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<tr>
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<td>Soft Starter</td>
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<tr>
<td>600 HP Motors</td>
<td>Soft Starter</td>
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</table>

Two speed motors when specified, shall be provided with DOL starter irrespective of it rating.

### 32.0 EARTHING

Earthing shall be provided in accordance with relevant BIS Codes and shall be copper strips /wires. The main panel shall be connected to main earthing system of the power supply. All single-phase metal clad switches and control panels be earthed with minimum 3 mm diameter copper conductor wire. All 3 phase motors and equipment shall be earthed with 2 numbers distinct and independent copper wires / tapes as follows:

1. Motor upto and including 10 HP rating.
   - 2 Nos. mm dia copper wires.
2. Motor 12.5 HP to 40 HP capacity.
   - 2 Nos. 4 mm dia copper wires.
3. Motor 50 to 75 HP capacity.
   - 2 Nos. 6 mm dia copper strip
4. Motor above 75 HP.
   - 2 Nos. 25 mm x 3 mm copper strips.

All switches shall be earthed with two numbers distinct and independent copper wires’ tapes as follows:

1. 3 phase switches and control panels upto 60 amps rating.
   - 2 nos. 10 sq mm size copper conductors.
2. 3 phase switches, and control panels 63 amps to 100 amps rating.
   - 2 Nos. 16 sq mm size copper conductors.
3. 3 phase switches and control panels 125 amps to 200 amps rating.
   - 2 Nos. 25 x 6 mm GI strips
4. 3 phase switches, control Panels, bus ducts, above 200 amps rating.
   - 2 Nos. 40 x 6 mm GI strips

The earthing connections shall be tapped off from the main earthing of electrical installation. The overlapping in earthing strips at joints where required shall be minimum 75 mm. These straight joints shall be welded / crimping type lugs of adequate capacity and size shall be used for all termination of connections.
wires. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substance.

33.0 DRAWINGS

Shop drawings for control panels and for wiring of equipment showing the route of conduit & cable shall be submitted by the contractor for approval of Architect/Consultant before starting the fabrication of panel and starting the work. On completion, four sets of complete "As-installed" drawings incorporating all details like, conduits routes, number of wires in conduit, location of panels, switches, junction/pull boxes and cables route etc. shall be furnished by the Contractor.

34.0 TESTING

Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with relevant BIS codes and test report furnished by a qualified and authorized person. The entire electrical installation shall be gotten approved by Electrical Inspector and a certificate from Electrical Inspector shall be submitted. All tests shall be carried out in the presence of Owner’s site representative. Testing of the panels shall be as per relevant BIS Codes:

35.0 PAINTING

All sheet steel work shall undergo a process of degreasing, thorough cleaning, and painting with a high corrosion resistant primer. All panels shall then be baked in an oven. The finishing treatment shall be by application of powder coating of approved shade.

36.0 MEASUREMENT OF ELECTRICAL CONTROL PANELS

Panels shall be counted as number of units. Quoted rates shall include as lumpsum (NOT measurable lengths) for all internal wiring, power wiring and earthing connections from the control panel to the starter and to the motor, control wiring for interlocking, power and control wiring for automatic and safety controls, and control wiring for remote start/stop as well as indication as per the specifications. The quoted rate of panels shall also include all accessories, switchgear, contactors, indicating meters and lights as per the Specifications and Schedule of Quantities. The end terminations to be included in the cable rate.

37.0 RUBBER MAT

Rubber mat shall be provided in front to cover the full length of all panels. Where backspace is provided for working from the rear of the panel, rubber mat shall also be provided to cover the full length of panel.

38.0 CABLE TRAYS

The cable tray shall be fabricated out of 2 mm thick pregalvanized sheet steel using proper jigs and fixtures.

All accessories such as bends, tees etc., shall also be manufactured at the tray manufacturer’s works. These shall not be fabricated at site.

Perforated cable trays shall be of similar material with 1.6 mm thick G.I cover on top retained. In position by screws

Cable tray sections shall be joined by fishplates.

The accessories like bends, reducers, etc., of similar material with galvanized hardware shall be supplied.
SEC 9
2.1.1.1.1.1.1.1.1. LIST OF APPROVED MAKES

SCHEDULE OF MANUFACTURERS – HVAC WORKS

All the materials supplied under this contract shall be from one of the manufacturers listed below. No alternate Makes shall be accepted unless all the listed Makes are unavailable. Materials proposed from listed Makes also must fully comply with detailed technical Specifications.

1. FAN COIL UNITS
   - BLUESTAR /ZECO
   - ETA /TRANE
   - CARRIER
   - VOLTAS,

2. DUCTED SPLIT AC
   - BLUE STAR
   - CARRIER
   - HITACHI /ETA
   - TRANE
   - VOLTAS

3. EXHAUST FANS (CENTRIFUGAL)
   - KRUGER /FLAKT / GREENHECK
   - NICOTRA / NADI / SYSTEM AIR/ACCEL

4. FANS PROPELLER
   - KRUGER/ALSTOM/ABB/ GEC/NADI
   - UNIVERSAL/CROMPTON/ALMONARD

5. AIR DISTRIBUTION DEVICES
   (GRILLS/DIFFUSER/SWIRL & DRUM DIFFUSER/DAMPERS)
   - AIR MASTER /AIR PRODUCT
   - CARRYAIRE
   - AIRFLOW /DYNACRAFT
   - RAVISTAR/COSMOS

6. GI SHEET
   - SAIL / JINDAL /TATA

7. DUCT SUPPORTS
   - HITECH / HILTI

8. EXPANSION VALVES
   - SPORLAN
   - DANFOSS

9. MOTORS
   - ABB
   - SIEMENS/KIRLOSKAR
   - CROMPTON GREAVES

10. ELECTRICAL COMPONENTS
    (PANELS)
    - TELE MECHANIC
    - SIEMENS
    - MARLIN GERIN
    - L & T
    - HAVELL

11. COPPER PIPES
    - RAJCO/ MANDEV / TOTALINE
    - KWALITY

12. INSULATION
    - ARMAFLEX/K-FLEX /SUPREME

13. PIPES
    - TATA /JINDAL /SAIL

14. BUTTERFLY / BALL VALVES
    - AUDCO
    - ADVANCE
    - INTERVALVE
    - BONOMI / CRI
15. NR VALVES     AUDCO
                ADVANCE
                INTERVALVE

16. Y STRAINER    EMERALD/SANT
                LEADER
                ADVANCE/

17. ALL INSTRUMENTS
    (INCLUDING PRESSURE & TEMP GAUGES)    DYWER/WAREE/TAYLOR
    /GURU/FIEBIG/BIPSON

18. ROOF EXTRACTION FANS  KRUGER / SYSTEM AIR /DYNAIR
                           NICOTRA / NADI / GREENHECK

19. SPRING ISOLATORS    KANWAL/DUNLOP/RESISTOFLEX
                         INDUSTRIES/POLYBOND

20. AIR FILTERS        AIR TECH
                       UCO
                       ARW
                       DYNA
                       CAMFILL
                       AAF/COSMOS

21. V A V TERMINAL BOXES     TRANE / CARRIER / TROX /JOHNSON /
                             BELIMO / BARCOL – AIR SAUTER

22. BALANCING VALVES       T&A / FLOWCON / OVENTROP
                           BELIMO /BONOMI/AUDCO/ADVANCE

23. FACTORY DUCTS         ROLASTAR/ ZECO/NUTECH/ WESTERN
                          DUCTS/GP SPIRO

24. SPIRAL DUCTS           GPSPIRO/WESTERN DUCTS/NUTECH/ZECO

25. FACTORY FABRICATED PLENUMS AIRMASTER/ROLASTAR/CARYAIRE/ NUTECH/
                                WESTERN DUCTS/GPSPIRO

26. FIRE DAMPER           AIRTECH/T.S.C
                         INSTRUMENTS/GEORGE RAO/CARYAIRE/AIR
                         MASTER

HVAC – ELECTRICALS

<table>
<thead>
<tr>
<th>SL.N</th>
<th>ITEMS DESCRIPTIONS</th>
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<td>1</td>
<td>ACB</td>
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<td>CONTACTORS AND O/L RELAY</td>
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<td>4</td>
<td>LOAD MONITORS / CONTROLLER</td>
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<td>MCBS</td>
<td>SIEMENS / LEGRAND / L&amp;T / ABB</td>
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<td>6</td>
<td>CAPACITOR (HEAVY DUTY MPP GAS FILLED)</td>
<td>SIEMENS (EPCOS)</td>
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<td>7</td>
<td>CTS AND PTS</td>
<td>KAPPA / SIEMENS</td>
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<td>8</td>
<td>CONTROL SWITCHES</td>
<td>KAYCEE / SIEMENS / SALZER/L&amp;T</td>
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<td>ELR / EARTH FAULT RELAY</td>
<td>JVS / ALSTOM / PROK DVS</td>
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<td>PROTECTIVE RELAYS</td>
<td>JVS / ALSTOM / SEG C</td>
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<td>11</td>
<td>PUSH BUTTONS</td>
<td>ABB/SIEMENS / TEKNIC/ SCHNEIDER/GE</td>
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<td>ENERGY METER</td>
<td>ELECTREX / ENERCON</td>
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<td>SINGLE PHASE PREVENTOR</td>
<td>L &amp;T/SEIMENS/CROMPTON/GE</td>
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<td>25</td>
<td>CABLE TRAYS</td>
<td>PROFAB/PATNI/ELCON/HILTI</td>
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PART - II – SPECIAL CONDITIONS

(Reference of the Clause of Part-I- General Conditions is mentioned against clauses of this part.)

SP.1 SPECIAL CONDITIONS of this PART-II shall be read in conjunction with GENERAL CONDITIONS (PART-I), and both shall form an integral part of the contract. Where these are at variance, the conditions stipulated in this PART, as Special Conditions shall supersede the relevant provision in the General Conditions.

ENGINEER

SP.2 The Consultant shall be:
M/s SEMAC LIMITED, 6-1-276, 2nd Floor, CONJEEVARAM HOUSE”, Padmaraonagar, Secundrabad

SP.3 The Consultant has been appointed by and duly authorized by the Employer to supervise, test, examine any materials and/or works, to order, cancel, alter, modify, any of the materials, items or works within the framework of the Contract. To approve / reject requests for modifications in works or schedule whether or not such orders, approvals, rejections, etc
The Consultant is further authorized to administer the Contract, check, correct, modify and certify or reject any bill or requests for payment for the materials, items or works in accordance with the terms of contract.

SP.4 The Ruling language for the Contract and related aspects shall be ENGLISH.
The Contract shall be governed by and construed in accordance with Laws of India.
The Contractor shall on his own and at his own expense obtain all necessary permits, permissions, certifications under the statutory provisions and to complete the execution of various items and the contract as a whole, including required registrations, certifications, and shall indemnify the Employer in all related matters.

SP.5 CONTRACTOR’S RESPONSIBILITY

SP.5.1 The Contractor shall furnish to the Consultant full particulars, drawings, etc. of all temporary works necessary for the execution of the works and shall allow sufficient time for Consultant to consider the same. The Consultant reserves the right to comment on the Contractor's proposals if they consider that modifications should be made. The Contractor shall be solely responsible for the stability and safety of all temporary works including obtaining statutory approvals and payment of statutory fees, if any. The Consultant will indicate the site(s) for such temporary works and the Contractor will have to restrict his requirements to the same. Should it be necessary to shift the temporary works to some other allotted place during the executions of the works, the Contractor shall do so, when informed by the Consultant r, at his own cost and without delay or demur. Such shifting of temporary works may be in part or in full.

SP.5.2 The Contractor shall be responsible for the clearance of the site of all scrub, debris, rubbish, etc. to be removed off site to allocation to be provided by the Contractor and approved by the Consultant. However, no trees shall be removed without the prior permission of the Engineer In Charge. The structures, services and works required to be demolished and removed shall also be removed off site to a location as mentioned above. The Contractor shall obtain necessary
permissions and approvals from local authorities for such disposals. The demolition shall include digging, excavating and removal of substructures, foundations and buried works. The cost of all this shall be borne by the Contractor.

The above is applicable for all site offices, labour camps, and godowns etc., which are not required after the Work is finally completed.

**SP 5.3** The Contractor shall at all the times during construction keep the Site clean and free from all debris and unwanted materials as per instructions of the Consultant. Storage of materials shall be in an organised manner and in proper compartments.

Storage on suspended floors shall not be permitted unless specifically approved in writing by the Engineer In Charge for specific materials in specific locations and in approved manner. The Engineer IN Charge shall be furnished with load details, if requested, before seeking approval for storage.

Regular cleaning operations shall be undertaken to remove all dust, debris, waste materials, etc. A cleaning schedule shall be maintained.

Contractor shall make his own arrangement for storage of those materials, which cannot be accommodated at site. Contractor shall be fully responsible for safe custody of the same. Materials shall be considered as the Consultant verifies “Delivered at Site” only after the physical presence of materials at site. Stores elsewhere shall not be eligible for being considered as "Delivered at Site”.

Contractor shall be responsible to keep entire site free from water due to water coming from any source at any level and shall protect all materials and works from being damaged by the water from any source. Contractor shall make proper arrangements for drainage prior to use of water for curing, testing, cleaning etc.

Any expenditure incurred by the Contractor in fulfilment of his obligations under this sub-clause shall be deemed to have been included in the Contract Sum.

**SP 5.4** The contractor shall co-ordinate with the activities of other agencies appointed by or permitted by the Employer, which may be simultaneously working in the working area of the contractor. The contractor shall not shift, remove / disturb, demolish any work or plant / equipment / material of any such agency without prior approval of Engineer-in-charge.

**SP 6** Within 15 days of the Award of Contract, the contractor shall submit to the Consultant and Engineer In Charge for approval a Programme showing the order of procedure in which he proposes to carry out the works and other documents as set out in **Clause 6 sub clause 9 of Part I**.

The Programme shall be prepared taking into account the activities of various other agencies involved in the project and shall be submitted for the Approval of the Consultant and Engineer In Charge. The Programme shall be reviewed by the Engineer in Charge from time to time and revisions if necessary shall be made for well co-ordinated and expedient implementation of the project. A separate Programme shall be prepared for each building/structure. The Employer will have the right to indicate priorities for execution of various items included in the Works. The Contractor will mobilize or re-mobilize or adjust his resources according to the priorities set by the Employer at no extra cost to the Employer. Even though overall period of the Contract shall be as stated in the CONTRACT DATA; the Consultant or the Employer may have to fix different periods of phase
wise completion keeping in view the targeted date for commissioning.

The Contractor shall abide by such different dates of completion, which shall be within the overall stipulated period of completion and will provide the contractor with a shorter duration within which the Contractor will have to complete such works. The Contractor will not be entitled any extra payment on this account.

**SP7**

All the Insurance shall be arranged by Contractor directly from any first class Insurance Company having a branch at Ojhar or Nasik and can deal with all matters pertaining to the subject. The insurance policies shall be in the joint names of the Employer and the contractor.

The following policies shall be maintained for the duration of the contract, or the extended period if required.

Contractor's All-risk Insurance Policy covering loss, damage, theft, burglary etc. of all materials and equipment, temporary works and the Works shall be insured for a total sum equal to the value of all such items plus ten percent of such value.

The Contractor shall make available the insurance policy in original before the commencement of work, and shall notify any change in the nature or extent of the works and also make available Additional Insurance of works if required in Special Circumstances.

Third Party Insurance shall be for a minimum amount upto Rs.5.00 lakhs per occurrence for 4 occurrences in contract period.

Contractor shall provide for adequate cover to his employees as per provisions of Workmen's Compensation Act.

Contractor shall indemnify the consultant and Employer from all claims that may arise on account of Contractor's operations at Site.

**SP8**

The Contractor shall comply with all rules, regulations and laws including safety of workmen for labour directly or indirectly engaged by the Contractor, his representative and sub-contractors if any approved by HAL. The Contractor at their own cost shall register themselves wherever and whomsoever required in this connection at local and state level.

**SP9**

The Contractors shall at their cost provide samples of all the materials for the approval of the Consultant and Engineer In Charge and shall provide alternative samples until the sample provided is as per the specifications and standards specified and an approval has been conveyed.

The Contractor shall at his cost provide one set of approved standards and codes to which the Proposed materials, items and works to be executed shall conform. Such a set shall be handed over to the Engineer In Charge for ready reference. All materials, items and works, when submitted for approval shall have reference of Tender Specifications and drawings and of clauses of relevant standard and codes for acceptance criteria.

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**SIGNATURE OF TENDERER WITH SEAL**

**EMPLOYER**
The Contractor shall, at his own cost, provide testing facilities at site and also arrange and bear the cost of testing from outside laboratories as stipulated in the tender and as directed by the Engineer in Charge.

**SP 10** The whole of the Works shall be completed within the contract period specified in the contract data and tender notice.

**SP 11** The contractor shall pay at the rate of 1/2% of the contract price per week of delay to the Employer as liquidated damages for the time, which shall lapse between the time prescribed in the tender notice and contract data, and the date of certificate of final completion of the works. Such liquidated damages shall be subject to a maximum limit of 10% of contract value or final sum.

**SP 12** The Employer shall issue Certificate of Completion of Works upon request from the Contractor as per Clause 11 sub clause 11 and 12, only if in the opinion of the Employer and the consultant the work is satisfactorily completed.

**SP 13** The Defects Liability Period shall be as specified in the contract data.

**SP 14** The Works shall be measured as given in the technical specifications or Bill of Quantities. If for a particular item of work, the mode of measurement is not given in the technical specifications or in the bill of quantities, then such work shall be measured as per the latest edition of Indian Standards IS : 1200.

**SP 15** The contractors shall execute the work directly by themselves. However for execution of specialized items, the contractor may seek the assistance of such parties who are having expertise in the respective field and their services will help the contractor to execute those items to the best quality and standards specified. However approval for engagement of such agencies will be at the discretion of the Engineer In Charge.

**SP 16 CERTIFICATES & PAYMENTS**

**SP 16.1**

The Contractor may submit weekly running bills in approved format for materials and works along with required details and measurements as directed by the Engineer in Charge. The Contractor shall submit Monthly Progress Report in triplicate in approved format. Failure to submit reports may result in holding up of Payment Certificate.

The bills shall be checked/verified and certified by the Consultant and the Engineer In Charge for Interim Payments for amounts, which in the opinion of the Consultant are due to the Contractor, based on actual executed quantities. Only the quantities of work executed, which correspond to the full description stated in the Bill of Quantities, shall be considered for payment. No part-rated items of work will be considered for payment in the bills.

All interim payments made to the Contractor during the progress of the works and thereafter against various running bills shall deem to be on account payments to be adjusted in the Pre-final or final bill submitted after the issue of Completion Certificate and handing-over of the Works to the Employer and further adjusted, if necessary at final account stage after the completion of Defects Liability Period and before release of the defect liability deposit.

Pre-final Bill shall be submitted within one month of issue of the Completion Certificate.
TERMS OF PAYMENT

16.2 Interest bearing Mobilisation advance as stipulated in CONTRACT DATA excluding sums of contingencies shall be payable to the Contractor against an irrevocable Bank Guarantee of like amount in the same currency, i.e. amount of advance and estimated interest liability as detailed at contract data, from a scheduled and/or Nationalized Bank.

Recovery of Advance shall be:

i). A percentage (as stipulated in the CONTRACT DATA applicable on the gross Interim Certificate amount.

PLUS

The interest (as specified in CONTRACT DATA).

16.2.1 Payment as stipulated in CONTRACT DATA for the value of the materials delivered at site for incorporation in the Works shall be included in Running Bills after due certificate by the consultant and Engineer in Charge. The Engineer In Charge’s assessment on the value shall be taken as final. Material advance will be recovered from next immediate running bill in full. In each running account bill material advance will be allowed based on the assessment of actual quantity of material available at site and actually required for incorporation in the work as certified by the Consultant and Engineer In Charge.

16.2.2 The Contractor may be paid weekly on the certificate of the Engineer in Charge, such sum or the price of the Works executed up to the end of the previous week after adjusting payments made in earlier bills and recovery of advances etc.

Pre-final bill will be certified after verification by the consultant and Engineer In Charge of all the required details, 'as-built' drawings and duly checked the final measurements.

The contractor may submit the final bill after completion of the entire works and services, certification of all the items of works executed, completion of all measurements of works actually executed at site and certified by the consultant and Engineer In Charge, completion of all testing and inspections, submission of all required documents, statements, registers, approval of all deviations and additional items, approval of extensions etc. by the Employer.

The contractor shall consider and include all his claims whatsoever in the final bill which shall construe and mean that the contractor shall not have any other claims whatsoever against HAL under this contract other than those indicated in the final bill. For this purpose the contractor shall enclose to the final bill a No demand Certificate, stating that he has no any other claims whatsoever against the company under this contract except the claims indicated in the final bill and defect liability amount if any.

On receipt of the final bill duly signed by the contractor with all the aforesaid enclosures, the same will be scrutinised by the Engineer-in-charge to see whether the claims are in order. He will also examine the cost recovered and to be recovered, total material advances paid, recovered any to be recovered, mobilisation advances paid, amount, recovered with interest and yet to be recovered total hire charges, electricity and water charges, already recovered and yet to be recovered & other particulars as may be necessary.

No claims of the contractor whatsoever shall be entertained after payment of the final bill.

16.2.4 Percentage of Retention Money and the Security Deposit, shall be as detailed in Sr. No. 5 and 6 of Contract Data.

SIGNATURE OF TENDERER WITH SEAL EMPLOYER
Notwithstanding anything contained elsewhere in this contract, the security deposit will be adjusted/refunded as follows:

a) The Performance Guarantee of 5% of contract sum will be returned to the contractor, along with the final bill only, duly discharged if necessary.

b) The Retention Money will be retained as defect liability deposit, which will be refunded on receipt of claim from the contractor after completion of the defect liability period and on rectification of all the defects (if any) pointed out during the defect liability period satisfactory and on certification by the consultant and Engineer In Charge.

c) In case of any of the defects are not attended by the contractor and as such the same are rectified by the Employer, the cost towards the rectification of those defects same will be recovered from the contractor from the defect liability deposit along with any other dues.

d) The security deposit i.e. Performance Guarantee & Retention Money shall be forfeited if the work is not completed in all respects by the contractor or the contractor withdraws or abandons the work during the course of execution.

SP 16.2.5 On submission of RA bills 75% of net value of work done will be paid on certification by Engineer In Charge along with recommendation of head of works department within 2 days and balance 25% payment shall be effected after detailed scrutiny within a week. Payment will be made through Account Payee cheques or Credited to the specified banks at HAL Township Ojhar or through RTGS.

SP 17 APPROVAL AND ACCEPTANCE

The work shall deem to have been accepted after fulfillment of all the following by the Contractor.

1. Obtaining certification from the competent and regulatory agencies, departments regarding completion of items wherever required for occupation and use of the Works and services and on handing over such certificates to the Employer.

2. Submitting As-Built Drawings, Catalogues, Brochures, Data Sheets, manuals as directed by the Engineer.

3. Submission of all registers, documents, and test results and all other documents as required to be maintained as per contract terms.

4. Completion of all measurements, verification and certification by the Consultant and the Engineer In Charge.

5. Obtaining Certificate of Completion, from the Employer.

5. Handing over of all the Works and services to the Employer.
Notwithstanding anything contained elsewhere in any of the clauses of the tender, the prices/rates quoted for each item/work in the Bills of Quantities shall be firm and fixed and shall be inclusive of all direct and indirect costs, duties, taxes, sales tax, consignment tax, Octroi / local tax, work contract tax, service tax, over heads, profits etc. on any of inputs, royalty on quarried items, incidental expenses for obtaining approvals etc. that may be involved in completing the item/work as required in the fulfillment of all obligations under the contract and to the satisfaction of the Engineer In Charge. Any variation in taxes, duties, levies, fees, charges etc. during the tenure of the contract shall be borne by the contractor and no claim for increase in prices / rates shall be accepted by the Employer. No additional expenses on this account shall be borne by the Employer.

Sales Tax on Works Contract shall be borne by the Contractor but the Employer has the right to deduct equivalent amount from running bill of Contractor and deposit the same directly with competent authority. The Contractor ought to be registered with Sales Tax Department.

The Employer has further right to deduct any and all of the Taxes deductible at source, including surcharge, if any and deposit the same with the competent Authority.

The Contractor shall supply, erect and satisfactorily maintain in good repair until final completion of works, well lighted, temporary, burglar proof two Site Offices of 25 sq.m. Carpet area each viz. one for Employer and one for Consultant as per approved layout for use at all times. The contractor shall provide adequate access to the offices. The Contractor shall be responsible during the continuance of the contract for the security of the offices and for all plans, documents and papers etc. contained therein. The offices shall be constructed to approved standards, well ventilated and adequately weather proofed and with sufficient general office furniture, fans and lockable steel cup-board in each office. The Contractor shall provide uninterrupted electric power and water to the Offices as directed for 24 hours. Contractor shall provide one brand new Computer of latest version of Compaq or Lenovo make along with required soft wares & accessories, as decided by EIC, one laser printer of Brother or HP make, along with computer trolley, UPS etc. On completion of the work, the computer and printers shall become HAL property.

The Contractor shall provide at all times for the duration of the contract all staff men, workmen and survey instruments for the exclusive use of the consultant and Engineer In Charge as directed by the Engineer in Charge for carrying out of his duties in connection with the contract. The contractor shall ensure that his survey team possesses the adequate knowledge and experience in their field to perform the work.

Such survey and distance measuring instruments, which must be approved by the Engineer in Charge shall include but not be limited to the following:

1. One Levelling instrument/Theodolite with horizontal circle and tripod.
2. Two metric levelling staffs not less than 3.5 metres high.
3. Two 100-metre (Freemans brand) rust less steel tape, three 30 meter (Freemans brand) rust-less steel tapes, two 30 metre linen tapes and three 5 metres rustles steel tapes of Freemans brand.
4. Adequate number of ranging rods, drop arrows, wooden setting-out pegs, etc.
The contractor shall be solely responsible for all such instruments and equipments and shall ensure that they are at all times in good repair and adjustment.

On final completion of works, the entire offices along with all facilities provided by the Contractor except computers and printers and its connected units, as stipulated in clause SP 19 in Vol.I of tender documents shall be taken back by the Contractor at his own cost. The cost of providing the facilities stated in SP 19 and SP 19.1 are to be borne by the Contractor.

SP 20 The Contractor shall arrange accommodation for his staff and labour outside the HAL factory premises. No accommodation / labour hutsments can be allowed within the Factory premises. Necessary land for Labour colony / camp for the construction work will be given outside the factory premises free of charges. Maintaining labour camp by providing fencing, security, sanitation, water and lighting arrangements etc, will be the responsibility of the contractor.

Residential accommodation contractors Engineers may be provided as per the availability and as per the terms of HAL, In Township area.

SP 21 All staff and labour shall be given identity badges of approved design by the Identity contractor and these shall be worn whenever the person is moving on the Site.

SP 22 The Contractor shall arrange for power for construction of temporary buildings / works at his own cost and nothing extra shall be payable on this account.

Alternatively, the Employer may, at his sole discretion, provide construction power at one point at site. Contractor shall arrange and install all distribution cabling / wiring etc. Power shall be metered at the point of supply by Employer. Cost of power supply (single & three phase) shall be recovered by the Employer from bills of the contractor @ Rs 4.20 for units 0-200, Rs 5.90 for units above 200. Rs 6.20 for units 20KW-50KW, Rs 8.10 for units above 50KW or Current rate prevailing as decided by CM (Maint.). Providing of construction power point under this clause by the Employer is entirely at the option of the Employer’s and is subject to availability.

The Contractor shall also install a set of mobile Diesel Generators of suitable capacity for construction, temporary buildings and temporary lighting in order to take care of power failure and in adequate / fluctuating supply of power. These shall be provided from the date of mobilization upto the commissioning. This will act as stand by power.

The contractor shall provide all accessories and cabling as required along with Gen-sets. The contractor shall provide the installation and shall maintain the same in good order for entire duration of work.

The contractor shall then remove and take away all the equipments and accessories and the likes.

The Contractor at his own cost shall arrange water for construction and the same is deemed to be included in the quoted rates.

Alternatively, the Employer may at his sole discretion provide water for construction at one or more point at site at absolute discretion of the Engineer in Charge. Contractor shall arrange and install all taping and distribution piping, water meter etc. The cost of taping, piping network and the cost of water meter shall be borne by the contractor. The water used will be metered and charged @ Rs. 20.60 per 1000 litres or Current rate prevailing as decided by SM(works)/EIC. Recovery will be made from the RA bills or any amount due to
SP 23 The Contractor shall provide sanitation and drainage facilities on the Site as stated subsequently, at his own cost.

The Contractor shall strictly control the labour so that the Site is not polluted, made dirty or littered with debris, wastes or the likes.

Any person found creating mess or litter or pollution should be removed from the Site immediately at Contractor's cost.

The Contractor shall provide sanitation facilities at convenient locations on Site top reserve the cleanliness of the Site. The effluent shall be directed as follows:

1. Waste Water: Collection and pumping out and disposal off the Site in approved manner.

   Sewage

   Septic tank provision – sludge to be collected and disposed off at intervals as directed.

   The locations of the above provisions shall be as marked on the Site Mobilization Scheme drawing to be submitted by the Contractor for approval by the consultant and Engineer in Charge.

SP 24 The Contractor shall take note of the Site conditions and shall obtain any further details about ambient conditions on his own and take into account while pricing his tender.

All items and equipments quoted shall be suitable for satisfactory working under the ambient conditions.

SP 25 The Contractor shall provide at his own cost, two Site sign Boards, of overall size 1 meter wide and 2 meters height and of approved design at directed location. The names of the Project, Employer, Consultants, and Contractor etc. shall be exhibited as directed.

SP 26 DRAWINGS AND DOCUMENTS

SP 26.1 The drawings and documents prepared for the project shall be treated as confidential documents and must not be copied or loaned to any other party without the express permission of the Engineer/employer.

SP 26.2 The tender drawings furnished by the Consultant are for Tender Purpose only and are intended as a guide to the Contractor and give general layout of buildings and structures and general positions of utilities, services and equipment only and in measuring from these drawings and preparing tender quotes the contractor must make due and proper allowance for all necessary diversions from the straight line, rises or falls as may be required for the proper execution of the works.

Detail drawings in all cases shall be worked to in preference to those of a more general nature and figured dimensions where indicated shall be followed in preference to scaled dimensions. Should any item of equipment, materials or labour which would reasonably and obviously be inferred as necessary for the complete, safe and satisfactory usage of the Works or part thereof, not be expressly specified, the contractor shall provide and execute such work as a part of the contract at no extra cost to the Employer.

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The consultant shall issue from time to time free of charge two sets of Contract Drawings, Approved for Construction, to the Contractor and one copy thereof to the Employer. Additional copies as and when required shall be supplied by the Consultant and costs shall be reimbursed by the Contractor. In case the issue of drawings does not conform to the Programme as planned and approved, the contractor shall immediately submit a revised Programme so that; by deployment of adequate resources, the Work is completed within the stipulated time period.

The Consultant may from time to time during the course of contract issue the Contractor with revised contract drawings and the Contractor shall ensure that all superseded drawings are removed from site and stored in a lockable cabinet as directed by the Consultant and replaced by revised contract drawings.

The Contractor shall ensure that a complete up to date Register of Drawing is maintained at Site indicating the date of receipt, the title of drawing, revisions etc. All Contract Drawings shall be properly filed and indexed for ready reference.

The Contractor shall ensure that only the valid up to date contract drawings are used for preparation of working drawings, setting out, construction etc.

Working drawings shall mean any or all drawings, required for satisfactory execution of the work, in addition to the contract drawings and shall be prepared and got approved by the contractor at his own cost.

Working drawings shall include Shop and Fabrication Drawings for Wood work, Steel / Metalwork, False ceiling, partitions, clamping and fastenings, all utility and services, Bar Bending Schedules etc. as required by the consultant and Engineer In Charge.

The Contractor shall be entirely responsible for co-ordination of entire work at site including the work carried out by Sub-Contractors (if approved by HAL) and shall ensure that all necessary working drawings are properly prepared by the Contractor and are submitted to the Consultant for approval in sufficient time so as not to cause any delay in the expeditious execution of the works as per the Programme. Such approval shall not absolve the contractor from his responsibility.

Working drawings to be prepared by the Contractor and his Sub-contractor(if approved by HAL) shall be such that all details are included as required by the Consultant at an appropriate scale to ensure that the Works are properly executed, co-ordinated, fabricated and installed in accordance with contract drawings and specifications.

The Contractor shall make a general check of all physical sizes and details of plant and equipment required and/or specified for the project and shall inform the Consultant of any matter that may come to his notice with which he disagrees. Any comments by the Contractor on the difficulty in incorporating the plant, materials and equipment in the project and the time required for the completion of the work shall be made to the Consultant.
The Contractor shall bring to the notice of the Consultant any discrepancies within or between contract drawings and/or the other contract documents prior to preparation of working drawings and commencement of work and shall not proceed with work until the Consultant gives clarifications and instructions to proceed.

"As Built Drawings" shall be provided by Contractor at the time of Pre-final bill and shall be prepared by the Contractor at his own cost.

As-built drawings shall be under preparation from the onset of the contract, in order that all minor amendments and discrepancies from the "Working Drawings" are incorporated. To ensure that this requirement is complied with, the Consultant shall inspect the drawings on his request as the Works proceed. 3 sets of "As-Built" drawings shall be submitted by the Contractor along with soft copy in CD or DVD.

At the discretion of the Consultant and subject only to his express agreement certain working drawings may be modified and submitted to the Consultant as the "As Built" drawings.

The Contractor shall also provide the Engineer in Charge through the consultant with two copies in a durable plastic case of the operating and Maintenance Instruction Manuals in respect of all equipments, machines etc.. The arrangement of these manuals shall be as follows:

SECTION A : Index
SECTION B : Description and details of materials, items, fittings and fixtures used for the project along with Catalogues & Addresses of the Suppliers.
SECTION C : Planned maintenance instruction and dates for order replacements.
SECTION D : List of recommended consumables.
SECTION E : List of "As-Built" Drawings

Until the Record Drawings, prints, transparencies and manuals referred to above have been received and approved by the Consultant, the Contract shall not be considered as complete and payment of monies will be withheld until such drawings, etc. have been submitted to and approved by the Consultant and the cost of providing such records including proper submission thereof is deemed to be included in the Contract Sum quoted by the Contractor.
20) Time is the essence of the contract and the contractor shall be required to complete the work in all respects within the time stipulated in the contract, since the contractor’s tender depends upon the time allowed. However, if in the opinion of the Engineer In Charge, the work is delayed by reasons of:

a) Abnormally bad weather, or  
b) By reasons of serious loss or damage by fire, or  
c) By reason of Civil commotion, local combination of workmen strike or lock out affecting any of the trades employed on the work, or  
d) By delay on the part of the agency or tradesmen engaged by HAL in executing the work not forming part of this contractor, or  
e) By reason of any other cause which is the absolute discretion of the Engineer In Charge is beyond the contractor’s control, then in any such case the Accepting Officer on the recommendations of the Engineer-in-charge, may make fair and reasonable extension of time in the completion date of the individual items of work or the contract as a whole, and such extension which will be communicated to the contractor by the Employer in writing shall be final and binding on the contractor. No claim whatsoever in this respects either for compensation or otherwise shall be admissible.

Upon the happening of any such event causing delay, the contractor shall immediately give notice thereof in writing to the Engineer in Charge, but shall nevertheless use constantly his best endeavor to prevent or make good the delay and shall do all that may reasonably be required to the satisfaction of the Engineer in Charge.

21) Contractor shall submit all check lists, pour cards etc. as per the format approved by the consultant/Engineer in Charge before commencement of the works. The formats are to be submitted along with the Quality plan, which shall also include methodology.

22) Reconciliation of materials for Cement & Steel is to be made by the Contractor on monthly basis.

**SP 33 PROTECTION OF ENVIRONMENT**

The contractor shall take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or other resulting from pollution, noise or other cause arising as a consequence of his method of operation.

During continuance of the contract, the contractor and his sub-contractors shall abide at all times by all existing enactments on environmental protection and rules made there under, regulations, notifications and bye-laws of the State or Central Government, or local authorities and any other law, bye-law, regulations that may be passed or notification that may be issued in this respect in future by the State or Central Government or the local authority.

Ensure that all lights provided by the contractor shall be screened so as not to interfere with signal light on the railways or with any traffic or signal lights of any local or other authority.

Take all reasonable steps to implement the environmental mitigation measures.

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provided for in the “Environmental Management Plan” to be submitted by the contractor in accordance with objectives, procedures and other provisions set forth therein and shall not take any action, which would prevent or interfere with such implementation.

Salient features of some of the major laws that are applicable are given below

a) **The water (Prevention and Control of Pollution) Act, 1974**, This provides for the prevention and control of water pollution and the maintaining and restoring of wholesomeness of water. ‘Pollution’ means such contamination of water or such alteration of the Physical, Chemical or Biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may, or is likely to, create a nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health of animals or plants or of aquatic organisms.

b) **The Air (Prevention and Control of Pollution) Act 1981**, This provides for prevention, control and abatement of air pollution, ‘Air Pollution” means the presence in the atmosphere of any ‘air pollutant’, which means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment.

c) **The Environment (Protection) Act, 1986**, This provides for the protection and improvement of environment and for matters connected therewith, and the prevention hazards to human beings, other living creatures, plants and property. ‘Environment’ includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property.

d) **The public Liability Insurance Act, 1991**, This provides for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling hazardous substances and for matter connected herewith or incidental thereto. Hazardous substance means any substance or preparation, which is, defined as hazardous substance under the Environment (Protection) Act 1986, and exceeding such quantity as may be specified by notification by the Central Government.

SP – SALIENT FEATURES OF SOME MAJOR LABOUR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTION WORKS.

a) **Workmen Compensation Act 1923**: The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

b) **Payment of Gratuity Act 1972**: Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years service or more or on death the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.
c) **Employees P.F. and Miscellaneous Provision Act 1952**: The Act provides for monthly contributions by the employer plus workers @ 10% or 8.33%. The benefits payable under the Act are:

i) Pension or family pension on retirement or death, as the case may be.

ii) Deposit linked insurance on the death in harness of the worker.

iii) Payment of P.F. accumulation on retirement / death etc.

d) **Maternity Benefit Act 1951**: The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

e) **Contract Labour (Regulation & Abolition) Act 1970**: The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by Law. The Principal Employer is required to take certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour.

f) **Minimum Wages Act 1948**: The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are schedule occupations.

g) **Payment of Wages Act 1948**: It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.

h) **Equal Remuneration Act 1979**: The Act provides for payment of equal wages for work of equal nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc.

i) **Payment of Bonus Act 1965**: The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs. 3500/- per month or less. The bonus to be paid to employees getting Rs. 2500/- per month or above upto Rs. 3500/- per month shall be worked out by taking wages as Rs. 2500/- per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act.

j) **Industrial Disputes Act 1947**: The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

k) **Industrial Employment (Standing Orders) Act 1946**: It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act
provides for laying down rules governing the conditions of employment by
the Employer on matters provided in the Act and get the same certified by
the designated Authority.

l) **Trade Unions Act 1926**:: The Act lays down the procedure for
registration of trade unions of workmen and employers. The Trade Unions
registered under the Act have been given certain immunities from civil and
criminal liabilities.

m) **Child Labour (Prohibition & Regulation) Act 1986**:: The Act prohibits
employment of children below 14 years of age in certain occupations and
processes and provides for regulation of employment of children in all
other occupations and process. Employment of Child Labour is prohibited
in Building and construction Industry.

n) **Inter-State Migrant workmen’s (Regulation of Employment &
Conditions of Service Act 1979**:: The Act is applicable to an
establishment which employs 5 or more inter-state migrant workmen
through an intermediary (who has recruited workmen in one state for
employment in establishment situated in another state). The Inter-State
migrant workmen, in an establishment to which this Act becomes
applicable, are required to be provided certain facilities such as housing,
medical aid, traveling expenses from home upto the establishment and
back, etc.

o) **The Building and Other Construction workers (Regulation of
Employment and Conditions of Service) Act 1996 and the Cess Act of
1996**: All the establishments who carry on any building or other
construction work and employs 10 or more workers are covered under this
Act. All such establishments are required to pay cess at the rate not
exceeding 2% of the cost of construction as may be modified by the
Government. The Employer of the establishment is required to provide
safety measures at the Building or construction work and other welfare
measures, such as Canteens, First-Aid facilities, Ambulance, Housing
accommodations for workers near the work place etc. The Employer to
whom the Act applies has to obtain a registration certificate from the
Registering Officer appointed by the Government.

p) **Factories Act 1948**: The Act lays down the procedure for approval at
plans before setting up a factory, health and safety provisions, welfare
provisions working hours, annual earned leave and rendering information
regarding accidents or dangerous occurrences to designated authorities. It
is applicable to premises employing 10 persons or more with aid of power
or 20 or more persons without the aid of power engaged in manufacturing
process.

**SP -35 CONTRACTOR’S SUPERVISION**

The contractor shall appoint a responsible and Competent Engineer
holding a Power of Attorney to act on his behalf in execution of the
contract.

If the contractor fails to appoint suitable Engineer as aforesaid the EIC
shall have full powers to suspend the execution of work and stop payment
of any advances / bills that may have become due until such date a suitable
Engineer is appointed and the contractor shall be held responsible for the
delay caused to the work and no extension of time on this account shall be
given to him.

Orders given to the contractor’s authorized Engineer shall be considered to have the same force, as if they had been given to the contractor himself. The authorized Engineer of the contractor shall be in attendance at the site during all working hours and shall monitor the execution of work with such additional assistance in each trade as detailed hereinafter or so the Engineer In charge may consider necessary.

The contractor or his accredited Engineer shall attend when required and without making any claim for doing so, either the office of the Engineer-in-Charge or the work site to receive instructions.

The Engineer In Charge shall have full power and without assigning any reasons, advice the contractor immediately to cease to employ in connection with the contract if any agent/servant or employee whose continued employment is in his opinion is undesirable.

The contractor shall not be allowed any compensation on this account.

The contractor shall deploy an accredited representative holding power of attorney to monitor the work. The qualification and experience of the Engineers shall be as detailed below to receive instructions from the Engineer-in-Charge.
Additional Special Conditions.

ASP-1: Contractor shall obtain entry permits from the Employer for his staff, labour, sub-agencies and vehicles.

ASP-2: The work at flight hangar area may interrupt due to testing schedule of Aircrafts and the Contractor should prepare his schedule taking in to consideration the obstruction during such period and arrange working in different shifts. Contractor will not be paid anything extra on this Account, but

ASP-3: Contractor should take into consideration that he may be required to work in split shift basis in Morning and evening hours avoiding noon peak temperature period for concreting of pavement.

ASP-4: Employer, in his absolute discretion upon the request of the contractor may permit the contractor to work during night hours if the employer is satisfied with the working arrangement made and the methodology proposed by the contractor.

ASP-5: The Employer may spare some suitable piece of land to the contractor free of any charges for installing his establishment and concrete weigh batching plant. The decision with regard to the location of land shall be exclusively that of the employer and shall be final, conclusive and binding upon the contractor.

ASP-6: Since the work is in a high security zone, the contractor will have to ensure that his representatives and the specialized agencies engaged by him do not have any criminal background and the authorized representative of the contractor shall produce an affidavit attested by notary public confirming his harmlessness and produce the particulars as may be required by the security department of the Employer and shall comply with all the requirements as may be directed.

The tenderer should get himself acquainted with all the formalities and procedures in this regard prior to submission of tender.

ASP-7: The contractor shall not be permitted to change the Technical staff designated for the project without prior approval of Engineer-in-charge. The permission shall not be withheld without valid reasons. In the event such permission is requested, the request shall be made at least 15 days prior to effecting such a change and the contractor shall depute a person of equal qualification and experience as a replacement as may be approved by the Engineer-in-charge. In case, the contractor replaces the technical staff without permission or is unable to comply with the other provisions of this clause, a penalty of Rs. 25,000/- per replacement shall be imposed upon the Contractor in addition to the penalties specified in SP_35

ASP-8: The cut trees, if any shall be the property of HAL. The contractor shall have to stack the same neatly within the HAL premises, at his cost.

ASP-9: For blasting operations if required the contractor shall obtain approval from HAL authorities as well as from statutory bodies. Blasting is not permitted for dismantling. The contractor has to demolish the same carefully without disturbing foundation and adjoining structure.

ASP-10: The hard rock obtained from excavation will have to be stacked at locations as directed by the Engineer In Charge.

ASP-11: The contractor has to directly pay the royalties / fees / rents as may be applicable for the work, to concerned authorities and produce proof of the same on demand. If the authorities make any demand of the same to HAL and if the contractor does not produce satisfactory documentary proof to establish that the payment as stipulated in the demand is made by the
contractor, HAL shall have the liberty to make the payment directly to the concerned authority and recover the same from the contractor.

ASP-12: The contractor may be allowed to bring Ready Mix Concrete from outside RMC plants in extreme emergencies, due to failure of plant erected at site and the progress of work is substantially affected and the consultant and EIC is satisfied about the arrangements especially in respect of infrastructure, location, lead etc. However, the contractor shall be responsible for the quality of the product. The consultant and Engineer In Charge including their representatives shall be given all the opportunities and facilities to inspect the said plant and infrastructure as and when required. The permission to bring RMC from outside RMC plant shall be exclusively at the discretion of EIC to attend emergencies.

ASP-13: The specifications and technical details in MES SSR PART-I, Specifications and the relevant IS codes or in the absence of IS codes the respective international codes shall be followed for all the materials, workmanship, sampling, testing, quality control measures irrespective of the fact that those are specified in the technical specifications or BOQ. The MES SSR, IS codes or any other codes wherever specified shall be the latest version.

ASP-14: The work is to be carried out in close co-ordination with Pre-Engineered Building contractor who has been engaged by HAL for the PEB structure. The Civil/Electrical and utility services activities shall be well planned and coordinated considering the PEB structure work.

ASP-15: The contractor shall follows environmental friendly activities, waste management, and energy saving measures, green building concepts in execution of the work.
Project: "Civil, Electrical and other utility services for package -Civil- II (Rotable complex)


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INTERPRETATIONS

ASTM – American Society for testing and materials material code
A/C – Air conditioning
AWS – American welding society
AHU – Air handling unit BOQ – Bill of quantities C/C – Center
to Center CD/DVD – Compact disc / Digital video disc

DG U/S EOT crane – Double girder underslung electric overhead traveling crane DL – Dead load
DFT – Dry film thickness EIC – Engineer-in-charge FFL – Finished floor level IS –
Indian standards, presently Bureau of Indian standards (BIS)
LL- Live load
Mt. – Meter
MT - Metric tonne
PEB – Pre-Engineered Buildings
RCC – Reinforced Cement concrete

SG U/S EOT crane – Single girder underslung electric overhead traveling crane SL – Seismic load
TCT – Total coat thickness
UPVC pipe – Un-plastisized poly vinyl chloride
1. DEFINITIONS AND INTERPRETATIONS

1) In the Contract, as hereinafter defined, the following words and expressions shall have the meanings hereby assigned to them, except where the context otherwise requires:

a) "Employer" or "Owner" means M/S HINDUSTAN AERONAUTICS LTD., AIRCRAFT DIVISION, NASIK, who will employ the Contractor and the legal successors in title to the Employer, but not, except with the consent of the contractor, any assignee of the Employer.

b) HINDUSTAN AERONAUTICS LIMITED, AIRCRAFT DIVISION, NASIK, hereinafter referred to as “HAL” shall mean the Board of Directors, General Manager or other Administration Officers of the said company. The Chief Manager (Works & Services), Sr. Manager (Works & Services) are authorized to invite tenders and enter into contract for works on behalf of the company.

c) "Contractor" means the persons, firm or company whose tender has been accepted by the Employer & includes the Contractor's personal, representative’s successors and permitted assigns.

d) Consultant means M/s SEMAC Limited, Conjeevaram House, 2nd Floor, 6-1 - 276, Padmaronagar, Secunderabad, 500 025 (India), its permitted assigns or its successors who shall act through it’s accredited representatives as the Agents of the Employer for the Contract.

e) “THE ENGINEER IN CHARGE” (EIC) means the Officer deputed by the Senior / Chief Manager (Works) to supervise the work or part of the work.

f) "Engineer In Charge’s Representative" means any engineer or assistant of the EIC or any person appointed from time to time by the EIC to perform the duties set forth in the tender document on behalf of the Engineer In Charge.

g) "Consultant's Representative" means any Project Manager, resident engineer or assistant of the Engineer or any clerk of works appointed from time to time by the Consultant to perform the duties set forth in the tender whose authority shall be notified in writing to the Employer by the "Consultant.

h) The 'Work' or 'Works' means the work described in the Tender Documents, Drawings and Specifications as may be issued from time to time to the Contractor by the Engineer In Charge, Consultants or the Engineer, including all modifications, extra and additional works and obligations to be carried out either on site or at any factory, or workshop or any other place for subsequent incorporation, as required for performance of the Contract.

i) "Contract” means the contract between the Employer and the Contractor to execute, complete and maintain the work / works and shall consist of Tender Notice, Form of Tender, Appendices to Form of Tender, other Appendices / Annexures / Formats of Bank Guarantee etc. as included in the Tender Document, General Conditions of Contract, Special Conditions, Specifications, Drawings, priced Bill of Quantities / Schedule of Rates, “Common set of Deviations” / Addendum / Corrigendum etc. as issued by the Employer before or after Pre-bid meeting but before last date of submission of tender, Contract Data and any other document as may be listed in the Tender as part of the contract, Letter of Intent / Acceptance, Contract Agreement between the Employer and the Contractor and Works order.
j) “PROVISIONAL SUM” means a lump sum included by HAL in the tender documents and represents the estimated value of the work for which details are not available at the time of inviting the tender.

k) "Contract Sum" means the sum named in the letter of Intent / Acceptance subject to such additions thereto or deductions there from as may be made under the provisions of the Contract during execution.

l) The “FINAL SUM” means the actual amount payable under the contract by HAL to the contractor for the entire execution on full completion of the work.

m) "Constructional Plant" means all appliances or things of whatsoever nature required for the execution or maintenance of the Works but does not include consumable materials or other things intended to form or forming part of the Works.

n) "Specifications" means the specification included and referred to in the Tender and any modification thereof or addition thereto as may from time to time be furnished or approved in writing by the Engineer In Charge.

o) "Drawings" means the drawings referred to in the specification and any modification of such drawings approved in writing by the Consultant and Engineer In Charge and such other drawings as may, from time to time, be furnished and approved in writing by the Engineer In Charge and Consultant.

p) "Site' means the land and/or other places on, in, into, under or through which the Work(s) are to be executed under the contract or any adjacent or any nearby land, path or street which may be allotted or used for the purpose of carrying out the Contract.

q) "Approved" means approved in writing, including subsequent written confirmation of previous verbal approval and "approval" means approval in writing, including as aforesaid.

r) "I.S." means `Indian Standards' issued by the Bureau of Indian Standards.

s) "MES" means Military Engineer Service and “SSR” means Standard Schedule of Rates ( Part-I and Part –II).

r) A “Week" means seven days without regard to the number of hours worked or not worked in any day in that week.

s) A “Day” means a day of 24 hours irrespective of number of hours worked or not worked in that day.

t) A “WORKING DAY” means a day other than prescribed by the Negotiable Instruments Act as being holiday and consists of the number of hours of labour as commonly recognized by good employers in the trade in the Nashik District where the work is carried out or as laid down in the HAL Regulations.

u) “DEVIATION ORDER" means an order given by the Manager (Works) or Sr. Manager (Works & Services) or Chief Manager (Works & Services) or Engineer-in-charge which become necessary to effect an alteration, addition or deduction or deletion, which does not radically affect the scope of nature of the contract.
v) “EMERGENCY WORKS” means any urgent measures, which in the opinion of the Engineer-in-charge become necessary during the progress of the work to obviate any risk or accident or for security.

w) “ACCEPTING OFFICER” means the Chairman, HAL or any other officer nominated by him.

x) ENGINEER-IN-CHARGE” or “MANAGER (WORKS), or “SENIOR MANAGER (WORKS AND SERVICES)” or “CHIEF MANAGER (WORKS & SERVICES)” means the Engineer-in-charge, Manager (Works), Sr. Manager (Works & Services) or Chief Manager (Works & Services) of HAL Aircraft Division, Nasik.


z) The “APPROVAL” and “DIRECTED” means the approval or direction of the Engineer in Charge / Employer.

aa) The “DATE” of completion is the date or dates for completion of the whole or any part of the work as set out in or ascertained in accordance with the individual work order or any subsequent agreed amendments thereto.

2) Words imparting the singular only also include the plural and vice versa where the context requires. Male also means Female or neuter and the other way around where context so requires.

3) The headings and marginal notes in these Conditions of Contract shall not be deemed to be part thereof or be taken into consideration in the interpretation or construction thereof or of the Contract.

2. CONSULTANT AND CONSULTANT’S REPRESENTATIVE

1) The Consultant and his representative shall carry out such duties as are specified in the Contract like giving instructions regarding execution of entire work as per the Engineering standards, issue of working drawings, providing clarifications on the drawings and specifications, quality control measures, guidance on all technical matters, scrutiny of claims, suggestion of modifications/changes as per the requirement of owner, all documentation works whatsoever required and connected with the execution of the subject work.

The consultant shall have no authority to relieve the Contractor of any of his obligations under the Contract.

3. ASSIGNMENT AND SUB-LETTING

1) The contractor shall not, assign or transfer the contract or any part thereof or any share, or interest therein to any other persons without the prior written approval of the employer.

No sum of money which may become payable under the contract shall be payable to any person other than the contractor.
Project: “Civil, Electrical and other utility services for package -Civil- II (Rotable complex) circumstance.

The contractor shall carry out the work directly by themselves and shall not sub-let any part of the Work(s) without the prior written consent of the Employer and such consent, if given shall not relieve the Contractor from any liability or obligation under the contract and he shall be responsible for the acts, defaults and neglects of any sub-contractor, his agents, servants or workmen as fully as if they were the acts, defaults or neglects of the contractor, his agents, servants or workmen. Sub letting of the contract will be allowed only for specialized items at the discretion of HAL. The contractor shall co-ordinate and shall be responsible for all aspects of his sub-contractor(s), without being relieved of any of his obligation under the contract.

4. CONTRACT DOCUMENTS

1) (a) The ruling language for the contract and related aspects shall be English.

The contract shall be Governed by and construed in accordance with the law of India and no suit or other proceeding relating to the Contract shall be filed or taken by the Contractor in any Court of Law which shall not have exclusive jurisdiction to hear and determine all actions and proceeding in connection with and arising out of the Contract, and the Contractor shall not submit to the jurisdiction of the aforesaid Court of Law for the purpose of any such action and proceedings.

2) The several documents forming the Contract are to be taken as mutually explanatory of one another, but in case of ambiguities or discrepancies the same shall be explained and adjusted by the Consultants who shall there upon issue to the contractor instructions thereon through the Consultant’s representative. In such event, unless otherwise provided in the contract, the priority of documents for execution of works shall be as follows:

- Description of items of work given in Bill of Quantities.
- Drawing
- Detailed Technical specifications.

5. DRAWINGS

1) The Drawings shall remain in the sole custody of the Engineer In Charge, but two copies thereof shall be provided to the Contractor free of charge. The contractor shall not use the said drawings for any purpose other than execution of the work till completion of the work in all respect.

2) One copy of the Drawings, furnished to the Contractor as aforesaid, shall be kept by the Contractor on the Site and the same shall at all reasonable times be available for inspection and use by the Engineer in Charge, his representative and the consultant or consultant’s representative and by any other person authorised by the Engineer In Charge in writing. The drawing shall be protected, preserved and safely kept at site office.

3) The Engineer In Charge or his representative and the Consultants shall have full power and authority to supply to the Contractor from time to time during the progress of the Works, such further drawings and instructions as shall be necessary for the purpose of the proper and adequate execution and maintenance of the Works. The Contractor shall carry out the work according to the drawings and instructions issued by the Engineer In Charge and Consultant from time to time and the contractor is bound by the same.
4) The Contractor shall give written notice to the Consultant and Engineer In Charge whenever the planning or progress of the Works is likely to be delayed or disrupted unless any further drawing or order, including a direction, instruction or approval, is issued by the Engineer In Charge or consultant within a reasonable time. The notices shall include details of the drawing or order required and of why and by when it is required and of any delay or disruption likely to be suffered if it is late.

6. GENERAL OBLIGATIONS

1) The Contractor shall, subject to the provisions of the Contract, and with due care Contractor’s and diligence, execute, complete and maintain the Works and provide all labour, General including the supervision thereof, materials, Constructional Plant and all other Responsibilities things, whether of temporary or permanent nature, required in and for such execution, and maintenance, so far as the necessity for providing the same is specified in or is reasonably to be inferred from the Contract.

2) The Contractor shall take full responsibility for the adequacy, stability and safety of all site operations and methods of construction. Provided that the Contractor shall not be responsible, except as may be expressly provided in the Contract, for the design or specification of the Permanent Works, or for the design or construction specification of any Temporary Works prepared by the Consultant. If the works contract expressly provides that any of the Permanent works shall be designed by the Contractor, he shall be fully responsible for such works, notwithstanding any approval given by the Consultant.

The contractor shall promptly inform the Consultant of any error, omission, fault and other defects in design, drawing or specifications for the Works which are discovered while reviewing the contract documents or in the process of execution of Works.

3) The Contractor shall, when called upon to do so, enter into and execute a Contract Agreement; to be prepared and completed in the form annexed with the Tender document and with modification as may be necessary by the Employer.

4) If, for the due performance of the Contract, the Tender shall contain an Performance undertaking that the Contractor to obtain, when required, a bond or a guarantee of Guarantee / a scheduled and/or nationalized bank to be bound with the Contractor to the Bond Employer in a sum not exceeding that stated in the clause 24 of Instructions to Tenderers and agreed to as per the Letter of Acceptance or Letter of Intent / Work Order for such bond or guarantee, the said bank and the terms of the said bond or guarantee shall be such, as approved by the Employer. Obtaining of such bond or guarantee or the provision of such sureties and the cost of the bond or guarantee to be so entered into, shall be borne in all respects by the Contractor. Performance Guarantee shall be valid upto the completion of works (including time for extension if granted) plus three months. During defects liability period 50 % of the Security Deposit i.e. Retention money shall be retained till the Defect liability period is over.
5) The Contractor shall be deemed to have inspected and examined the Site and its **Inspection** surrounding and information available in connection therewith including the **of Site** prevailing security environment and incumbent requirements of the employer and to have satisfied himself, before submitting his Tender, as to the form and nature thereof, including the subsurface conditions, the hydrological and climatic conditions, the extent and nature of the work, accommodation & facilities he may require and, in general, shall be deemed to have obtained all necessary information as mentioned above, as to risks, contingencies and all other circumstances which may influence or affect his Tender.

The Contractor is further deemed to have taken particular notice of approaches and way leaves etc. connecting the site. The Employer does not undertake to improve the same any further & the Contractor will have to improve the same or make new approaches and way leaves, at his own cost, if the existing approaches & way leaves are considered inadequate and unsuitable by the Contractor. Use of such new or improved approaches and way leaves shall be afforded to the Employer, the Engineer, the Consultants and any other concerned person, without any restrictions or compensation.

6) The Contractor shall be deemed to have satisfied himself before tendering as to the **Sufficiency of Tender** prevailing site conditions, the correctness and sufficiency of his Tender for the Works and of the rates and prices stated in the priced Bill of Quantities and the Schedule of Rates and Prices, if any, which Tender rates and prices shall, exception, so far as it is otherwise provided in the Contract, cover all his obligations under the Contract and all matters and things necessary for the proper execution and maintenance of the Works, risks, contingencies and all other circumstances which may influence or affect his Tender. No claim in this regard shall be entertained at any point of time..

7) Contractor shall not enter or take possession of the site (other than for inspection purposes) unless permitted to do so by the Engineer In Charge. Contractor may provide temporary access to the site if necessary or required, at his cost. After completion of the work or after determination of the contract for whatsoever reasons it may be, the contractor shall remove and clear away the access route restoring the area to its original conditions as directed by the Engineer In Charge failing which the Employer shall clear the temporary access and the expenses incurred by Employer shall be borne by the contractor. Also Employer shall not be responsible nor is liable to account for any materials / property of the contractor in such an event.

Employer shall have right to order execution of other works (whether or not **Additional works** connected with the work in the contract) on the site contemporaneously with the execution of the original work and the contractor shall give reasonable facilities for this purpose and execute those items. Employer reserves the right of taking over at any time any portion of site, which **Taking over** it may required and the contractor shall at his own expense clear such portion forthwith.

No photographs, diagram etc. of the site or of the work or any part of thereof shall be taken, published or otherwise circulated without the prior written approval of the Employer.

Employer’s officials connected with the contract will have the right of entry to the site at all times. The Employer shall have the power to exclude from the site any person whose admission or presence thereto may lead to threat, in his opinion, be undesirable for any reasons whatsoever.
8) The Contractor shall execute and maintain the Works in strict accordance with the Contract, to the entire satisfaction of the Employer and shall comply with and adhere strictly to the consultant’s and Engineer In Charges instructions and directions, or any matter whether mentioned in the contract or not, touching or concerning the works. Instructions and directions given by the consultant or the Engineer in Charge, if any, will be acted upon, on the same forwarded to the Contractor, in writing by the Engineer in Charge.

9) Within 15 days of award of the Contract, Contractor shall, submit to the Engineer for his approval, the following:
   - Organization chart detailing the responsibilities of individuals at site.
   - “CPM / PERT” chart showing all activities, their interdependence and resource allocation.
   - Construction and Execution, commissioning Procedure, inspection, test plans with various formats for the works to be executed.
   - Quality Control Manual & Quality plan.
   - Safety and Environment management procedures.
   - Warehousing procedures.

10) The Contractor shall whenever required by the consultant and Engineer in Charge, submit a revised programme showing the modifications to the approved programme necessary to ensure completion of the Works within the time for completion as defined in contract conditions. The Contractor may have to revise the programme depending upon the requirements of the Employer. It must be clearly understood that the Contractor may have to induct additional resources contingent to the requirement of the Employer so as to enable the Employer to meet his target of commissioning the project. Nothing extra shall be paid to the Contractor on account of such contingencies.

If at any time the Engineer in Charge and the consultants observe that the actual progress of the works does not conform to the approved programme referred to above, the Contractor shall produce, a further revised programme showing modifications to the approved programme (including additional resource allocation schedule) necessary to ensure completion of the works within the time for completion.

The submission of revised programmes as detailed above shall neither relieve the Contractor of any of his duties or responsibilities under the Contract, nor entitle the Contractor to any enhancement of the Contract Sum on this account.

11) The Contractor shall give or provide all necessary superintendence during the execution of the Works that may be considered necessary for due fulfillment of the Contractor's obligations under the Contract. The Contractor or a competent and authorized representative approved by the consultant and Engineer In Charge is to be constantly on the Works and shall give his whole time to the superintendence of the same. If such approval is withdrawn owing to whatsoever reasons, and after receiving written notices of such withdrawal, the Contractor shall remove the representative from the Works and shall not thereafter employ him again on the Works in any capacity and shall replace him by another representative approved by the Engineer In Charge, as soon as is practicable. Such authorized representative shall receive, direction, and instructions from the consultant and Engineer In Charge on behalf of the Contractor.
12) The Contractor shall provide and employ:
   a) Sufficient & qualified technical staff on Site in connection with the execution and maintenance of the Works.
   b) Only such technical assistants who are skilled and experienced in their respective fields, foremen and leading hands who are competent to give proper supervision to the work and they are required to supervise, and
   c) Such skilled, semiskilled and unskilled labour as necessary for proper and timely execution and maintenance of the works.

The Engineer In Charge shall be at liberty to object to and ask the Contractor to remove forthwith from the Works any person employed by the Contractor in or about the execution or maintenance of the Works who, in the opinion of the Engineer in Charge, misconducts himself, or is incompetent or negligent in the proper performance of his duties, or whose employment is otherwise considered by the Engineer in Charge to be undesirable and such person shall not be again employed upon the Works without the written permission of the Engineer In Charge. Any person so removed from the Works shall be replaced as soon as possible by a competent substitute approved by the Engineer In Charge.

13) As the works are being executed in a sensitive and restricted defence services layout, the contractor shall thoroughly screen the work force to be deployed and check their antecedents, if required through police verification before deploying them at site. Every effort shall be taken by the contractor that persons having bonafide character only is employed in connection with the above work and the contractor shall be responsible to vouch for the character of the persons employed by them in connection with the subject contract.

The Contractor, shall take all steps necessary to ensure that the persons employed on any work in connection with the contract have noticed that the Indian Official Secrets Act 1923 (XIX 1923) applies to them and will continue to apply even after the execution of such works under the contract.

14) The work shall be executed in a workman like manner and to the satisfaction, in all respects to the Consultant and Engineer In Charge. The contractor is entitled for payment of any work or items of works executed by him only after passing the said executed works by the consultant and Engineer-in-charge and upon entering the measurements of such passed work in the measurement book and accepted by the contractor. The consultant/ Engineer-in-charge will communicate or confirm his instructions to the contractor in respect of the execution of the work in a site order book maintained at his office and the contractor shall visit his office daily and shall confirm receipt of such instructions by signing the relevant entries in the said book. Such entries will rank as orders or notices in writing within the intent and meaning of those conditions. Failure or refusal to sign the said book does not absolve the contractor of his responsibilities to give effect to any orders noted therein. Signature made on subsequent pages of the site order book or any of the registers maintained in connection with the contract shall be considered that he has is in full knowledge of all the entries made till that place and deemed to have accepted the content therein.

15) The Contractor shall be responsible for the true and proper setting-out of the Works in relation to original points, lines and levels or reference given by the consultant or EIC in writing and for the correctness, subject as above mentioned, of the position, levels, dimensions and alignment of all parts of works and for the provision of all necessary instruments, appliances and labour in connection therewith. If, at any time during the progress of the works, any error appears or
arise in the position, levels, dimensions or alignment of any part of the Works, the Contractor, on being required to do by the Engineer in Charge, shall at his own cost, rectify such error/(s) to the satisfaction of the Consultant or the Engineer In Charge. The checking of any setting out or of any line or level by the consultant or EIC shall not in any way relieve the Contractor of his responsibility for the correctness thereof and the Contractor shall carefully protect and preserve all bench marks, sight-rails, pegs and other markings, points, things used in setting-out the Works. Any rectification works required to be done by the Contractor shall be at the Contractor's own cost.

16) If, at any time during the execution of the Works, the consultant or EIC require the Contractor to make boreholes to carry out exploratory excavation, such requirement shall be ordered in writing and shall be deemed to be an addition ordered under the provisions, unless a provisional sum in respect of such anticipated work shall have been included in the Bill of Quantities. Core cutting of concrete pavement is required to be performed to ascertain the strength of the concrete minimum to the extent specified in the BOQ and no additional payment will be admissible for the same. The contractor shall perform this action at any point of time till expiry of defect liability period.

17) The Contractor shall in connection with the Works shall provide and maintain at his own cost all lights, guards, fencing and watching when and wherever necessary or required and also as directed by the Consultant or EIC, or by any duly constituted authority, for the execution and for the protection of the Works/ environment, and/or for the safety and convenience of the public or others. The contractor shall have full regard for the safety of all persons entitled to be on the site and keep the site, which is under his control and the works, which are not completed and taken over by the Employer in an orderly state appropriate to avoidance of any danger to such persons.

18) From the commencement of the Works, until the date stated in the Certificate of Completion for the whole of the Works pursuant to Clause 11-sub clause 12 hereof, the Contractor shall take full responsibility for the care thereof. If the Engineer In Charge issue a Certificate of Completion in respect of any part of the Works, the Contractor shall cease to be liable for the care of that part of works from the date stated in the Certificate of Completion in respect of that part and the responsibility for the care of that part shall pass to the Employer.

19) Blank

20) The contractor shall, within 15 days after the date of the Letter of Acceptance, provide to the Engineer In Charge for his information, a detailed cash flow estimate, in quarterly period, of all payments to which the Contractor will be entitled under the Contract and the Contractor shall subsequently supply revised cash flow estimates, if required. The submission to and consent by the Engineer In Charge of such flow estimates shall not relieve the contractor of any of his duties or responsibilities under the contract.

21) The Contractor shall give all notices and to pay all fees required to be given or paid by any National or State Statute, ordinance, or other Law, or any regulation, or bye law or any local or other duly constituted authority in relation to the execution of the Works and by the rules and regulations of all public bodies and companies whose property or rights are affected or may be affected in any way by the Works during the currency of contract or after completion of the work.
22) The Contractor shall conform in all respects with the provisions of any such statute, ordinance or Law as aforesaid and the regulations or bye laws of any local or other duly constituted authority which may be applicable to the Works and with such rules and regulation of public bodies and companies as aforesaid and shall keep the Employer indemnified against all penalties and liability of every kind for breach of any such Statute, Ordinance or Law, regulation or bye-law during the currency of contract or after completion of the work.

7. INSURANCE, INDEMNITY ETC.

1) Without limiting his obligations and responsibilities under Clause 6 sub clause 17 above, the Contractor shall insure in the joint names of the Employer and Contractor against all loss or damage from whatever cause arising, for which he is responsible under the terms of the Contract and in such a manner that the Employer and Contractor are covered for the period till completion of the work in all respect, for any loss or damage occasioned by the Contractor in the course of any operations carried out by him for the purpose of complying with his obligations in execution of the work in all respect:-under the Clause 12 for:-

a) The Works executed or being executed to the estimated contract value thereof plus 10% (to allow for any additional costs resulting from the loss or damage) which includes the value of materials required for incorporation in the work.

Such insurance shall be affected with an insurer and in terms approved by the Employer, and the Contractor shall submit the insurance policy or policies along with receipts for payment of premiums to the Engineer in Charge and the contractor shall keep the policy current and effective till completion of the work in all respect.

Alterations to the terms of insurance shall not be made without the approval of the Engineer In Charge.

Both the parties shall comply with all conditions of the insurance policies as may be applicable to the parties.

2) The Contractor shall, except if and so far as the Contract provides otherwise, indemnify the Employer against all losses and claims in respect of injuries or damage to any person or material or physical damage to any property whatsoever which may arise out of or in consequence to the execution of the Works and against all claims, proceedings, damages, costs, charges and expenses whatsoever in respect of or in relation thereto.

3) Before commencing the execution of the Works the Contractor, but without limiting his obligations and responsibilities under sub clause 2 of this Clause, shall insure against his liability for any material or physical damage, loss or injury which may occur to any property, including that of the Employer, or to any person, including any employee of the Employer and of the Consultant, by or arising out of the execution of the Works or in the carrying out of the Contract.

4) Such insurance shall be made with an insurer and in terms approved by the Employer, and for the amount stated in the contract data of tender. The Contractor shall, whenever required, submit to the Employer, the policy or policies of insurance and the receipts for payment of the premiums. The contractor shall keep the policy current and effective till completion of the work.
5) The terms shall include a provision whereby, in the event of any claim in respect of which the Contractor would be entitled to receive and be indemnified under the policy being brought or made against the Employer, the insurer will indemnify the Employer against such claims and any cost, charges and expenses in respect thereof.

6) The Employer shall not be liable for or in respect of any damages or compensation payable at law in respect or in consequence of any accident or injury to any workman or other person in the employment of the Contractor, save and except an accident or injury resulting from any act or default of the Employer, his agents, or servants. The Contractor shall indemnify and keep indemnified the Employer against all such damages and compensation, save and except as aforesaid, and against all claims, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

7) The Contractor shall insure against such liability of the nature referred to in sub clause 6 of this Clause with an insurer approved by the Employer, and shall continue such insurance during the whole of the time that any persons are employed by him on the Works and shall when required, produce to the Employer, such policy of insurance and the receipt for payment of the current premiums. Provided always that, in respect of any persons employed by any sub-contractor (if approved by HAL) the Contractor's obligation to insure as aforesaid under this sub-clause shall be satisfied if that sub-contractor shall have insured against the liability in respect of such persons in such a manner that the Employer is indemnified under the policy, but the Contractor shall require such sub-contractor to produce to the Employer, such policy of insurance and the receipt for the payment of the current premium. The contractor shall keep the policy current and effective till completion of the work.

The insurances shall be generally covered but not limited to the following:

1. Workmen’s Compensation policy at the work site.

2. Personal Accident Policy for Supervisors, Engineers, and other employees who are not workers, working at site. This policy should also cover all liability at common Law and under the amendments thereof.

3. Third party insurance as detailed at contract data.

4. Contractor’s All Risk Insurance, insuring Employers, Contractor and its sub-contractors (if approved by HAL) against physical loss and damage to the materials, equipment, apparatus and machinery and all work to be performed. The insurance coverage shall be of the amount equivalent to contract-sum plus 10% of contract price including fully insuring properties and works.

The contractor shall keep all the policies current and effective till completion of the work handing over to employer
Each of the above policies shall cover Employer and Contractor as their interest may appear and all policies of insurance affecting the Works shall provide that there shall be no subrogation as against consultant and Employer.
8) If the Contractor fail to effect and keep in force the insurances referred to in this Clause above, or any other insurance which he is required to effect under the terms of the Contract, and statutory provisions, then and in any such case the Employer may effect and keep in force any such insurance and pay such premiums as may be necessary for that purpose and from time to time deduct the amount so paid and any other expenses incurred by the employer as aforesaid from any monies due or which may become due to the Contractor, or recover the same as a debt due from the Contractor. The Contractor shall however, be fully responsible for any consequence arising out of his failure to effect and keep in force the insurances irrespective of whether the Employer effects the insurance as above or not.

9) Policies and certificates of insurance shall be delivered by the Contractor to the Engineer in Charge before commencing the execution of works commencing the insurance coverage from the date of commencement of the work or otherwise specified. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

8. MISCELLANEOUS ITEMS.

1) All gold, silver, oil and other minerals of any description and all precious stones, coins, treasures, relics, antiquities and other similar items, all fossils, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the site of the works shall as between the Employer and the Contractor be deemed to be the absolute property of the Employer. The Contractor shall not take any such article or thing and shall immediately upon discovery thereof and, before removal, acquaint the Engineer in Charge of such discovery and carry out his orders as to the disposal of the same. Whole of the excavated materials shall be the property of the Owner and shall be used or disposed off only as directed by the consultant and the Engineer in Charge in accordance with the related provisions in the Contract.

2) The Contractor shall save harmless and indemnify the Employer from and keep the Employer indemnified against all claims and proceedings for or account of infringement or any patent rights, design trademark or name or other protected rights in respect of any Constructional Plant, machine, work, or material used for or in connection with the Works or any of them and from and against all claims, proceedings, damages, cost charges and expenses whatsoever in respect thereof or in relation thereto Except where otherwise specified, the Contractor shall pay all tonnage and other royalties, rent and other payments or compensation, if any, for getting stone, sand, gravel, clay or other materials whatsoever required for execution of the Work.

It shall be the responsibility of the contractor to pay all royalties whatsoever whether / arising out of the deeds and actions on the part of the contractor either on HAL’s property or otherwise to the authorities concerned. In case HAL is required to pay such royalties due to failure on the part of the contractor in paying the same, HAL shall recover the same from the contractor in a manner as deemed fit by it.

3) All operations necessary for the execution of the Works shall, so far as compliance with the requirements of the Contract permits, be carried on so as not to interfere unnecessarily or improperly with the public Convenience, or the access to use and occupation of public or private roads and foot paths or to or of properties whether in the possession of the Employer or of any other person. The Contractor shall save harmless and indemnify the Employer in respect of all claims, proceedings damages, cost, charges and expenses whatsoever arising out of, or in relation to any such matter in
so far as the Contractor is responsible therefore.

4) The Contractor shall use every reasonable means to prevent any of the routes communicating with or on the routes to the Site from being damaged by any traffic of the Contractor or any of his sub-contractors (if approved by HAL) and in particular, shall select routes, choose and use any such extraordinary traffic as will inevitably arise from moving of plant and material from and to the Site shall be limited, as far as reasonably possible, and so that no unnecessary damage or injury may be occasioned to such routes.

5) In case any damages are caused to pathway/road/highway or bridges consequent to unsafe and unusual method of transportation to move Constructional Plant, machinery or pre-constructed units or any other material required for the execution of the work and is reported by the appropriate authority, the contractor shall make good the damages as per the requirement of respective authorities or pay the charges or penalties imposed by them. In case the contractor fails to do so and on advice of the respective authorities HAL will deduct such charges or penalties from the contractors bill and paid to the respective govt. bodies.

6) Where the nature of the Works is such as to require the use by the Contractor of waterborne transport, the foregoing provisions of this clause shall be construed as though "Road / highway" including a dock, sea wall or other structure related to a water way and "vehicle" included craft, ferry or any transport related to water borne traffic and shall have to effect accordingly.

7) The Contractor shall, in accordance with the requirements of the Engineer In Charge, afford all reasonable opportunities for carrying out their work to:
   a) Any other contractor/(s) or agencies employed by the Employer and their workmen
   b) The workmen of the Employer and of any other duly constituted authorities who may be employed in the execution on or near the Site of any work not included in the Contract or of any contract which the Employer may enter into in connection with or ancillary to the Works. The Contractor will not be paid any compensation on this account.

8) During the progress of the Works the Contractor shall keep the Site reasonably free from unnecessary stores or dispose off any Constructional Plant not in use and surplus material and clear away and remove from the Site any wreckage, rubbish or Temporary Works no longer required. The contractor shall ensure that none of the materials of the contractor or excavated materials or plant shall be stacked / placed on or in such vicinity of existing Roads, Pavement, access to buildings/hangars, runway or taxiway that it will affect the movement vehicles, aircrafts or aircraft parts or damage any assets of the Employer.

9) On the completion of the works or from time to time as may be directed during execution of works, the Contractor shall clear away and remove from the site, all constructional plant, surplus materials, rubbish and Temporary Works of every kind, and leave the whole of the Site and Works clean and in a workmanlike condition to the satisfaction of the consultant and Engineer In Charge. However during execution, the plant and equipment brought by the Contractor cannot be withdrawn / taken away from the site without the permission of the Engineer In Charge. In the event of completion of the work part by part or building/hangar wise, such area of the work or buildings completed shall be cleared off all debris and surplus materials and give peaceful vacant possession to Employer for use.

9. LABOUR
   1) The Contractor shall make his own arrangements for the engagement of all labour and workmen, local or otherwise, and save, in so far as the Contract...
The Contractor shall strictly comply with all the labour laws, regulations, etc. in force and applicable to the labour employed by him or his sub-contractors (if approved by HAL) including those working on labour-rate basis on the Works. The contractor shall obtain the labour licence and maintain all records and documents in compliance to various provisions of labour laws.

2) The Contractor shall provide potable drinking water for the use of the Contractor's staff and workers. The contractor shall provide water both for domestic and works purpose.

3) The Contractor shall not, otherwise than in accordance with the Statutes, Ordinances and Government Regulations or Orders, for the time being in force, consume, import, sell, give, barter or dispose any alcoholic liquor or drugs by himself or his sub-contractors (If approved by HAL), or employees.

4) The Contractor shall not give, barter or otherwise dispose off to any person or persons, any arms or ammunition of any kind or permit or occupy the same as aforesaid.

5) The Contractor shall in all dealings with labour and workmen in his employment, have due regard to all recognized festivals, day of rest and religious or other customs.

6) In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government, or the Local medical or sanitary authorities for the purpose of dealing with and overcoming the same at his own cost.

7) The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or against his employees and for the preservation of peace and protection of persons and property in the neighborhood of the Works against the same.

8) The Contractor shall be responsible for observance by his sub-contractors (if approved by HAL) of the foregoing provisions.

9) The contractor shall employ labour in sufficient number to maintain the required rate of progress and of the quality required to ensure workmanship of the degree required by the specifications, Engineering standards and to the satisfaction of the Engineer-in-charge.

The contractor shall remain liable for the payment of all wages or other moneys to his work people or employees under the payment of wages Act, 1936, Employer's liability Act, 1938, workman’s Compensation Act, 1923, or any other Act or enactment relating there to and rules framed there under from time to time. The contractor shall work only on and during the hours or working day, unless he obtains the prior written approval of the Engineer-in-charge to do otherwise. Even if such approval is given, there shall be no liability in respect of any excess cost arising thereof upon the Employer and the contractor shall follow all provisions of labour law.

10) The Contractor shall, always maintain all labour records as per statutory provisions and, furnish a return in detail in such form and at such intervals as the Engineer in Charge may prescribe showing the supervisory staff and the numbers of the several classes of labour from time to time employed by the Contractor on the Site and such information regarding Constructional Plant. Further the contractor shall be promptly in attendance and submit all records and
11) The salient features of some labour laws applicable to establishments engaged in building and other construction works are mentioned in SP 34 for contractor’s general guidance. However the contractor shall comply all the provisions covered in the labour law.

10. MATERIALS, PLANT AND WORKMANSHIP

1) All materials and workmanship shall be of the respective kinds described in the contract and testing of the same shall be in accordance with relevant standard prescribed including the method of testing. The contractor shall also perform such tests as may be required and as directed by the Engineer In Charge from time to time at the place of manufacture or fabrication or on the Site or at such other place or places as maybe specified in the Contract, or at all or any of such places. The consultant shall witness / attend the tests, interpret the results and recommend to the Employer for acceptance. The Contractor shall provide such assistance, instruments, machines, labour and materials as normally required for examining, measuring and testing any work and the quality, weight or quantity of any material used and shall supply samples of materials before incorporation in the Works for testing as may be selected and required by the Consultant and Engineer In Charge.

2) The Contractor shall supply samples of all the materials and the approved samples shall be kept at site office for verification on bulk supply. The cost of samples and the expenditure for sampling for testing shall be borne by the contractor.

3) The cost of making any test shall be borne by the Contractor if such test is clearly intended by or provided for in the Contract or is necessary for ascertaining the quality of materials intended to be used by the Contractor in the Works, and any other test to establish compliance of the design parameters.

The testing shall be conducted by or from authorized Govt. laboratories only. In case the Govt. laboratories at Nasik-Pune-Mumbai area do not conduct the specified test, such tests shall be carried out at laboratories having NABL accreditation.

4) If any test is ordered by the Engineer In Charge which is either

   a) not so intended by or provided for, or
   b) is additional or repetition to that specified in the preceding para for re-confirmation

   In such case the cost of such test shall be borne by the Contractor, if the test result shows that the workmanship or materials are not in accordance with the provisions of the Contract or as per the instructions of Consultant’s or Engineer In Charges, otherwise (if the test result found to be in accordance with the requirement) the cost shall be borne by the Employer.

5) The Consultant, the Employer and any person authorized by them shall at all times have access to the Works and to all workshops and places where work is being prepared or from where materials, manufactured articles or machinery are being obtained for the Works and the Contractor shall afford every facility for and every assistance in obtaining the right to such access.

6) No part of the Works shall be covered up or put out of view without the approval of the Employer.
of the Consultant or the Engineer In Charge and the Contractor shall afford full opportunity for the Consultant or the Engineer In Charge to examine and measure any work which is about to be covered up or put out of view and to examine foundation strata before permanent work is placed thereon. The Contractor shall give due notice to the Consultant or the Engineer In Charge whenever any such work such as foundation, service lines, pipes etc. are ready or about to be ready for examination and the Consultant shall, attend for purpose of examining and measuring such works.

7) The Contractor shall uncover any part or parts of the Works or make openings in or through the same or take out cores from the same as the Consultant / Employer may from time to time direct and shall reinstate and make good such part or parts, openings to the satisfaction of the Consultant / Employer. If any such part or parts have been covered up or put off view after compliance with the requirements of sub clause 6 above and are found to be executed in accordance with the Contract, the expenses of uncovering, making, openings in or through, reinstating and making good the same shall be borne by the Employer (Paid under respective items in BOQ). In the event of detection that the material or work is not conforming to the specifications the costs for uncovering shall be borne by the Contractor including the rectifications.

8) The Consultant and the Engineer In Charge shall during the progress of the Works have power to order in writing from time to time for:

a) the removal from the Site, of any materials, which, in the opinion of the Consultant or the Engineer In Charge, are not in accordance with the Contract, within such time or times as may be specified in the order,
b) the substitution of proper and suitable materials,
c) the removal and proper re-execution, not-withstanding any previous test thereof or interim payment therefore, of any work which in respect of materials or workmanship is not, in accordance with the Contract, in the opinion of the Consultant or the Engineer In Charge.

9) In case of default on the part of the contractor in carrying out such order as specified in preceding para, the Employer shall be entitled to employ and pay other persons to carry out the same and all expenses consequent thereon or incidental thereto shall be recoverable from the contractor by the Employer or may be deducted by the Employer from any monies due or which may become due to the Contractor.

10) The contractor shall for the purpose of testing the materials establish a field laboratory.

11) The contractor shall for the purpose of making concrete for the works has to set up a centralised batching plant with computerised controls of capacity of approx. 30 cum. per hour, at a location approved by the consultant / Employer. The contractor shall have to make arrangements for any development or access to the said location or from the said location to the site of works entirely at his own cost. Such land made available by the Employer will be free of rent.

11. COMMENCEMENT, DELAYS AND SUSPENSION

1) The Contractor shall, on the written order of upon being so required by the Employer, suspend the progress of the Works or any part thereof for such time or times and in such manner as the Employer may consider necessary and shall during such suspension properly protect and secure the work, so far as it is necessary in the opinion of the Engineer in Charge. The extra cost incurred by the Contractor in giving effect to the above Employer's instructions under this Clause
shall be borne by the employer except in following cases:-

a) if not provided for in the Contract, or (i.e. staggered period specified in the contract or due to technical reasons etc)

b) necessary by reason of some default on the part of the Contractor, or

c) necessary by reason of climatic conditions on the Site, or

d) necessary for the proper execution of the Works or for the safety of the Works or any part thereof in so far as such necessity does not arise from any act or default by the Employer and in cases where insurance cover exists.

Provided that the Contractor shall not be entitled to any such extra cost unless he gives written notice of his intention to claim to the Engineer In Charge within fifteen days of the Employer’s order. The Employer shall settle and determine such extra payment and/or extension of time to be made to the Contractor in respect of such claim as shall, in the opinion of the Employer be fair and reasonable, and provided the Contractor has taken all steps to mitigate the losses.

2) If the progress of the Works or any part thereof is suspended on the written order of the Employer and if permission to resume work is not given by the Employer within a period of ninety days from the date of suspension thereof, unless such suspension is within paragraph a), b), c) and d) of sub clause 1 of this Clause, the Contractor may serve a written notice to the Employer requiring permission within fifteen days from the receipt thereof to proceed with the Works or that part thereof in regard to which progress is suspended.

3) The Contractor shall commence the works physically on site within 15 days from the receipt by him of a written order to this effect from the Employer and shall proceed with the same with due expedition and without delay. The Contractor shall complete the construction of temporary offices, stores, laboratory, labour establishment etc. and mobilise required resources substantially during this period.

4) Save in so far as the Contract may prescribe, the extent of portions of the Site of which the Contractor is to be given permission from time to time and the order in which such portions shall be made available to him and subject to any requirement in the Contract as to the order in which the Works shall be executed, the Employer will along with the written order to commence the Works, give to the Contractor possession of so much of the Site as may be required to enable the Contractor to commence and proceed with the execution of the Works in accordance with the programme or revised programmes referred to in the Clause 6, if any, and otherwise in accordance with such reasonable proposals of the Contractor as he shall, by written notice to the Engineer in Charge, make and will, from time to time as the Works proceed, give to the Contractor possession of such further portions of the Site as may be required to enable the Contractor to proceed with the execution of the Works in accordance with the said programme or proposals, as the case may be. If giving possession of the work site is delayed by the Employer due to any reasons, the Employer shall consider grant of extension of time for the completion of the work. However, the contractor will not be entitled for any monetary compensation or other concessions other than grant of extension of time.

5) The Contractor shall bear all costs and charges for special or temporary right of way required by him in connection with access to the Site. The Contractor shall make arrangements at his own cost for any additional accommodation outside the Site as required by him for the purposes of the Works.
6) Subject to any requirement in the Contract as to completion of any section of the Works before completion of the work as a whole, the whole of the Works shall be completed, in accordance with the provisions of the Clause 11 sub clause 12 hereof, within the time period specified in the tender notice and Price bid from the stipulated date of commencement specified in the letter of acceptance. Time is the Essence of the Contract.

7) Should the amount of extra or additional work of any kind or any cause of delay referred to in these Conditions or exceptional adverse climatic conditions or other special circumstances of any kind whatsoever which may occur, other than through a default of the Contractor, which entitle the Contractor to an extension of time for the completion of the Works, the contractor shall make a written request detailing all facts and data to the Employer and the Employer shall determine the amount of such extension and shall notify the Contractor accordingly. However the employer may not account any extra or additional work or other special circumstances unless the contractor had notified with detailed particulars regarding such circumstances to the Consultant and Engineer In Charge from time to time and such submissions may be investigated at that point of time.

8) Subject to any provision to the contrary contained in the Contract, none of the Permanent Works shall, save as hereinafter provided, be carried on during the night or on Sundays, if locally recognized as days of rest or their locally recognized equivalent days, without the permission in writing of the Engineer In Charge except when the work is unavoidable or absolutely necessary for the saving of life or property or for the safety of the Works, in which case the Contractor shall immediately intimate the Consultant or Engineer In Charge. The provisions of this Clause shall not be applicable in the case of any work, which it is customary to carry out by rotary or double shifts.

9) If for any reason, which does not entitle the Contractor to an extension of time, the rate of progress of the Works or any section is at anytime, in the opinion of the Engineer In Charge, too slow to ensure completion by the prescribed time or extended time for completion, the consultant or Engineer In Charge shall so notify the Contractor in writing and the Contractor shall thereupon take such steps as are necessary and the Engineer in Charge may approve to expedite progress so as to complete the Works or such section by the prescribed time or extended time. The Contractor shall not be entitled to any additional payment for taking such steps. If, as a result of any notice given by the Engineer in Charge under this Clause, the Contractor shall seek his permission to do any work at night or on Sundays, if locally recognised as days of rest or their locally recognised equivalent days which may be considered by the Engineer In Charge considering the project schedule, progress schedule and other factors.

10) If the Contractor fails to achieve completion of the Works within the time prescribed in the sub clause 6 of Clause 11 then the Contractor shall pay to the Employer the sum stated in Part II – Special Conditions as liquidated damages for such default and not as a penalty for every day or part of a day which shall elapse between the time prescribed in sub clause 6 of Clause 11 hereof and the date of certified completion of the Works. The Employer may, without prejudice to any other method of recovery, deduct the amount of such damages from any monies in his hands, due or which may become due to the Contractor. The payment or deduction of such damages shall not relieve the Contractor from his obligations under the contract to complete the Works or from any other obligations and liabilities under the Contract.
11) When the whole of the Works have been substantially completed and have satisfactorily passed all the tests that maybe prescribed in the Contract, the Contractor may give a notice to that effect to the Employer through the Consultant accompanied by an undertaking to finish any outstanding work within a time frame. Such notice and undertaking shall be in writing and shall be deemed to be a request by the Contractor to the Employer to issue a Certificate of Completion in respect of the works. Thereafter the contractor shall be present by himself for inspection of the entire work along with the consultant and Engineer In charge on the specified time notified by the Engineer In Charge. The Employer on recommendation of the consultant shall, within twenty-one days of the date of delivery of such notice either issue to the Contractor, with a copy to the Consultant, a Certificate of Completion stating the date on which, in his opinion, the Works were substantially completed in accordance with the Contract or give instructions in writing to the Contractor specifying all the work which, in the Employer’s and consultant’s opinion, requires to be done by the Contractor before the issue of such Certificate. The Employer shall also notify the Contractor of any defects in the works affecting substantial completion that may appear after such instructions and before completion of the Works specified therein. The Contractor shall be entitled to receive such Certificate only on making good of any defects so notified.

12) Similarly, in accordance with the procedure set out in sub clause 11 above, the Contractor may request and the Employer shall issue a Certificate of Completion (for part of the work) in respect of:

a) any section of the Works in respect of which a separate time for completion is provided in the Contract: and

b) any substantial part of the Works or buildings which has been both completed to the satisfaction of the Engineer in Charge and occupied or used by the Employer.

Provided always that a Certificate of Completion given in respect of any section or part of the Works before completion of the whole of the work shall not be deemed to certify completion of any ground or surfaces requiring reinstatement, unless such Certificate shall expressly so state.

By issuing completion certificate building wise (Part work) does not relieve the contractor in fulfilling the obligations under the contract as a whole. The defect liability period will be reckoned from the date on which the final completion dates of the contract as whole.

12. DEFECTS LIABILITY

1) The defect liability period for the works executed under this contract shall be 18 months from the date of completion of the work as a whole. However for specialized items like water proofing, antitermite treatment etc. will have longer defect liability period as specifically indicated against respective items in the BOQ or Technical specifications or other parts of the tender documents. Even in case of part completion of work and taking over by employer, the defect liability period (18 months or longer periods in case of specialized items as specified in the tender) will be reckoned from the date of completion of the work as a whole.

2) Any defects, shrinkage, settlement, cracks or any other faults which may appear or be noticed within the Defect Liability Period, and arising in the opinion of the consultant and Engineer in Charge, shall be rectified and

Certification of Completion of Works

Certification of Completion by Stages

Definition of Defects Liability Period

Execution of Work of Repair etc.
made good by the contractor at his own cost within reasonable time as informed to the contractor.

3) All such work shall be carried out by the Contractor at his own expense if the necessity thereof shall, in the opinion of the Engineer In Charge, be due to the use of materials or workmanship not in accordance with the Contract, or due to neglect or failure on the part of the Contractor to comply with any obligation, expressed or implied, on the Contractor's part under the Contract.

4) If the Contractor fails to do any such work as aforesaid required by the Employer or Consultant, the Employer shall be entitled to employ and pay other persons to carry out the same and if such work which, in the opinion of the Engineer, the Contractor was liable to do at his own expense under the Contract, then all expenses consequent thereon or incidental thereto shall be recoverable from the Contractor by the Employer or may be deducted by the Employer from any monies due or which may become due to the Contractor.

5) The Contractor shall, search under the directions of the Consultant or Engineer In Charge for the cause of any defect, imperfection or fault appearing during the progress of the Works or during the Defects Liability Period. If such defect, imperfection or fault shall be one for which the Contractor is liable as aforesaid, the cost of the work carried out in searching as aforesaid shall be borne by the Contractor and he shall in such case, repair, rectify and make good such defect, imperfection or fault at his own expense in accordance with the provision of this Clause.

6) During defect liability period, The contractor shall arrange for site inspection of entire work (Civil, Electrical and entire utility services) on a quarterly basis. The contractor shall depute minimum 2 Engineers, one of Civil and allied works and the other for Electrical and utility services, having adequate experience in attending maintenance works. After inspection a detailed list of items needs rectifications or repairs is to be listed out and make immediate arrangement to attend the repairs and maintenance satisfactorily. On attending the repairs and maintenance the contractor shall submit a detailed compliance report and shall be in attendance for joint verification with the consultant or Engineer in Charge. If the contractor fails to depute suitable persons for periodic survey as detailed above and the defects noticed are not attended in time a penalty of Rs. 50,000.00 will be recovered towards inspection charges for each quarter. This Rs.50,000.00 per quarter will be in addition to the expenditure whatsoever may be incurred by Employer for getting the rectifications done through other sources.

13. A ALTERATIONS/ADDITIONS/OMMISIONS

The EIC shall make any variation of the form, quality & quantity of the work or any part ther of that may in his opinion, be necessary and for that purpose of if for any other reason it shall in his opinion be desirable, he shall have power to order the contractor to do and the contractor shall do any of the following:

a) Increase or decrease any work included in the work
b)Omit any such work
c)Change the character or quality or kind of any such work
d)Change the levels, lines, positions and dimensions of any part of the works and
e)Execute additional work of any kind necessary for the completion of the works

And no such variation shall in any way vitiate or invalidate the contract, but the price, if any of all such variations shall be taken into account in ascertaining the amount of the contract sum. The contractor shall not be entitled to any
compensation on account of omission or decrease in work under this clause.

13 B DEVIATIONS

1) The contractor shall carry out the deviations as may be ordered upto a maximum of +10% of the contract sum at the same terms, conditions and rates. There will not be any lower deviation limit. The Engineer-in-charge may delete or reduce any items of work at his sole discretion and the contractor will not have any claim whatsoever on this issue and the contractor shall be entitled for payment against the actual work done at the contract rates only.

Ordering of the deviations will be subject to the following conditions

a) The net sum of all deviations is less than the permissible deviations limit

b) The arithmetical sum of all additions and deletions should not exceed twice the deviation limit.

c) Deviation ordered in respect of any individual trade item included in the contract shall not exceed 50 percent of the value of that trade item in the contract as a whole or half of the deviation limits for the contract whichever is less.

d) The value of additions of items of any individual trade item not already in the contract shall not exceed 10 percent of the deviations limit.

The contractor shall not make alternations, additions or omissions from the works as described in the contract except with written instructions of the Engineer-in-charge. No such deviations from the work described in the tender documents be valid unless the same has been specifically confirmed and accepted by the Engineer-in-charge in writing and incorporated in the contract.

Variations shall include additions (extra items), alterations which shall be included in the updated programme of execution of works.

2) The Engineer-in-charge may deviate either by way of addition or deduction from the work so described provided that the contract sum be not thereby varied on whole by more than the percentage set out in the contract. The value of all additions and deletions will be added to or deducted from the contract sum. Whenever the Accepting Officer intends to exercise such a right, his intention shall specify the deviation which are to be made, lump sum assessment or the proposed basis of payment, the extra time allowed, if any and the date for completion of the entire contract. Any objection by the contractor to any matter concerning the order shall be notified by him in writing to the Engineer-in-charge, within seven days from the date of such order but under no circumstances, shall the work be stopped unless so ordered by the Engineer-in-charge owing to differences or controversy that may arise from such objection. In the absence of such modifications of objection by the contractor, he shall be deemed to have accepted the order and the condition stated therein. In the event of the contractor failing to agree with the Engineer-in-charge regarding the items of the proposed deviations, the objection shall be referred to the Engineer-in-charge whose decision shall be final and conclusive and binding on the contractor.

3) All extra or additional work done by the order of the Consultant or Engineer in Charge shall be priced at the rates and prices set out in Part II – Special Condition
of Contract.

14. PROCEDURES OF CLAIMS

1) Notwithstanding any other provision of the contract, if the contractor intends to claim any additional payment pursuant to any clause of these conditions or otherwise, he shall give notice of his intention to the consultant, with a copy to the Employer, within one month after the event giving rise to the claim has first arisen.

The Contractor shall submit to the Consultant (with a copy to the Engineer in Charge) once in every month a full and detailed account of all claims for any additional payment to which the Contractor may consider himself entitled and of all extra or additional work ordered by the Engineer in Charge which he has executed during the preceding month. No final or interim claim for payment for any such work or expense will be considered which has not been included in such account of claim, provided always that the Consultant shall be entitled to recommend payment for any such work or expense, notwithstanding the Contractor's failure to comply with this condition if the Contractor has, at the earliest practicable opportunity, notified the Consultant and Engineer In Charge in writing that he intends to make a claim for such work.

2) All the claims are to be approved by the Employer before releasing payment. No payment will be released till the time Employer approves the matter.

15. PLANT, TEMPORARY WORKS AND MATERIALS

1) All Constructional Plant, Temporary Works and materials provided by the Contractor shall, when brought on to the Site, be deemed to be exclusively intended for the execution of the Works and the Contractor shall not remove the same or any part thereof except for the purpose of moving it from one part of the Site to another, without the consent, in writing of the Consultant, which shall not be unreasonably withheld. Upon receiving the consent of the Consultant, the Contractor shall apply for issue of Gate Pass etc. to the Employer so as to observe the administrative and security procedures, set by the Employer.

2) Upon completion of the Works, the Contractor shall remove from the Site all the said Constructional Plant and Temporary Works remaining thereon and any unused materials provided by the Contractor.

3) The Employer shall not at any time be liable for the loss or damage to any of the said Constructional Plant and temporary works or materials.

4) The operation of sub clause 1 to 3 above shall not be deemed to imply any approval by the Consultant, of the materials or other matters referred to therein nor shall it prevent the rejection of any such materials at any time by the Consultant/Employer.

16. VALUATION OF PAYMENT

1) The quantities set out in the Bill of Quantities are the estimated quantities of the Work but they are not to be taken as the actual and correct quantities of the Works to be executed by the Contractor in fulfillment of his obligations under the Contract. The quantities are likely to be reduced/increased/deleted and the contractor shall not have any claim on such variation in quantity.
The contractor is required to submit the detailed measurements of all the works executed under the contract. This submission of measurements shall be based on physical measurements taken jointly with the consultant, of the actual work performed or executed by the contractor. The authorised representative of the contractor shall be in attendance for taking the measurements and shall provide all assistance, appliances required in taking the measurements.

2) The Consultant shall, except as otherwise stated, ascertain and determine by measurement the value in terms of the Contract of work done in accordance with the Contract. He shall, when he requires any part or parts of the Works to be check measured, give notice to the Contractor's authorised agent or representative, who shall forthwith attend or send a qualified agent to assist the Consultant in making such measurement and shall furnish all particulars required by them. Should the Contractor not attend or neglect or omit to send such billing Engineer, then the measurements checked by the Consultant or approved by him shall be taken to be the correct measurement of the work. For the purpose of measuring such permanent work as is to be measured by records and drawings, the Consultant’s Representative shall prepare records and drawings month by month of such work and the Contractor, as and when called upon to do so in writing shall, within five days, attend to examine and agree such records and drawings with the Consultant’s Representative and shall sign the same when so agreed. If the Contractor does not so attend to examine and agree such records and drawings, they shall be taken to be correct. If, after examinations of such records and drawings, the Contractor does not agree the same or does not sign the same as agreed, they shall nevertheless be taken to be correct, unless the Contractor shall, within five days of such examination, lodge with the Engineer In Charge, for decision by the Engineer in Charge, notice in writing of the respects in which such records and drawings are claimed by him to be incorrect.

2.a) The measurements will be further verified and certified by the Engineer In Charge . The contractor’s representative shall attend immediately for verification of the measurements whenever called for. Taking of measurements, recording and certification by the consultant shall be carried out regularly as the work progress and all hidden items shall be measured, recorded and certified before covering the same. The measurements taken shall be signed and dated by the authorized representative of the contractor and consultant and the same day. It will be the responsibility of the contractor to have regular measurements, certification and billing. If the contractor or contractor’s representative fails to attend when required the Engineer-in-charge shall have power to proceed by himself to the measurements, and in that case these measurements shall be deemed to have been accepted by the contractors as final and no further claim will be entertained.

3) The Works shall be measured net, notwithstanding any general or local custom except where otherwise specifically described or prescribed in the Contract. The mode of measurements specified in the bill of quantities, technical specifications, MES SSR and IS codes will be followed. The MES SSR and IS codes to be followed in case there is no specific mention in the BOQ or Technical specifications.

For expedition of recording of measurements & billing, contractor shall adopt latest computer software packages and shall provide such packages to the Consultant and Engineer In Charge for their approval and implementation.

3.a) The contractor will be entitled for payment of the work done after fulfilling the requirement of recording the measurements in MB and submission of his bill.
n HAL prescribed proforma. Running bills will be paid for the work completed to the entire satisfaction of the Engineer-in-charge, after making the following deductions, if any:

a) All previous running account payments
b) Cost of entire stores issued by HAL whether incorporated in the work or not
c) Full value of the advances paid against the materials whether incorporated in the work or not
d) Mobilisation advance
e) Hire charges, for electricity and water supplied by HAL
f) All statutory deductions
g) Any other dues recoverable by HAL from the contractor under the present contract or any other contract.

Material advances to an extent of 75% of the cost of material (other than perishable items) which in the opinion of the Engineer-in-charge which are reasonably required for incorporation in the work and which are actually brought to the site, will be considered for payment subject to the following conditions.

a) No material advance will be paid on such materials which will not go into the work such as shuttering, centering, scaffolding, plant, tools and equipments, etc.
b) No material advance against self-life items will be paid
c) For the purpose of evaluating the cost of the materials the contractor’s bills towards the purchase of the materials will be compared with the derived rate of those materials from the item rates under the contract and 75% of the cost as per the bills or such derived rates whichever is less, will be considered for payment of materials advance.
d) The contractor shall execute an indenture bond/hypothecation deed on required stamp paper in favour of HAL in the format prescribed under this contract for claiming advance on materials.
e) All such materials shall be insured against theft, loss fire, damages, etc. as may be prescribed by the Engineer-in-charge and endorsed in favour of HAL.
f) Payment in respect of materials collected at site will be made only upon giving a certificate by the Engineer-in-charge stating that:
   - The stores have been physically brought to site and have not been incorporated in the work.
   - The stores are required for the work
   - The stores have been stored satisfactorily and are not likely to deteriorate in stock
   - The quantities of stores tally with the quantities of the contract items
   - They have been valued as stated in Clause No. (c) above
   - The materials conform to the specifications and are of the tested quality.
The contractor shall be responsible for the safe custody of the materials and shall not remove them from site without written permission of Engineer In Charge.

The contractor shall once in every month submit to the Engineer-in-charge of 5) his claim in detail for the work done by him upto and including the previous months which are not covered by his contract agreement in any of the following respect.

a) Deviation from the items and specification provided in the contract documents.
b) Extra items/new items of work
c) Quantities in excess of those provided in the contract schedule
d) Items in respect of which rates have not been settled.

He should in addition, furnish a clear certificate to the effect that the claims submitted by him as aforesaid cover all his claims and that no further claims shall be raised by him in respect of the work done upto and including the period under report.

17 ENTRUSTING SPECIALIZED WORKS TO OTHER AGENCIES.

17.1) The contractors shall execute the work directly by themselves. However for execution of specialized items, the contractor may seek the assistance of such parties who are having expertise in the respective field and their services will help the contractor to execute those items to the best quality and standards specified. In such cases the contractor shall seek permission from Employer specifically indicating the nature and items of work for which the services of specialized firm is proposed to be availed.

17.2) The contractor shall submit the Credentials, to the Consultant and Engineer In Charge., of the specialized parties covering their technical know how and expertise in the respective field, experience having performed similar nature of work of value nearer to that of the item The contractor shall then furnish all the documents whatsoever required to ascertain the technical capability of those firms to take up the specified part of the work, as called for by the Consultant or Engineer in Charge.

17.3) On verification of the data and documents submitted by the contractor as described in the preceding para, by the Consultant or adopting any other means for verification of the technical capability of the party, the Engineer In Charge, will communicate the approval or otherwise.

17.4) The engagement of specialized party and communicating the approval by the Employer for the same shall in no way relieve the contractor from his responsibilities for completing the work as per the terms of contract. The liabilities whatsoever may arise in executing that specified part of the work by the specialized agencies should be borne by the contractor.

17.5) The contractor shall submit an undertaking on a stamp paper of Rs. 100.00 value stating that all liabilities or issues whatsoever may arise in execution of the specified part of the work entrusted to specialized firms will be absolved by the contractor and at any point of time HAL will not be made a party to whatsoever issues, claims arising thereof. The contractor shall also be
required to obtain a bond from those parties who have been entrusted with execution of specialized works, indemnifying the employer from any liability or claim whatsoever may arise during execution or thereafter in connection with that part of work or any other consequential issues. The bond in original shall be submitted to the Engineer In Charge before commencement of the work and the party shall be allowed to perform the work only after obtaining the requisite bond.

17.6) For all purpose, the work got executed from the specialized agencies as described in the preceding paras will be deemed to have been executed by the contractor and the contractor will be responsible for any defects arising in the work during the defect liability period.

18. CERTIFICATES AND PAYMENT

1) The contractor may submit Running Account bills at an interval not less than seven days subject to a maximum of four bills in a month in order to expedite the progress of work. The contractor shall ensure that the bill submitted shall be based on the measurements taken jointly at site, recommended by the consultant and certified by the Engineer in Charge and shall also comply with all contract provisions regarding submission of documents, registers, test results etc. in connection with the same.

2) Where advances are to be made by the Employer to the Contractor in respect of Constructional Plant and Materials, the conditions of payment and repayment shall be as set out in the Special Conditions of Contract.

3) No certificate other than the Certificate of Final Completion referred to in sub clause 4 of this Clause shall be deemed to constitute approval of the works.

4) The Contract shall not be considered as complete until a Certificate of Final Completion shall have been signed by the Employer stating that the Works have been completed and maintained to his satisfaction.

5) The Employer shall not be liable to the Contractor for any matter or thing arising out of or in connection with the Contract or the execution of the works, unless the Contractor shall have made a claim in writing in respect thereof as per sub clause 1 of Clause 14, before giving of Certificate of Final Completion.

6) Notwithstanding the issue of the Certificate of Final Completion, the Contractor and, subject to sub clause 5 of this Clause, the Employer shall remain liable for the fulfillment of any obligation incurred under the provisions of the Contract prior to the issue of the Certificate of Final Completion which remains unperformed, at the time such certificate is issued and, for the purposes of determining the nature and extent of any such obligation, the Contract shall be deemed to remain in force between the parties hereto.

19. REMEDIES AND POWERS

1) If the Contractor shall become bankrupt or have a receiving order made against him, or shall present his petition in bankruptcy, or shall make an arrangement with or assignment in favour of his creditors, or shall agree to carry out the contract under a committee of inspection of his creditors or, being a corporation, shall go into liquidation (other than a voluntary liquidation for the purposes of amalgamation or reconstruction), or if the Contractor shall assign the Contract, without the consent in writing of the Employer first obtained, or shall have an execution levied on his goods, or if the Consultant shall certify in writing to the
Employer that in his opinion, the Contractor:-

a) Has abandoned the Contract, or
b) Without reasonable excuse, has failed to commence the Works or has suspended the progress of the Works for twenty-eight days after receiving from the Consultant’s/Engineer In Charge’s written notice to proceed, or
c) Has failed to remove materials from the site or to pull down and replace work for twenty eight days after receiving notice from the Consultant/Engineer In Charge that the said materials or work had been condemned and rejected by the Consultant or Engineer In Charge under these conditions, or
d) Despite previous warnings by the Consultant, in writing, is not executing the Works in accordance with the Contract, or is persistently or flagrantly neglecting to carry out his obligations under the Contract, or
e) Has, to the detriment of good workmanship, or in defiance of the Consultant’s or Engineer In Charge’s instructions to the contrary, sublet any part of the Contract
f) In the opinion of the Consultant, the progress of work achieved by the contractor is so poor that the contractor shall not be able to complete the work within the specified time.

Then the Employer may, after giving fourteen days notice in writing to the Contractor, enter upon the site and the Works and expel the Contractor there from without thereby voiding the Contract, or releasing the Contractor from any of his obligations or liabilities under the Contract, or affecting the rights and powers conferred on the Consultant or Employer by the Contract, and may himself complete the Works or may employ any other agency to complete the Works. The Employer or such other agency, may use for such completion, so much of the Constructional Plant, amenities and materials, which have been deemed to be reserved exclusively for the execution of the Works, under the provisions of the Contract, as he or they may think proper. The Employer, at his option, may sell or choose to return to the Contractor, without prejudice to any of his rights under the Contract, the said Constructional Plant, amenities and unused materials. In case of sale, the sale proceeds shall be applied towards the satisfaction of any sums due or which may become due from the Contractor under the Contract. The return of the Constructional Plants, amenities and unused materials to the Contractor by the Employer, shall be without prejudice to the right of the Employer to recover his dues form the Contractor by any other means available to the Employer.

2) The Engineer shall, as soon as may be practicable, after any such entry and expulsion by the Employer, fix and determine ex party, or by or after reference to the parties, or after such investigation or inquiries as he may think fit to make or institute and shall certify what amount, if any, had at the time of such entry and expulsion been reasonably earned by or would reasonably accrue to the Contractor in respect of work actually done by him under the Contract and the value of any of the said unused or partially used materials, any Constructional Plant and any amenities brought into existence exclusively for execution of the Works.

3) If the Employer shall enter and expel the Contractor under this Clause, he shall not be liable to pay to the Contractor any money on account of the Contract, until the expiration of the Defects Liability Period and thereafter until the costs of execution, damages for delay in completion, if any, and all other expenses incurred by the Employer have been ascertained and the amount thereof certified by the Engineer. The Contractor shall then be entitled to receive only such sum or sums, if any, as the Consultant may certify would have been payable to him upon due completion by him after deducting the said amount. If such amount shall exceed the sum which would have been payable to the Contractor on due
completion by him, then the Contractor shall, upon demand, pay to the Employer the amount of such excess and it shall be deemed a "debt due" by the Contractor to the Employer and shall be recoverable accordingly.

4) If, by reason of any accident, or failure, or other event occurring to or in connection with the Works, or any part thereof, either during the execution of the work, or during Defects Liability period, any remedial or other work or repair, shall, in the opinion of the Consultant or Engineer In Charge, be urgently necessary for the safety of the Works and the Contractor is unable or unwilling at once to do such work or repair, the Employer may employ and pay other persons to carry out such work or repair as the Consultant or Engineer In Charge may consider necessary. If the work or repair so done by the Employer is the work which, in the opinion of the Consultant or Engineer In Charge, the Contractor was liable to do at his own expense under the Contract, all expenses properly incurred by the Employer in so doing shall be recoverable from the Contractor by the Employer, or may be deducted by the Employer from any monies due or which may become due to the Contractor.

Provided always that the Consultant or Engineer In Charge, as the case may be, shall, as soon after the occurrence of any such emergency as may be reasonably practicable, notify the Contractor thereof in writing.

20. Blank
21. BLank

22. SETTLEMENT OF DISPUTES

1) Wherever, in any of the documents forming part of the Contract, the Engineer In Charge has been vested with the final powers, his decision, opinion, certificate or any other discretion shall be final conclusive and binding on the parties and shall be without appeal. All other matters shall be subject to the right of arbitration.

2) Except for matters stated above all other disputes and difference arising out of or in connection with the contract, whether during the progress of work or after completion, shall be referred to and settled by Arbitration by Arbitrator to be nominated by the Employer. Arbitration shall be as per provisions of sub-clause 15 of SP 32 (Misc.).

23. NOTICES

1) All certificates, notices or written orders to be given by the Employer or by the Consultant to the Contractor under the terms of the Contract shall be served by sending by registered post or by Courier or delivering the same to the Contractor's principal place of business, or office established at site, such other address as the Contractor shall nominate for this purpose.

2) All notices to be given to the Employer or to the Consultant under the terms of the Contract shall be served by sending by registered post or by Courier or delivering the same to the respective addresses nominated for that purpose in respective conditions.

3) Either party may change a nominated address to another address in the country by prior written notice to the other party and the Consultant may do so by prior written notice to both parties.

24. CHANGES IN COSTS

1) It is a fixed price contract and hence there will not be any adjustments to the Contract Sum consequent to rise or fall in the cost of labour and / or materials, taxes or any other matters affecting the cost of the execution of the Works.
25. MEETINGS

The Contractor is required to attend all the management meeting as called for. The business of shall be to review the progress of work and plans for remaining work and to deal with matters rose in accordance with the early warning procedure. The Consultant shall record the business of management meetings and shall provide copies of the said record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken is to be decided by the Consultant in consultation with Engineer-in-charge.

26. CANCELLATION CONTRACTS

The Accepting Officer, whose decision shall be final and conclusive shall without prejudice to any other right or remedy which shall have accrued or shall accrue thereafter to HAL, cancel the contract in any of the following cases and the contractor shall be liable to make payment to HAL for any loss or damage resulting from any such cancellation to the same extent as provided in the case of cancellation for default.

If the contractor:

a) Offer or give or agree to give to any person in HAL service any gift or consideration of any kind as an inducement or reward for doing or for bearing to do or for having done or for borne to do any act in relation to the obtaining or execution of this or any other contract for HAL service or

b) Enter into a contract with HAL in connection with which commission has been paid or agreed to be paid by his or with his knowledge unless the particulars of any such commission and the terms of payment thereof have previously been disclosed in writing to the Accepting Officer.

c) Obtain a contract with HAL as a result of ring tendering or by non-bonaified methods of competitive tendering without first disclosing the fact in writing to the Accepting Officer.

d) Misrepresent any fact while tendering for any work or create conditions favourable for acceptance of his tender.
2) The Accepting Officer may without prejudice to any other right or remedy which shall have accrued or shall accrue there after HAL, shall cancel the contract in any of the following cases:

Being an individual, or if a firm, any partner thereof shall at any time be adjudged bankrupt or have a receiving order or order for administration of his estate made against him or shall take any proceeding for liquidation of compensation under any Bankruptcy Act for the time being in force or make any conveyance or assignment of his effects or composition or arrangement for the benefit of his creditors or propose to do so, or if any application be made under any Bankruptcy Act for the time being in force for the sequestration of his estate or if a trust deed be rented by him on behalf of his creditors of.

a) Being a company shall pass a resolution or the court shall make an order for the liquidation on its affairs, or a receiver or Manager on behalf of the debenture holders shall be appointed or circumstances shall arise which entitle the court or debenture holders to appoint a receiver or Manager or.

b) Assigns, transfers, sublets or attempts to assign, transfer or sublet any portion of the work without the prior written approval of the Accepting Officer. Whenever the Accepting Officer exercises his authority to cancel the contract under this condition, he may complete the work by any means at the contractor’s risk and expense provided always that in the event of cost of completion (as certified by the Engineer In Charge which is final & conclusive) being less than the contract cost, the advantage shall accrue to the HAL and that if the cost of completion exceeds the moneys due to the contractor the contractor shall either pay the excess amount ordered by the Engineer In Charge or the same shall be recovered from the contractor by other means.

a) In case the HAL completes the work under the provisions of this conditions, the cost of such completion to be taken into account in determining the excess cost to be charged to the contractor under this condition shall consist of the cost of material purchased and labour provided by the HAL with an addition of such percentage to cover superintendence and establishment charges, as decided by the Engineer In Charge whose decision shall be final and conclusive.

3) a) If the contractor makes default in commencing the work within a reasonable time or within the time specified, or having taken over the site does not commence the work within a reasonable time, or if the contractor, in the opinion of the Manager (Works)/Sr. Manager (Works & Services) during the currency of the contract makes default in proceeding with the work, or progress of work is slow, or in the opinion of the Manager (Works)/Sr. Manager (Works & Services) the workmanship is poor, or if the contractor fails to comply with any of the terms and condition of the contract, or fails to complete the work in full or part and clears the site on or before the date of completion, or fails to achieve the progress as set out under the contract or fails to carry out the orders issued by the Engineer-in-charge/Manager (Works)/Sr. Manager (Works & Services) or Deputies or abandons the contract or otherwise commits any breach of contract, the Accepting Officer or Sr. Manager (Works & Services)/Manager (Works) or any other officer nominated by the Accepting Officer shall cancel the
contract as a whole or in part or any items of work under the contract without any prior notice to the contractor at the sole cost, risk and expense of the contractor and get the balance work executed either by HAL itself, or by another contract or through any other agency as deemed fit. In such an event, the contractor shall be liable to make to make good and compensate all losses, expenses whatsoever, incurred or to be incurred, by the HAL.

b) In case HAL completes the work by itself, the cost of such completion to be taken into account in determining the excess cost to be charged to the contractor shall consist of cost of all materials and labour provided by HAL with an addition of such percentage to cover superintendence and establishment charges, as may be decided by the Manager (Works)/Sr. Manager (Works & Services) of HAL, whose decision shall be final, conclusive, and binding on the contractor.

c) In the event of completion of the work either by HAL or by another contractor or through any other agency, if the cost of completion works out less than the cost under this contract, advantage shall accrue to the HAL.

If at any time after acceptance of the tender HAL feels that for any reasons whatsoever, if the whose or any part of the work is not required to be carried out, the Engineer In Charge shall give notice in writing of the fact to the contractor and upon receipt of such notice the contractor shall stop the execution of such work as indicated in the notice forthwith. The contractor shall have no claim to any payment of compensation or otherwise whatsoever on account of any profit or advantage which he might have derived from the execution of the work in full, but which he did not derive in consequence of the foreclosing of the work. He shall be paid at contract rates for the full amount of the work executed including such additional work (e.g. clearing of site etc) as may be rendered necessary by said foreclosing. He shall also be allowed a reasonable payment (as decided by the Accepting Officer, which shall be final and binding on the contractor) for any expenses sustained on account of labour and materials collected, brought to site or for which the contractor is legally bound to accept delivery from the supplies, but which could not be utilised for the work as verified by the Engineer In Charge.

4) In the event of cancellation of the work under the terms of the contract, the contractor shall, within 10 days from the date of receipt of such cancellation order, come forward and complete measurements and recording thereof the unmeasured work and also recording of list of materials unused, jointly with the Engineer-in-Charge or his authorised representative, failing which, Engineer-in-charge shall complete the aforesaid work in the absence of the contractor in the presence of any person unconnected with the work, which shall be final, conclusive and binding on the contractor.