SABARMTI RIVERFRONT DEVELOPMENT

Sabarmati River Front Development Corporation Limited

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Between Gandhi Bridge and Nehru Bridge,
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BID DOCUMENT

RIVERSIDE SAVORIES-CONSTRUCTION OF BUILDING WITH TUNNEL ROAD AND BETWEEN NEHRU BRIDGE TO ELLISBRIDGE, RIVERFRONT-WEST.

Contract Package : SRFDCL

VOLUME-02

IV) Technical Specification-HVAC

1.0 DX AIR COOLED HIWALL SPLIT AC UNITS – Minimum 4 Star Rating

Hi-Wall Mount Split Units shall be remote control operated and shall be with single or multi splits design as per the ratings and quantities provided in the schedule of quantities.

The units shall be ready-to-operate type and shall comprise of a Indoor type Fan-Coil unit (installed within the room) and Outdoor Air Cooled Condensing unit connected through insulated refrigerant piping. The system shall be charged with first charge of refrigerant after proper pre-commissioning process.

Single phase connection shall be provided by user at one point near each Hi Wall split unit. Rest of the electrical work including cabling from the power point up to the Unit's electrical panel including voltage stabilizer shall be supplied, laid and installed by vendor only.

The units shall be of one among the Approved Makes mentioned elsewhere in this Tender.

1.1 Brief Features Desired In Indoor (Fan-Coil) Unit

Hi Gloss finish all fiber body.

Highly efficient 3 layered air purification system to remove dust/bacteria and odors from the Return air.

Four bend heat exchanger design for efficient heat transfer

Noise level of Indoor Unit at operating speed shall not be exceeding 48 dB measured at a distance of 3 M from source.

Operated through remote control having a large LCD display, temperature set-point, sleep mode operation, On/Off timer, Real time clock, Auto-restart, filter status warning, dry mode operation (reduces the humidity without the temperature when required)

1.2 Brief Features desired in Outdoor Condensing Unit

Operating on single phase 230±10% V supply

Preferred Rotary Scroll compressor design for low power consumption per ton generated – not exceeding above 1.28 kW per TR

Electrolytic zinc steel sheet with antirust coated components to ensure rust free outdoor unit even in humid condition.

Hydrophilic fins to improve the heating efficiency by accelerating the defrosting process.

2.0 REFRIGERANT PIPING

a. All refrigerant pipes and fittings shall be hard drawn copper tubes and wrought copper / brass fittings suitable for connection with silver solder / phos-copper.

b. All joints in copper piping shall be sweat joints using low temperature brazing and / or silver solder. Before joining any copper pipe or fittings, its interiors shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using carbon dioxide / nitrogen.

c. Refrigerant lines shall be sized to limit pressure drop between the evaporator and condensing unit to less than 0.2 kg per sq.cm.

d. Sight glass with moisture indicator and removable type combination dryer cum filter with MS housing and brass wire mesh / punched brass sheet shall be installed in liquid line of the refrigeration system incorporating a three valve by pass. After ninety days of operation, liquid line drier cartridges shall be replaced.

e. Horizontal suction line shall be pitched towards the compressor and no reducers shall be provided for proper oil return.

f. After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using Freon mixed with nitrogen / carbon dioxide at a pressure of 20 kg per sq. cm (high side) and 10 kg per sq. cm (low side). Pressure shall be maintained in the system for a minimum of 12 hours. The system shall then be evacuated to a minimum vacuum of 70 cm of mercury and held for 24 hours. Vacuum shall be checked with a vacuum gage.

g. All refrigeration piping shall be installed strictly as per the instructions and recommendations of air conditioning equipment manufacturer.

3.0 DRAIN PIPING:

3.1 All pipes to be used for cold water (makeup) drain, condensate drain and fittings shall be MS class 'C' (medium class) conforming to relevant BIS Codes.

3.2 All jointing in the pipe system shall be by screwed / welded joints & / or by screwed flanges using rubber insertion gaskets. Pipe threads and flanges shall be as per relevant BIS Codes.

3.3 All pipes supports and nuts and bolts shall be mild steel, hot dip galvanized / painted with synthetic animal paint.

3.4 Fittings shall be galvanized steel 'medium class' malleable casting of pressure rating suitable for the piping system. Flanges shall be of approved make. Supply of flanges shall include bolts, nuts, and gaskets as required. Sufficient number of flanges and unions shall be provided for future cleaning and servicing of piping. Tee-off connection shall be through equal or reducing tees. All equipment and valve connections or connections to any other mating pipes shall be through flanges required for the mating connections.

3.5 All condensate drain piping shall be insulated and painted as per the section "Insulation" if indicated in Bill of Quantities.

3.6 After the piping has been installed, tested and run for at least three days of eight hours each, all exposed & uninsulated piping shall be given two finish coats, of approved colour, conforming to relevant BIS Codes. The direction of flow of fluid in the pipes shall be visibly marked with identifying arrows. For painting of insulated and clad pipes refer to insulation section.

4.0 SHEET METAL WORK:

4.1 Codes And Standards

Ducts shall be made of Aluminum sheet & confirm to IS: 655.
Aluminum sheet shall confirm to IS: 737. The duct construction shall be as follows:

4.2 Rectangular G I duct construction:

MAX. SIDE	THICKNESS-G AL	TYPE OF JOINT	BRACING

Up to 750	22	25 mm QSS flanges	None
751 to 1500 MS angle	20	25 mm x 3 mm MS angle flange.	25 mm x 3 mm
1501 to 2250 MS angle	18	40 mm x 3 mm MS angle flange.	40 mm x 3 mm at 1.25 m centers.
2251 & above MS angle	16	40 mm x 3 mm MS angle flange.	40 mm x 3 mm at 1.25 m centers.

4.3 Hangers for G I Duct:

Supporting Details for Ducts are given below			
Larger Side of Duct mm	**Support Channel mm**	**Vertical Rod Dia mm**	**Maximum Spacing between supports mm**
0-400	27x18x1.2	M8	2400
401 – 1000	38x24x2	M8	2400
1001 – 1250	38x24x2	M10	2400
1251 – 1600	38x40x2	M10	2400
1601 – 1800	38x40x2	M10	2400
1801 – 2000	40x60x3	M12	2400
2001 – 2500	40x60x3	M12	2400
2501 mm and above	40x80x3	M16	2400

4.4 Aluminum Duct Installation:

All ducts shall be fabricated and installed in workman like manner, generally confirming to IS: 655: 1963 updated. Round duct shall be die- formed for achieving perfect circle configuration.

Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made airtight.

All exposed ducts within conditioned spaces, shall have slip joints - no flanged joints. The internal ends of slip joints shall be in the direction of air flow. Ducts and accessories within ceiling spaces, visible from air-conditioned areas shall be provided with two coats of mat black finish paint.

Changes in the dimensions and shape of ducts shall be gradual. Air-turns shall be installed in all vanes, arranged to permit the air to make the turn without appreciable turbulence.

Ducts shall be fabricated as per details shown on drawings. All ducts shall be rigid and adequately supported where required standing seams, teas, or angles, of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

All sheet metal connections, partitions and plenums required to confine the flow of air to and through the filters and fans, shall be constructed of 16 G Aluminum, thoroughly stiffened with 25mmx25mmx3mm angle iron braces and fitted with all necessary inspection doors as required to give access to all parts of the apparatus. Doors shall be not less than 45 cm x 45 cm in size.

Plenums shall be panel type and assembled at the site. Fixing of MS angle, iron flanges on duct pieces shall be with rivets heads from inside and riveting shall be done from outside.

Rubber lining 6 mm thick shall be used between duct flanges instead of felt, in all clean room ducting installations.

The contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of this specifications and drawings. The work shall meet with the approval of the engineer In-charge at site in all it parts and details.

The contractor shall make all necessary provisions and allowances to avoid beams or other structural work, plumbing or other pipes, and / or conduits, the ducts shall be transformed, divided or curved to on a side, (the required area being maintained) all as per the site requirements.

If a duct cannot be run as shown on the drawings, the contractor shall install the ducts between the required points by any path available, in accordance with other services and as per approval of site engineer.

All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported by providing support channels made up of aluminum. The threaded rods should be made up of partially annealed medium carbon steel of grade 4.8 strength class or greater.
The Duct supports should be designed by a qualified engineer/manufacturer and valid Load calculations should be submitted for approval.

Ducting over ceiling shall be supported from beams using beam clamps for ducts running perpendicular to the beams and girder cleats for ducts running parallel to the beams, A relevant approval of site engineer is required for the same. All connections to the beam for supports should be FM Approved or UL Listed of VDS Approved. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling.

Where metal ducts or sleeves terminate in woodwork, tight joints shall be made by means of closely fitting heavy flanged collars. Where ducts pass through brick or masonry openings, wooden frame work shall be provided within the opening and crossing of ducts provided with heavy flanged collars on each side of the wooden frame work, so that duct crossing is made leak - proof.

All ducts shall be totally free from vibration under all conditions of operation. Wherever duct work is connected to fans / air handling units or blower coil units that may cause vibrations in the ducts, ducts shall be provided with two flexible connections, located close to the unit, in mutually perpendicular directions, flexible heavy canvas sleeve at least 10 cm long securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting ductwork rigidly held by independent supports on both ends. The flexible connection shall be suitable for pressures at the point of installation and shall be of approved make.

4.5 Dampers:

All dampers shall be louver dampers of robust construction and tight fitting. The design, method of handling, and control shall be suitable for the location and the service required.

Dampers shall be provided with suitable links, levers, and quadrants as required for their proper operation, control or setting devices shall be made robust, easily operable and accessible through suitable access doors in the ducts. Every damper shall have an indicating device clearly showing the damper position at all the times.

Dampers shall be placed in ducts at every branch supply or return air duct connection, whether or not indicated on the drawings, for the proper volume control and balancing of the system.

4.6 Fire dampers:

All supply and return air ducts at AHU room crossing and at all floor crossings shall be provided with approved make Motorized fire dampers of at least 2.0 hour fire rating.

Fire damper blades shall be single / multi piece folded high strength galvanized steel construction. In normal position, these blades shall be gathered and stacked at the frame head, providing maximum air passage and preventing passing air currents from creating noise or chatter. The blades shall be held in position by solenoid valve. All fire dampers shall be smoke sensor actuated and solenoid valve operated. Ionization type smoke sensors shall be provided in the return air paths.

In case of fire, the intrinsic energy of the folded blades shall be utilized to close the openings. The thrust from closing of the damper shall operate a limit switch mounted in the bottom frame of fire damper

within the duct. Closing of this limit switch shall cut off the power supply to the AHU fan. Stopping all air flow instantaneously. No hinges or blade linkages shall be permitted which may give way under heat or air pressure. The thrust of suddenly released tension shall instantly drive the blade down and keep it down without the use of springs, weights or other devices subject to failure.

Fire damper sleeves and access doors shall be provided within the ducts in accordance with the manufacturers recommendations.

The contractor shall also furnish to the owner, the necessary additional spare solenoid valve, as recommended by manufacturer, at the time of commissioning of the installation.

4.7 Supply and Return Air Registers:

Supply and return air resisters shall be of anodized Aluminum section construction with individual adjustable bars as shown on drawings and indicated in Bill of quantities. Supply air register shall be generally double deflection type, with removable key operated volume control dampers. Return air resisters shall be generally similar to supply air resister but without dampers. All supply and return resisters behind wooden grilles shall be single deflection type with one-way bars only, the supply air resisters being provided with removable key operated volume control dampers.

All resisters shall be selected in consultation with site engineer. Different spaces shall require horizontal or vertical face bars and different width of margin frames.

All resisters shall have a soft, continuous rubber gasket between the periphery of the register and the surface on which it has to be mounted. The effective area of the registers shall not be less than 75 % of gross face area.

Resister shall be adjustable pattern as each grille bar shall be pivot able to provide pattern with 0 to ± 50° horizontal arcs and up to 30° deflections downwards. Bars shall hold deflection settings under all conditions of velocity and pressure. Excluded Aluminum registers shall have fixed bars.

Set-back vertical members of approved thickness shall reinforce bar longer than 45 cm.

4.8 Supply And Return Air Diffusers:

Supply and return air diffusers shall be of approved make as shown on the drawings and/or indicated in the Bill of quantities.

Round or Rectangular Diffuser: Shall be anodized Aluminum section construction, square, rectangular, or round diffusers with flush fixed pattern. Diffusers for different spaces shall be selected in consultation with site engineer. Supply air diffusers may be equipped with fixed air distribution grids, removable key operated volume control dampers, and anti-smudge rings as required in specific applications, all as per requirements of Bill of quantities.

Linear Diffuser: Shall be anodized Aluminum section construction, one or two-way blow linear diffusers. Supply air diffusers shall be provided with volume control / balancing dampers within the supply air collar. Diffusers for different spaces shall be selected in consultation with site engineer and provided as per requirement of Bill of quantities. All linear / square / round diffusers shall have volume control dampers of MS construction.

4.9 Method of Measurements for Air Distribution System

Sheet Metal work:

Duct Length shall be measured along the center line from flange face to face unless otherwise stated. Ductwork shall be measured on the basis of external surface area (length as measured above, multiply by duct perimeter) of ducts including the joints for each duct section. Duct measurement shall be taken before application of the insulation. For taper section average perimeter shall be used for measurement. For special pieces like bends, reducers, branches, and collars, mode of measurement shall be identical to as described above using the length along the center line. The quoted unit rate for external surface of

ducts shall include all wastage allowances, flanges and gaskets for joints, nuts and bolts, hangers and angles, and angles/flats with double nuts for supports, felt strip between duct and support, vibration isolation, inspection chamber / access panel, splitter damper with quadrant and lever for position indication, turning vanes, straightening vanes, and all other accessories required to complete the duct installation as per the specifications. These accessories shall not be separately measured nor paid for.

Duct Accessories: Shall be measured by the cross section area perpendicular to air flow.

Grilles and diffusers:

Width multiplied by height, excluding flanges, volume control dampers shall form part of the unit rate for registers and shall not be separately accounted.

Diffusers: Cross-section area for airflow at discharge/capture area, excluding flanges. Volume control dampers shall form part of unit rate for supply air diffusers and shall not be separately accounted.

Linear Diffusers: Shall be measured by linear measurements only not by cross sectional areas, and shall exclude flanges for mounting of linear diffusers. The supply air plenum for linear diffusers shall be measured with ducting as described earlier.

Fire Damper: Shall be measured by their cross sectional area perpendicular to the direction of airflow. Quoted rates shall include the necessary collars, and flanges for mounting, inspection pieces with access door, solenoid valves etc. No special allowances shall be payable for extension of cross section outside the air stream.

Flexible connection: Shall be measured by their cross sectional area perpendicular to the direction of airflow. Quoted rates shall include the necessary mounting arrangement, flanges, nuts and bolts and treated-for-fire requisite length of canvas cloth.

4.10 Testing & balancing:

After the installation of the entire air distribution system is completed in all respects, all ducts shall be tested for air leaks by visual inspection.

The entire air distribution system shall be balanced using anemometer. Measured air quantities at fan discharge and at various outlets shall be identical to or less than 5 % in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time. Complete air balance report shall be submitted for scrutiny and approval, and four copies of the approved balance report shall be submitted along with the completion documents.

5.0 FLEXIBLE DUCT:

5.1 General:

The scope of this section comprise supply, installation, testing and commissioning of flexible ducting conforming to these specifications and in accordance with requirements of drawings and schedule of quantities

5.2 Duct Materials:

Un Insulated Flexible duct

Wherever specified, uninsulated flexible duct shall be made of double lamination of metalized polyester film permanently bonded to a coated spring steel wire helix. Duct shall be in tear and puncture resistant construction.

Insulated Flexible Duct

Wherever insulated flexible duct are specified inner core for the same should be made of double lamination of polyester film permanently bonded to a coated spring steel wire helix. Blanket of fiber glass insulation of R 3.6(RSI - 0.64 m2K/W) having density of 16 kg/Cu.meter and thickness of 25 mm shall be wrapped over the inner core & covered with tear and abuse resistant outer jacket cum vapor barrier made of fiber glass reinforced double layer of metalized polyester film laminate.

5.3 Installation:

Care must be taken to install all the flexible duct in fully extruded position and bends made with adequate radius as per manufacturer recommended practices.

Hangers and Supports

The flexible duct must be installed fully extended to produce optimum results.
The maximum allowable sag, between any two adjacent suspension points, should not exceed 50 mm per meter.

The distance between any two adjacent suspension points may vary from 1.50 to 3.00 meter, depending upon the type of flexible duct in use.

Flexible ducts mounted above suspended ceiling should always be independently supported. Ducts mounted in these locations are susceptible to damage whenever ceiling panels need to be periodically interchanged, unless they are separately supported

Bending Radius

All bends should be made as large as possible and should have a radius of not less than the diameter of the duct in use. This reduces un-favorable pressure losses and is particularly important for metal-based products which are more susceptible to stress rupturing. Double bends should be avoided, however if un-avoidable, ensure that each radius is not less than R = 2 x D.

Straps

Ideally the hanging straps should support the flexible duct with a minimum of half the circumference surface in contact, and without reducing the effective inside diameter of the duct. It is also recommended that the minimum width of material to be used for the hanging straps should be at least 25 mm.

Flexible Duct to Conventional Duct Connection

Extra care should be taken when making connection to fixed conventional ducts, etc., and ensure that they do not become too stressed. An additional support is recommended to obviate this potential problem.

Metal based flexible duct products are particularly prone to fracturing due to stress caused as a result of sharp connection.

Connections to ceiling illumination “troffer boxes” should be served in the most direct manner similar to that described for conventional ducts.

Too many bends, when connecting to “troffer boxes” and / or any other type of air supplying component, may result in excessive pressure loss and the generation of noise.

Longer Length Installation

In the event where extreme length of flexible duct is to be installed, round duct connectors made of galvanized sheets of at least 30 cm long should be used to connect the duct at every distance of 10 meters. Use metal or galvanized hangers as recommended (point 3) to support the point where connections are made. Light railing is a good alternative hanging support when using long length of flexible duct.

Direct Contact

It should be emphasized that the flexible duct must not be in direct physical contact with un-insulated heating or hot process pipes. If in the event where such situation can not be avoided, additional 1" thick insulation should be wrapped around pipes that are in contact with the duct

6.0 INSULATION:

6.1 Scope:

The scope of this section comprises the supply and fixing of insulation conforming to these specifications and in accordance with requirement of Bill of quantities.

Material:

Insulation material shall be Nitrile Rubber – Class O

Closed Cell Elastomeric Nitrile Rubber Insulation material shall have anti-microbial product, which is EPA approved, as an integral part of insulation that cannot be washed off or worn off, which does not allow the microbes to function, grow and reproduce. Microbiological growth on insulation surface should confirm to following standards: Mould Growth – UL 181; Fungi Resistance – ASTM G21/C1 338 and Bacterial resistance – ASTM G 22. Density of Material shall be between 40 to 60 Kg/m3.

Thermal conductivity of Elastomeric Nitrile rubber shall not exceed 0.033 W/m°K at an average temperature of 0°C. The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O' Fire category as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990. Water vapour permeability shall not exceed 1.74 x 10-14 Kg/m.s.Pa, i.e. Moisture Diffusion Resistance Factor or 'μ' value should be minimum 10,000.

Thickness of insulation shall be as specified for particular application or as specified in Bill of quantities. Samples of insulation material shall be submitted for approval and shall be tested for thermal conductivity values. Adhesive used for setting insulation shall be cold setting compound non-flammable, vapor proof adhesive, shalimar CPRX compound or equivalent approved make.

6.2 Duct Insulation:

a. Duct acoustic Lining

Internal Acoustic lining for ducting is proposed (discharge duct) with 19 mm thick Arma sound material.

Acoustic duct lining shall be applied inside the duct for a minimum distance of 3 meter or as shown in the drawing from the outlet of air handling units or as specified in drawings or as indicated in Bill of quantities. Acoustical duct lining shall be applied as follows:

i) The inside surface of the duct shall be cleaned and covered with cold setting adhesive compound.

ii) Depending on size of duct fit min. 2 or more rows of insulation fixing pins to each face of duct at every 300 mm center distance. Pins shall be self-adhesive, bond on type.

Carefully position insulation over the pins, pressing firmly so that pins penetrate through the insulation. Fit spring clip or lock washer over pins pushing them down until they are tight against insulation. Snip off any excess shank from pin. Seal all joints and openings with self-adhesive tape.

iii) Depending on size of duct fit min. 2 or more rows of Mechanical fasteners (G.I Bolts) of sufficient length to each face of duct at every 300 mm center distance. Pins can be self-adhesive type, bond on type.

Carefully position insulation over the bolts, pressing firmly so that bolts penetrate through the insulation. Fit G.I nut over the bolts pushing them down until they are tight against insulation. Snip off any excess shank from bolt. Seal all joints and openings with self-adhesive tape.

iv) The inside surface shall be covered with fiberglass tissue paper and 26 gauge perforated aluminum sheets having at least 15 percent perforation.

v) The aluminum sheet shall be screwed using cup washers. And neatly finished to give smooth inside surfaces. Use of nails shall not be permitted.

vi) The aluminum perforated sheet shall be screwed along with G.I nut to give smooth inside surfaces.

vii) All Meeting Rooms, Training Rooms, Conference Rooms, Well area & Executive Dining area return air duct will be acoustically insulated.

b. Duct thermal insulation:

Thermal insulation shall be applied over external surface of duct as per following procedure:

With Nitrile Rubber of thickness & density as per BOQ.

Duct surfaces shall be thoroughly cleaned and joints shall be made air tight.

Apply a thin layer of tar paints of Rubber Adhesive, Adhesive shall be applied on all side of duct.

Fix the insulation of specified thickness over the surface of the duct tightly before adhesive dries out.

All transverse and longitudinal joints shall be sealed with 40 mm wide Adhesive tape.

6.3 Drain Pan Insulation:

If insulated drain pan is not part of the AHU, then drain pan shall be insulated as under:
25 mm thick Nitrile Rubber shall be applied over the surface with help of cold setting adhesive.

6.4 Acoustic Insulation of AHU Room:

Walls and ceilings of AHU rooms shall be provided with acoustic insulation; further the return air volume within the truss areas for each AHU return path shall be isolated with Acoustic insulation. The procedure shall be as under:

Fix 25mm x 25mm (if specify in BOQ 50mm x 50mm) wooden battens, treated with solegnum and fire resistant paint, at 600 mm centers to the wall and ceiling by means of row plug and brass screws.

Fix one layer of 25mm (if specify in BOQ 50mm) thick resin bonded fiber glass between battens with cold setting adhesive compound.

Entire insulation shall be covered with fiber glass tissue paper.

Fix 3 mm thick perforated hard board sheets with round headed brass screws over the entire insulation surface taking care to fix the sheet on solegnum treated wooden battens. If specified in Bill of quantities, 26 G perforated aluminum sheets, having 15 % perforation shall be fixed over insulation surface with round headed brass screws taking care to fix the sheet on wooden battens. Overlapping of aluminum sheets shall be covered with aluminum strips.

Acoustical lining of walls shall be terminated approximately 150 mm above the finished floor to prevent damage to insulation due to accidental water logging in plant/AHU rooms.

Protective Coating shall be a flexible, fire resistive fungicidal resistant compound suitable for vapor sealing insulated ducts and pipes.

Protective Coating shall be suitable for indoor / outdoor use and sustain in high humidity environments.

Water vapor presence shall not exceed 0.932 metric perms at 1.3 mm dry film thickness when tested in compliance with ASTM E 96.

When tested for surface burning characteristics in compliance with ASTM E-84, flame spread shall be 5 and smoke developed 10 and complies with ASTM 4804 for flammability resistance.

Protective Coating shall be UL classified and should conform to UL 723 for surface burning characteristics.

The Protective Coating should conform to ASTM D 5590 standard for fungal resistance.

Protective Coating shall be available in color matching the design or façade requirement and UV resistant.

The Protective Coating should be easy to apply with brush.

Third Party Test Certification must be furnished by the Manufacturer to substantiate the claims.

6.5 Under Deck Insulation:

Under deck Insulation of the exposed roof shall be carried out with xx mm Extruded Poly Styrene Board having following Thermal insulation characteristics:

Insulation material technical specifications: Light weight self-extinguishing Expanded polystyrene boards

Material: Expanded Polystyrene (EPS) boards
Thickness: 50 mm
Density: 32 kg/m^3

- Insulation material should have density 32 kg/m^3.
- Insulation material shall have maximum thermal conductivity (k-value) 0.034 W/m K at 10˚C mean temperature in accordance with testing standard ASTM C-518.
- It shall have minimum thermal resistance (R-value) 8.35 hr ft^2 ˚F/BTU at 10˚C mean temperature.
- It shall have water absorption less than 0.5 %.
- Material shall have minimum compressive strength 1.4 kg/cm^2 as per IS 4671.
- Material shall have minimum cross breaking strength 2.2 kg/cm^2 as per IS 4671.

Application:
- Clean the surface to be insulated.
- Apply 50 mm thick Expanded Polystyrene boards under the slab with the help of G.I wire, screw washer & necessary mechanical accessories.

6.6 Method of Measurement for Insulation:

Measurement of duct, piping, equipment, plant room and false ceiling insulation shall be taken as per following basis.

All duct thermal insulation and acoustic duct lining shall be measured on the basis of prime surface area (bare duct surface area), excluding all openings for grilles and diffusers and including all flanges, dampers etc. Thus the surface area for thermally insulated duct as well as acoustically lined duct shall be equal to perimeter (comprising outer width and depth of bare duct to be insulated) multiplied by centerline length of duct including all tapered pieces, tees, bends, branches etc. Support structure required for the ducting support will not be considered as an extra. Acoustic insulation of AHU and A.C. plant room shall be measured on the basis of finished surface area.

Insulation covering above insulation:

a. Self-bonded olefin sheet – Outdoor area (Service Area/Mezz. Area/Shaft)

Material	:	Self-Bonded olefin sheet
Color	:	Silver White
Reflectivity	:	0.92

- It shall have backing of moisture protective metalized foil.
- Insulation material shall have a total Unit Weight 67.58 g/m2.
- Insulation material shall have Thickness 150 µm.
- Insulation material shall have Melting Point/Range of 135 °C.

b. Glass Cloth – Inside area

Material	:	Acrylic based woven fiberglass fabric made from E glass (self-adhesive)
Color	:	Black / Blue / Red / Gray
Thickness	:	0.19 mm ± 0.02

- Insulation material shall have a total mass 280 GSM ± 5%.
- Insulation material shall have PSA mass 50 GSM ± 5%.
- Insulation material shall have base fabric mass 225 GSM ± 5%.
- Insulation material shall have resistance to Thermal / Fire / Chemical / Electrical.
- Insulation material shall be dimensionally stable.

7.0 CENTRIFUGAL FAN :

7.1 Scope:

The scope of this section comprises the supply, erection, testing and commissioning of fans conforming to these specification and in accordance with the requirement of bill of quantities.

7.2 Centrifugal exhaust air fan:

A. Type :

Centrifugal fan shall be SWSI class I construction arrangement 3 (i.e. bearings on both sides) or as specified in BOQ complete with access door, squirrel cage induction motor, v-belt drive, belt guard and vibration isolators. Type, direction of discharge/rotation and motor position shall be as shown in the drawing and/or in the bill of quantities.

Centrifugal shall be Double inlet Double width (DIDW) / SISW as the case may be class-I centrifugal and vibration isolators Discharge arrangements. The fans shall be a self-contained unit comprising of motor, belt drive/direct drive arrangement in suitable factory fabricated acoustically treated housing. The efficiency of fans at operating conditions should be more than 75%.

B. Housing:

Housing shall be constructed of 14 gauge sheet steel welded construction. It shall be rigidly reinforced and supported by structural angles. Split casing shall be provided on larger sizes of fans, however neoprene/asbestos packing shall be provided throughout split joints to make it air tight. 18 gauge wire mesh inlet guards of 5 cm sieves shall be provided on both inlets. Housing shall be provided with standard clean out door with handles and neoprene gasket. Rotation arrow shall be clearly marked on the housing.

C. Fan wheel:

Fan wheel shall be backward – curved non-overloading type utilizing hollow sectioned aerodynamically shaped aerofoil blades. Fan wheel and housing shall be statically and dynamically balanced. For Fans up to 450 mm dia., fan outlet velocity not exceed 1450 rpm. For Fans above 450 mm dia., the outlet velocity shall be within 700 meter/minute and maximum fan speed shall not exceed 1000 RPM. High static pressure fan speed shall be as per manufacturer.

D. Shaft:

Shaft shall be constructed of steel, turned, ground and polished.

E. Bearings:
Bearings shall be of the sleeve/ ball bearing type mounted directly on the fan housing. Bearings shall be especially designed for quiet operation and shall be of the self-aligning, oil/grease pack pillow block type.

F. Motor:

Fan motor shall be TEFC, Squirrel cage, induction motor, with IP-55 protection and class 'F' OR equivalent insulation as per particular application. Motor shall be suitable for 415± 10% volts, 3 phase, 50 cycles, and A.C. supply. Motor shall be of continuous duty and specially designed for quiet operation and motor speed shall not exceed 1450 rpm. Motor nameplate horsepower shall exceed brake horsepower by a minimum of 10%. The fan and motor combination selected for the particular required performance shall be of the most efficient (smallest horse power), so that the sound level is lowest.

G. Drive:

Flexible coupling with guard shall be provided if fan- motor arrangement is direct drive type if specified in bill of quantities. `V' belts and pulleys shall be provided if fan-motor arrangement is variable drive type. Belt guard with vent shall be provided for belt protection and heat dissipation.

H. Vibration Isolation:

M.S. base shall be provided for both fan and motor, built as an integral part, and shall be mounted on a concrete foundation through spring isolators. The concrete foundation shall be at least 150 mm above the finished floor level.

8.0 CENTRIFUGAL CABINET EXHAUST AIR FAN:

8.1 Scope:

The scope of this section comprises the supply, erection, testing and commissioning of fans conforming to these specification and in accordance with the requirement of bill of quantities.

8.2 Centrifugal Cabinet Exhaust Air Fan

Application/ Location as per Layouts and Selection as per Tender annexure

Specifications same as FFU above but shall be without Filters

- Kitchen Exhaust Fan:

The fan for kitchen exhaust shall be backward inclined curved impeller type with self cleaning properties. It shall have limit load characteristics. The motor drive train shall be kept outside the air stream. Casing for Fan shall be made of Al extruded PUF insulated panels.

9.0 DRY SCRUBBER:

Equipment Description

The Industrial Electronic Air Cleaning System shall be supplied as a one-piece factory joined assembly of individual section(s) selected to treat oil mist, smoke, fume, grease & dust/ powder problem.

9.1 Unit Housing:

Housing shall be 1.2mm thick cold steel construction & powder coated to protect against rust and corrosion. It shall have a single hinged door for cell access, located one side of the unit. The door shall be gasketed to prevent air leakage. There shall be a safety interlock switch to cut off primary supply when the access door is opened.

9.2 Finish:

The external finish shall be a durable industrial grade semi gloss epoxy coating.

9.3 Lonizing – Collecting Cells:

Ionizing-Collecting cell(s) shall be of one-piece construction 13.38” (340mm) deep in direction of airflow. The dimension of the collection cell shall be 18.89” (480mm) H x 21.65” (550mm) W Max. All support framing, end plates and ionizer ground electrodes shall be 0.090 inch (2.2mm) thick aluminum. Both repelling and collector plates shall be 0.032 inch (0.8mm) thick aluminum alloy material rigidly retained in place with tubular spacers and tie rods. Each plate shall be corrugated, perpendicular to airflow direction. Spacing between plates shall be no less than 0.318 inch (8mm). Each cell shall weigh at least 14 kg with at least 8 ionizing wires.

UNIT SHALL BE SELECTED SUCH THAT THE FACE VELOCITY ACROSS THE ESP CELLS DOES NOT EXCEED 3.2 M/S & MINIMUM COLLECTION AREA SHALL BE 2.1 SQM/1000 CMH.

9.4 Ionizer:

Ionizing electrodes / wires shall be of tungsten material, rigidly supported both vertically and laterally. Ionizing electrode to ground electrode spacing shall be 1.0" (25mm). High voltage support insulators shall be of Teflon material, glazed to enhance dielectric strength and retard tracking.

9.5 Air handling Capacity:

Each Ionizing / Collecting Cell shall be capable of handling up to 2500cmh of air. There shall be one or two such Ionizing / Collecting Cells per module, handling up to 2500 cmh & 5000cmh per module respectively.

The rated efficiency shall be up to 95% based on the **NIOSH 5026 OIL MIST TEST.4.0**

9.6 Power Supply:

Power supplies shall be 100% solid state, operate on 240 VAC, 50 HZ, 1 Phase input and provide a dual high voltage output of 12 to 13 KVDC for the ionizer and 6.0 to 6.5 KVDC for the collector in normal operation conditions. Current output at the high tension shall be 12mA. A

maximum power output for the solid state power supply shall be 120 watts to maintain the specified collection efficiency. Integrally mounted Electrical interlocks shall be provided to prevent access to the high voltage components without first interrupting the primary input power. The power supply shall operate over a temperature range of -32 degrees F to 140 degrees F, be overloaded self-protecting and accommodate an LED lights indicating the performance status of the ionizing/collecting cell. High voltage output components in the power supply shall be sealed with epoxy for moisture resistance.

9.7 Outstanding Features:

The power pack shall incorporate a short circuit arc protection with automatic power restoration system to prevent overload.

9.8 Performance Indicator:

There shall be 2 LED lights (Green & Red) installed on the access door of the unit to indicate the status of the air cleaning system.

9.9 BMS (Building Management System) interface:

The power supply (pack) shall have a 3 wire dry contacts (NO/NC) for remote link to Building Management System. This is for performance indication of the air cleaning system.

9.10 Electrical:

Factory wiring will be in accordance with the National Electrical Code. Required field wiring shall conform to the National Electrical Code and any local code requirements. The manufacturer shall be informed of any local variances to the National Electrical Code.

10.0 AIR WASHER UNIT:

10.1 General:

Direct cooling system includes components of evaporative media, re-circulating pump, sump drain, overflow, automatic fill and level control and internal piping. House all components in a common casing.

Exterior panels shall be removable to permit access to any interior component.

The unit will be sectionalized double skin construction made out of 0.63mm white pre-coated GI outer skin, 0.63mm GI inner skin, 23+/-1 mm CFC free PUF Insulation to density of 38-42Kg/m3. The structural construction shall be extruded aluminum profile.

The skid will have necessary cross members to take care of the load of fan blower assembly. All the components of the unit will be of proper design and quality to ensure vibration free and noiseless operation.

- **Filters**

The filters shall comprise of HDPE filters of cell/box type construction with 85% efficiency down to 20 or 10 microns. The filters should be slidable and washable.

Pre-coated Louvers should be provided for outdoor installation units.

- **Re-Circulation pumps**

The recirculation pump should be of SS 304 submersible type and of approved Ebara make. The pump should be designed such that it can handle the designed amount of water flow and maintain required head. The pumps should be designed such that pump shaft horsepower (BHP) shall not exceed motor rated horsepower throughout the entire operating range of the pump performance curve. Pump shall be built to operate.

The pump shall be furnished with a non-mechanical double oil seal.

The pump motor shall be minimum 1/3HP, 0.3 Kw, 230 Volts, 50 Hz single phase motor. The motor shall be supplied with built-in thermal protection with automatic reset and shall be rated for continuous duty.

- **Piping**

All internal piping shall be of UPVC.

- **Direct Evaporative Media**

The media shall be celdek with Thickness of 200 mm in case of 7mm flute. The water tank shall be made up of 18SWG (1.2mm) thick SS 304 plain sheet to house adiabatic heat exchangers.

The water tank shall be designed as chassis to hold the heat exchangers support system. The water distribution system shall be designed properly to get proper efficiency across the heat exchangers. The piping shall be used of rigid UPVC material. Piping connections should be made so as to ensure uniform distribution of water. The sump shall be fitted with float valve.

- **U-V Filter**

Provide UV filter for re-circulation line.UV filtration controls the bacterial disinfections in the supply water line thereby restricting the growth of algae and fungus. The capacity shall be based on the flow rates of individual machines.

10.2Blower Section:

The blower section shall include AMCA certified centrifugal Backward curved DIDW fans. The unit shall be of GI construction. It shall have individual motor and drive and shall be mounted on C channel frame and cushy foot mounts. The fan shall be constructed and rated based on the delivery against the rated static pressure with the media and filters in place. The fan shall be of riveted construction and made with GI sheet of required thickness. The fan wheels shall be of multiblade type and mounted on two self alignining pillow block bearings of required size. The fan shall be run with the help of 'V' groove drives as per the recommendation of the drive supplier. The blower housing shall be made of machine made roll formed Pittsburgh joint construction and the drive shall be provided by a motor of required capacity.

10.3Motor:

Motors shall be IE2 (EEF-1) type of ABB/Siemens/BB approved make.

10.4Control Panel:

Panel shall be Non - Compartmentalized panel and should have RYB indication -Indication lamps, Incomer-SFU/MCCB Blower/Pump controls- Thru' -MPCB, Contactor with OLR, Digital display-VAF meter, ATE-PLC - for logic control.

It should have both Auto and Manual mode. It should have light indicator with push buttons for each component i.e. Primary fan and Pump that shows On – Off – Trip status.

11.0 TUBE AXIAL FLOW FAN

11.1 SCOPE:

The scope of this section comprises the supply, erection, testing and commissioning of fans conforming to these specifications and in accordance with the requirement of bill of quantities.
Tube Axial Fans are suggested for Ductless Car Park Ventilation. Axial Fan shall be adjustable pitch blade type having non-overloading feature. Fan shall comprise of following components.

Capacities: Fan capacities shall be as per the schedule shown in Tender BOQ

Fan: Fan shall be complete with motor, motor mount, belt driven (or direct driven) and vibration isolation type, suspension arrangement as per approved for construction shop drawings.

Casing: shall be constructed of heavy gage sheet steel. Fan casing, motor mount and straightening vane shall be of welded steel construction. Motor mounting plate shall be minimum 20mm thick and machined to receive motor flange.

An inspection door with handle and neoprene gasket shall be provided. Casing shall have flanged connection on both ends for ducted applications. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be bonderized, primed and finish coated with enamel paint.

Rotor: hub and blades shall be cast aluminium or cast steel construction. Blades shall be die-formed aerofoil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Fan blades mounting on the hub shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. The fan pitch control may be manually readjusted at site upon installation, for obtaining actual airflow values, as specified and quoted.

Motor: shall be energy efficient, squirrel cage, thermally enclosed, fan cooled, standard frame, continuous duty, single winding/ Dahlander winding (for dual speed applications) type suitable for 400V/3 Ph/ 50Hz , AC power supply provided with class F insulation for normal operations and H class for smoke exhaust application , IP55 in accordance with EN 60034-5/IEC 85. Motor Kw must be higher than Bkw by minimum 10-15%.

The speed of the fans shall not exceed 1440 RPM for fans with impeller diameter above 450 mm, and 2880 RPM for fans with impeller diameter 450 mm and less. For lowest sound level, fan shall be selected. for maximum efficiency or minimum horsepower. Motor shall be specially designed for low noise operation. Fan sound level shall not exceed 75 dBA at 1 m distance from the unit. Fan attenuators shall be provided after acoustic assessment to achieve the specified noise level within occupied areas. The motor bearings should be life lubricated and completely maintenance free and can be used at any installation position at indicated maximum temperature of transported air. The life expectancy of the bearing should be at least 40000 hours (L10)

Motor conduit box shall be mounted on exterior of fan casing, and lead wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible metal conduit.

Where axial flow fans of bifurcated type are indicated, the motors shall be out of the air stream.

Minimum fan efficiency shall be 65%.

FAN shall be direct driven to have less losses in transmission mounted on extended motor shaft of carbon steel material.

Drive: To fan shall be provided through direct or belt drive; belt drive shall be with adjustable motor sheave and standard sheet steel belt guard with vented front for heat dissipation. Belts shall be of oil-resistant type.

Vibration Isolation: The assembly of fan and motor shall be suspended from the slab by vibration isolation suspension of rubber-in-shear type OR Mounted flush with the wall with proper isolation to avoid transmission of vibrations to the wall and structure.

12.0 PROPELLER FAN UNIT:

12.1 Scope:

The scope of this section comprises the supply, erection, testing and commissioning of fans conforming to these specification and in accordance with the requirement of bill of quantities.

12.2 Propeller Fan Unit :

Application/ Location as per Layouts and BOQ

These fans shall be of single phase type and installed for
Propeller fans shall be of approved make in tender, direct-drive, three or four-blade type mounted on a steel mounted plate with orifice ring to deliver as per duty points.

Please refer tender bill of quantities for duty point and quantities as applicable.

Mounting Plate
The mounting plate shall be constructed of 12/16 gauge sheet steel, depending upon the fan size and finished with baked enamel paint of approved shade. The mounting plate construction shall be of streamlined venturi inlet type (reversed for supply application). Orifice ring shall be correctly formed by spinning or a stamping to provide easy passage of air without turbulence & to direct the air stream.

Fan Blades

Fan blades shall be constructed of aluminum or steel. Fan hub shall be of heavy welded steel construction with blades bolted to the hub. Fan blades shall be quiet in operation and shall be statically and dynamically balanced at the factory.

Shaft
Shall be of steel (EN 8), accurately ground and shall be of ample size for the load transmitted and shall not pass through first critical speed through the full range of specified fan speeds.

Motor
Shall be standard energy efficient (easily replaceable) permanent split capacitor or shaded pole for small sizes, totally enclosed with pre-lubricated sleeve or ball bearings, designed for quiet operation with a maximum speed of 750 RPM and. will be suitable for 415 +/- 10% volts, 50 cycles, 3 phase supply and shall be suitable for either horizontal or vertical service, as indicated on drawings and BOQ.

Accessories
The following accessories may be required and provide with propeller fans as indicated in the BOQ:

Wire guard on inlet side and bird screen at the outlet.
Fixed or Gravity operated steel louver shutters built into a steel frame.

Regulators for controlling fan speed for single phase fan motors.
Single phase preventers for 3 phase fans

13.0 ROAD TUNNEL VENTILATION:

13.1 System Description and Function and Responsibilities

The contractor shall provide a turn key Road Tunnel ventilation system that is consistent with the scheme as indicated on the drawings. The proposed scheme utilizes Jet fans and CO sensors. The system shall serve both CO evacuation and smoke extract function.

The contractor shall provide a full engineering proposal that includes the following information for review by the Engineer, Architect & EIC.

CFD models for Tunnel allowing 3 numbers runs each for CO and Smoke Extract mode.

Specification, manufacturer's data and performance data for all devices and equipment to be utilized in the system.

Control schematic for operation of the system.

All ancillary devices such as motorized dampers, silencers, smoke detectors, CO detectors, etc. those are required to ensure proper system operation in both the CO and smoke modes.

All necessary devices that are required to interface with the base building systems such as fire alarm detection and BMS etc.

The system principles are as follows: Fully automatic smoke control. Lower the air temperatures during fires. Improved firefighting access. High air movement preventing fire spread. Efficient cross ventilation.

13.2 CO-Detection

The car park ventilation systems shall be controlled by an individual CO-Monitoring system for entire car park located on each level to optimize efficiency. The contactors within the motor control panel shall be controlled by a Carbon Monoxide monitoring panel which shall contain D.D.Cs (Direct Digital Controllers) where the pre-determined switching strategy and logic will be loaded. The CO monitoring panel shall receive signals from CO sensors located throughout the levels at a spacing of no. more than 1 per 350 m2. The 24V AC power supply for the CO sensors shall be mounted in the same panel. The power supply shall be looped across the CO sensors. The proposed CO sensor shall provide a 0-10 VDC signal for measuring the CO level in the car park area.

CO monitoring devices shall be mounted remotely throughout the basement. The devices shall be mounted in accordance with the manufacturer's guidelines but no greater than 1.5 m above FFL.

The contractor should refer to the specific requirements of the sensor supplier for quantities of CO-detectors. The minimum design requirement shall ensure a simple CO-detector covers a maximum area of 350 sqm.

13.3 CO Sensor

The sensor shall be suitable for wall mount & capable of following features:

Digital display of the CO level : 0 to 200 ppm Analog output : 4 to 20 mA Low Voltage operation : 24 VAC / VDC Wall Mount Configurations

Test Switch : Provides mode for system self-test. Automatic Calibration (Field Calibration Kit) Overrange indication.

Start-up mode : steps display and output through test ranges. Operating range : within OSHA range for CO exposure.

Solid – Stat sensor : Life expectancy of 7 to 10 years. Multiple sensors with one power supply.

Carbon monoxide sensor shall comprise of a carbon monoxide meter and a 0-10 VDC transmitter an all-electronic system that utilizes a microprocessor to measure carbon monoxide (CO), calculate various calibration factors and analog output. The sensor shall average samples over a time period and update the output every 2 ½ minutes. The sensor is intended to be used in enclosed basement, where it provides CO data to building automation computers or controllers. A box shall house the sensor and provide an easy-to-mount, study housing for the system.

Sensors shall be mounted on walls or columns about 1500 mm above the floor. Sensors shall be evenly spaced and not put in corners, or directly in front of air inlets. Each sensor must have a cable directly to the control panel.

In addition to above CO-sensor shall comply with following :

Power	24 VAC / VDC @ 150 mA
Measurement range	0 to 200 ppm of CO (4-20 mA)
Electrical class	General Purpose, non-hazardous.

Operating temperature range 0 deg. To 125 deg.F (-18 deg. To 52 deg.C)

13.4 Fire / Smoke Detection

The Road Tunnel Ventilation system shall interface with the fire alarm control panel to receive signals from the detectors.

The Contractor shall be responsible for the full integration of the fire alarm and ventilation control systems.

13.5 Control Panels:

The manufacturers engineered solution shall allow for a stand-alone intelligent PLC control system for both CO monitoring and smoke control. Tunnel shall have individual PLC Control Panel. The PLC control system shall control all exhaust & supply air fans. The broad logic shall be as follows:

PLC based Logic panel shall be provided to receive signals from the Carbon Monoxide Detector panel and the Fire Control Panel which will contain DDC (Direct Digital Controller) to give command to Exhaust and Supply air fans for their operation on the basis of the logic provided to the PLC panel as shown below:-

Condition 1 : Under normal ventilation condition, air shall be drawn through all parts of the basement by the axial fans (operating at low speed) at a rate equivalent to 3 air changer per hours.

Condition 2: When the CO level rise beyond 25ppm the fan shall operate at higher speed to achieve the CO ppm level below 25 ppm.

Condition 3: If the CO level continues to rise to the high limit set value to 50ppm, the extract fans shall operate at high speed to provide a rate equivalent to 6 air changes per hour.

Condition 4: In the event that Smoke is detected in the Tunnel a priority Signal shall be provided by the fire detection panel .

13.6 Performance Data

All fans shall be selected for the lowest operating noise level. Capacity ratings, power consumption, with operating points clearly indicated, shall be submitted and verified at the time of testing and commissioning of the installation.

13.7 Testing

Capacity of all fans shall be measured by an anemometer. Measured air flow capacities shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

A. Performance Data

All fans shall be selected for the lowest operating noise level. Capacity ratings, power consumption, with operating points clearly indicated, shall be submitted and verified at the time of testing and commissioning of the installation.

B. 10.2 Testing

Capacity of all fans shall be measured by an anemometer. Measured air flow capacities shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

13.8 INSTALLATION

i) The Contactor shall supply all required bolts, base frame(wherever required), vibration isolators any other accessories and shall assure that the components are placed securely in proper position.
ii) Vibration isolators shall be provided with an efficiency of not less than 80%.

13.9 TESTING

All the fans shall be tested for performance at the factory and the following test results shall be furnished.

i)CFM
ii)Static pressure at the specified flow rate
iii)KW input to motor

13.10 **Jet Ventilation Fan**

Jet Fans, a part of ductless car park ventilation system, should be supplied as completely assembled before dispatched to the job site having characteristics as of high-performance ventilation with small air volume. Each unit shall consist of fan having inlet cones, protective screen, two silencers, terminal box & mounting arms or brackets.

Fan: Fan shall be axial flow type balanced dynamically and statically. The fans shall have adjustable aluminum impeller or shall be fully welded. The complete fan assembly with its Casing, impeller & motor (not only the motor or one of the items) shall be imported from manufacturer and certified as tested for 300 Deg C for 2 hours operation.

Casing: The Casing of Jet Fans shall be made of Hot Dipped Galvanized Steel with flanges at both ends.

Motor: The Motor shall run on the electrical power suitable for 50Hz. The Type of motor shall be suitable for 2 speed or single speed as specified in the BOQ.

Protective Guards: The fans shall have protection guards at inlet side.

Silencers: Noise level from Jet fan shall not exceed 52 dB(A) at 1 mtr distance. Silencers Casing should be rolled, pre-galvanized sheet steel with spun end rings incorporating tapped inserts for fixing.

Absorbent material used should be of acoustic grade mineral fiber with a layer of erosion resistant facing and must be further protected by a sheet of pre-galvanized perforated steel.

Minimum length of silencers should be 900mm.

13.11 VENTILATION SYSTEM SPECIFICATIONS:

The intent of this document is to specify the systems and equipment's for Ventilation system for basement service areas / car park areas.

The equipment schedule for the same is already provided above; the system shall be designed in accordance with the details provided under various schedules there in.

13.12 CODES AND STANDARDS

- All relevant codes as per BS for underground ventilation design shall be complied by the bidder.
- Duct Construction Standard as per IS :655 and applicable SMACNA Codes for ducting design, fabrication and installation
- NFPA compliance for fire safe HVAC design
- BMC Instruction

  The scope of this tender covers design, supply, installation, testing, commissioning and handing over of ventilation system for
  a. Basement Car park areas
  b. Utility Equipment Rooms

The area, air quantity requirement and the equipment's for the above compliance are mentioned under Schedule 1 and 2 above.

14.0 AIR CURTAINS

14.1 Scope:

The scope of this section comprises the supply, erection, testing and commissioning of fans conforming to these specification and in accordance with the requirement of bill of quantities.

14.2 Air Curtains

Proposed to trap the Air Conditioned air near entrances opening into AC areas, the Air Curtains shall be installed on the Non AC portion of the entrance/exit doors; the length of the curtain assembly shall exceed the actual width of the OPEN Door Portion for effective entrapment of conditioned air.

Curtains shall be CRCA Powder Coated with suitable color shade, Polymer Suction Grille.

Impellers shall be Aluminum material, statically/dynamically balanced, low noise operation, forward curved driven by Motor of reputed make, 240 V, Single phase and double ended shaft.

Housing
The self-supporting compact unit construction to be made of galvanized sheet steel. The housing and galvanized sheet metal should be of Zink plated (Z275) with a thickness of 35 um. Visible surfaces with high-quality plastic powder coated (polyester powder coating, 60 um) in a subtle gray and white combination of both RAL9016 and RAL7042. A dominant and timeless design, hinged front and front access panel, high-grade aluminum allows integrating technical detail for each input. With M8 nuts, the air curtain is simple and easy to mount on the wall or ceiling. Matching design panels for cable connections are available as accessories for every type of installation. For vertical installations of either single or several air curtains, vertical installation accessories are available for each specific needs and requirement.

Fans

Vibration-free individually driven, double inlet five -stage variable high performance centrifugal fans with external rotor motor for extremely quiet operation, IP 44, with accessible motor protection and thermal contacts with class B insulation and ensure low noise operation. The newly developed sound-absorbing lined air outlet pressure chamber provides the internal air flow for reduced emissions of the engine noise and the formation of a highly effective flow profile.

Inlet grille Integrated and located on top of the unit, not visible from below for hiding dust; guarantees a quiet slipstream.

Outlet grille
The streamlined grey powder coated outlet nozzle rod profiles, are lockable between 0 ° and 30 ° (in and out) and creates and provides a guided, aerodynamic air flow and high shielding effectiveness; Thermo zone Technology.

Electrical connection
The main control connection is mounted and located on the top of the device and easily accessible to its integrated control system and designed are according to ISO 9001:2000.

Control system
The provided control system should be an intelligent and adaptive control system, allowing and operating the installed air curtain with five different fan speed for being energy efficient as possible yet providing the best and most efficient air curtain effect. Including the control system, a calendar program can easily be set and adjusted according to each specific needs for the air curtain of operating without any manual handling. The air curtain can together with included and installed control system be also connected to either 0-10V or Modbus BMS system.

Certification
The air curtain must comply to EN and ISO standards valid for air curtains and tested and approved according ISO standards (ISO 27327-1), EN standards (EN 308; EN 12238; EN 60335) and AMCA standards (AMCA 210; AMCA 220-5; AMCA 300).

15.0 PAINTING - COLOUR CODE.

All **Equipments** shall be supplied with approved finish. Shop coat of paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with two coat of synthetic enamel paint. Pump base-plate / piping supports subject to water exposure to be painted with rubber paint using zinc base primer. Water treatment Units to be painted with anticorrosive paint / CGC, as exposed to acid and caustic solutions.

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 synthetic enamel paint of approved shade.

All exposed condenser water piping shall be applied with cold galvanizing spray / paint.

15.1 Standard colour code:

The tentative colour code given below shall be followed. However changes if any will be indicated well in advance. All painting colour code shall be approved before execution. No separate payment shall be made for painting work.

Item :	**Colour:**
▪ Condenser, Pumps, Belt guards	▪ Battleship Grey
▪ Motors	▪ Siemens Grey
▪ Chiller	▪ Dark Blue
▪ AHU	▪ Mulshell Grey
▪ POT Strainers	▪ Grey
▪ B.M Valve / Copper Line	▪ Golden
▪ Gauge Panel / MP panel	▪ Siemens Grey
▪ Chilled water Line –	

In let / Return / & storage tank	▪ Light Blue
Out let / Supply	▪ Dark Blue
▪ All supports / Stands / drain	▪ Black
▪ Condenser water piping	
In let / Return / & storage tank	▪ Light Green
Out let / Supply	▪ Dark Green
▪ Cooling Towers	▪ Light Green
▪ Ducting / Grilles / Diffusers	▪ Approved by DTA

All "Approved shade" shall be duly approved by DTA.

16.0 INSPECTION AND TESTING:

16.1 Inspection (pre-dispatch & site), testing & acceptance

Pre-dispatch inspection shall be carried out for certain items. All the system equipment, parts shall be checked for physical damage, before commencing the installation work. Complete fabrication, installation and commissioning work shall be jointly supervised and shall be carried out as per the specifications and instructions of site Engineer In-charge. All the rotating equipment shall be checked for static and dynamic balancing, minimum operating vibration and noise.

All the system / equipment shall be checked before / after satisfactory commissioning, at manufacturer's works / site as may be required for the approved technical specifications, performance data provided by supplier / manufacturer. Actual capacity of each equipment shall be calculated based on the test readings, recorded jointly, for design conditions / operating conditions. Performance acceptance is subject to comparison of test results with supplier / manufacturer's performance data and contract specification. Acceptance is subject to satisfactory installation, commissioning and performance testing with respect to technical specifications. Rejected items must be replaced or rectified for the defects. In case of system modification / rectification complete performance tests are to be repeated. Site test readings shall be jointly recorded.

In general following Inspection / tests are involved. Type of test, duration of test, testing procedure / parameters, will be as per the applicable BIS codes. However the detail Inspection and test procedure shall be worked out jointly by the purchaser and the contractor along with the approval of drawings, within 30 days from the date of contact agreement.

a. Pre-dispatch Inspection.
b. Pre-dispatch testing at manufacturers shop / factory. (Material, performance, pressure, joints, etc.)
c. Physical Inspection – Pre-installation at site.
d. Performance testing at site (capacity, power consumption, pressure drop, vibration, etc.)
e. Calibration at site.

16.2 Test certificates:

Contractor shall furnish following Test certificates:

- Material testing of various components of the equipment/ system parts.
- Fabrication inspection / test certificates– Radiography and others
- Welder's qualification certificate.
- Performance test certificates carried out by manufacturer before Pre- dispatch inspection & testing.
- Performance test certificates carried out by manufacturer.
- Performance guarantees certificate / calibration certificate
- All equipment operation and maintenance manual.

16.3 Testing The Equipment's at Site:

The following aspects shall be considered for performance testing.

- Prevailing conditions shall be as close as to design conditions.
- Type, quantity, location, frequency, duration of test parameters shall be decided and recorded accordingly during the test.

- Rated capacity, power consumption, and other operating parameters shall be checked.
- Functional test for all Instruments, controls (safety and capacity) shall be carried out to check for the expected operation / action / accuracy / response time / repeatability parameters.

A. Units:
   - Main volts / Amps.

B. Compressor:
   - Refrigerant suction pressure (LP, Bar) / Temp. °C.
   - Refrigerant Discharge pressure (HP, Bar) / Temp. °C
   - Discharge cutout pressure (Bar)
   - Discharge cutin pressure (Bar)
   - Suction cutout pressure (Bar)
   - Suction cutin pressure (Bar)
   - Compressor motor Amp.

C. Cooling Coil:
   - Surface(Face) area - Sq.m
   - Return (entering coil) air Temp. DBT / WBT °C
   - Supply (leaving coil) air Temp. DBT / WBT °C
   - Air velocity across the cooling coil - m/min.
   - Air volume -CMH capacity

D. Air cooled Condenser:
   - Surface (Face) area - Sq.m
   - Air Temp. In - DBT °C
   - Air velocity across the coil - m/min.
   - Air Temp. at Fan outlet - DBT °C
   - Air Temp. at Grilles, Supply Duct outlets - DBT °C
   - Air volume -CMH at Supply Duct outlets
   - Air volume – CMH at fresh air intake

E. Room Conditions:
- Average reading of DBT / WBT °C, at 12-00 PM, 14-00 PM, and 16-00 PM on a test (summer / monsoon) day, shall be recorded to check the inside / room design condition.

17.0 SUPPORT STRUCTURE:

17.1 Support from RCC slab

17.1.1 DUCT SUPPORTS

Description

The Duct should be simply supported by Support Channel made up of cold rolled steel of quality **DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1**.

The Support channel should be **pre galvanised with minimum GSM of 120** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.

The Threaded Rods used for the suspension of the Duct should be made up of **partially annealed** medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard.**
The Drop-in anchors used for the suspension of the rods should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

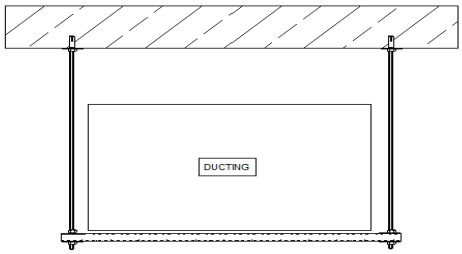
It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.

Supporting DETA (European Technical Approval) ils for low pressure systems are given below

Larger Side of Duct mm	Support Channel mm	Vertical Rod Día mm	Maximum Spacing between supports mm
0-600	27x18x1.2	M8	2400
601-1250	38x24x2	M8	2400
1250-2100	38x40x2	M10	2400
2100 and above	40x60x2.5	M12	2400

Fig.A. Typical Arrangement for Duct Supports from RCC slab



17.1.2 **CHW pipe / ref. pipe support:**

Description

The CHW Pipes should be simply supported by **Split Clamps with rubber support insert.**

Split Clamps should be as per **DIN 3567** pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

Rubber support insert should be made from **EPDM or NR/SBR Rubber**
The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp and rubber support insert should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1.**

The Support channel should be **pre galvanised with minimum GSM of 120** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.

The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade **4.8 strength class and as per DIN 976 standard**.

The Drop-in anchors used for the suspension of the rods should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

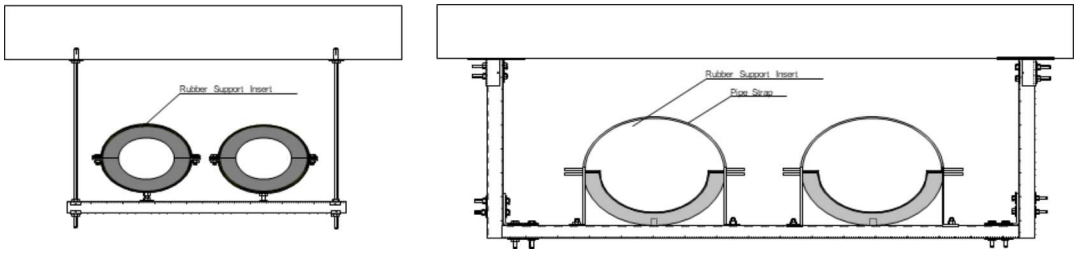
It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

Maximum Support Spacing (m)

Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)
Upto 15	1.8	65	3.7	250	5.0
20	2.4	80	3.7	300	6.1
25	2.4	100	3.7	350	10.0
32	2.7	125	3.7	400	10.5
40	3.0	150	4.5	450	11.0
50	3.0	200	5.6	500	12.0

Fig B. Typical Arrangement for Pipe Supports from slab



17.1.3 **Drain pipe support**

Description

The Drain Pipes should be simply supported by **Split Clamps**.

Split Clamps should be pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.

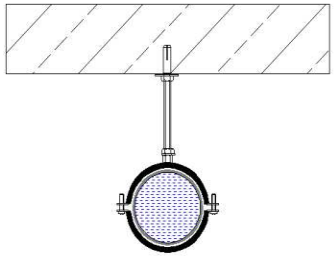
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

The Drop-in anchors used for the suspension of the rods should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

Maximum Support Spacing (m)					
Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	1.0	32	1.0	65	1.2
20	1.0	40	1.0	90	1.4
25	1.0	50	1,1	80	1.5

Fig C. Typical Arrangement for Drain Pipe Supports from slab



17.2 **Support from building shaft**

17.2.1 **DUCT SUPPORTS**

Description

The Duct should be simply supported by Support Channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1**

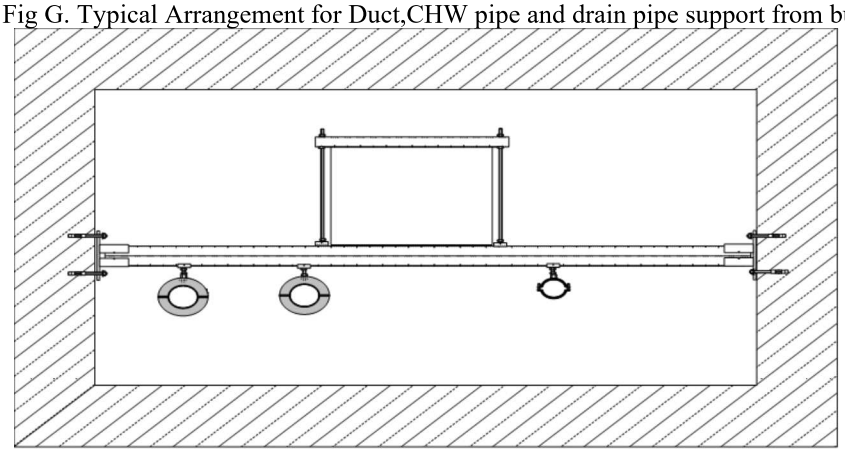
The Support channel should be **pre galvanised with minimum GSM of 120** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.
The Threaded Rods used for the suspension of the Duct should be made up of **partially annealed** medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard.**

The Drop-in anchors or stud anchor used for the suspension of the rods should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.
The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.
Supporting DETA (European Technical Approval) is for low pressure systems are given below

Larger Side of Duct mm	Support Channel mm	Vertical Rod Dia mm	Maximum Spacing between supports mm
0-600	27x18x1.2	M8	2400
601-1250	38x24x2	M8	2400
1250-2100	38x40x2	M10	2400
2100 and above	40x60x2.5	M12	2400

Fig G. Typical Arrangement for Duct,CHW pipe and drain pipe support from building shaft



17.2.2 **CHW PIPE / REF. PIPE SUPPORT:**

Description

The CHW Pipes should be simply supported by **Split Clamps with rubber support insert.**

Split Clamps should be as per **DIN 3567** pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

Rubber support insert should be made from **EPDM or NR/SBR Rubber**
The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp and rubber support insert should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1.**

The Support channel should be **pre-galvanised with minimum GSM of 120** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.
The Threaded Rods used for the fixing Pipe clamp with channel that should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

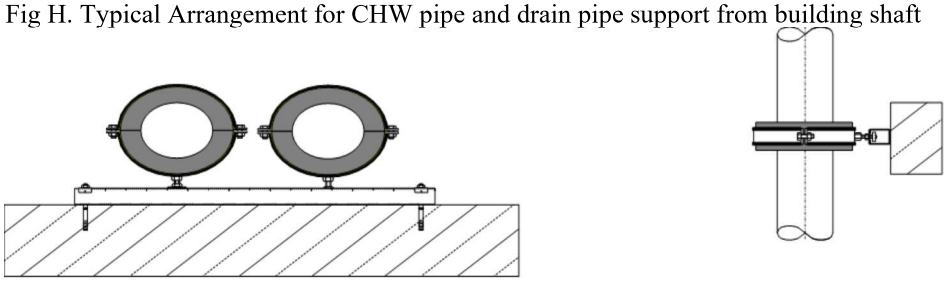
The Drop-in anchors or stud anchor used for the channel fixing with shaft that should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

Maximum Support Spacing (m)					
Nominal Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	1.8	65	3.7	250	5.0
20	2.4	80	3.7	300	6.1
25	2.4	100	3.7	350	10.0
32	2.7	125	3.7	400	10.5
40	3.0	150	4.5	450	11.0
50	3.0	200	5.6	500	12.0

Fig H. Typical Arrangement for CHW pipe and drain pipe support from building shaft



17.2.3 **Drain pipe support**

Description
The Drainpipes should be simply supported by **Split Clamps**.

Split Clamps should be pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard.**

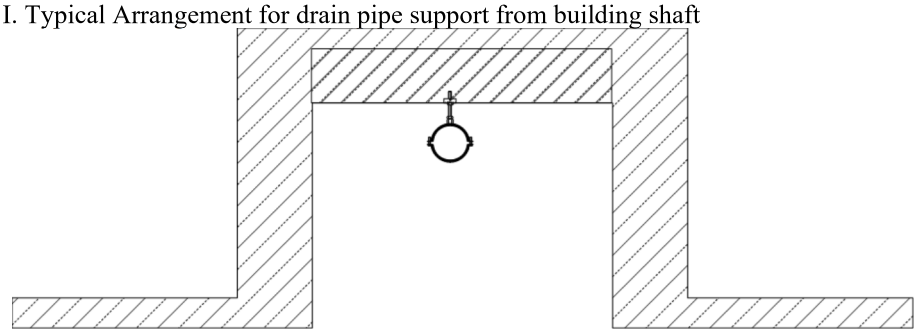
The Drop-in anchors or stud anchor used for the suspension of the rods should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

Maximum Support Spacing (m)

Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)
Upto 15	1.0	32	1.0	65	1.2
20	1.0	40	1.0	90	1.4
25	1.0	50	1,1	80	1.5

Fig I. Typical Arrangement for drain pipe support from building shaft



17.3 **Support on terrace**

17.3.1 **DUCT SUPPORTS**

Description

The Duct should be simply supported by Support Channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1**

The Support channel should be **pre galvanised with minimum GSM of 120** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.
The Threaded Rods used for the assembly of channel structure that should be made up of **partially annealed** medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard.**

The Drop-in anchors used for the fixing channel with terrace that should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

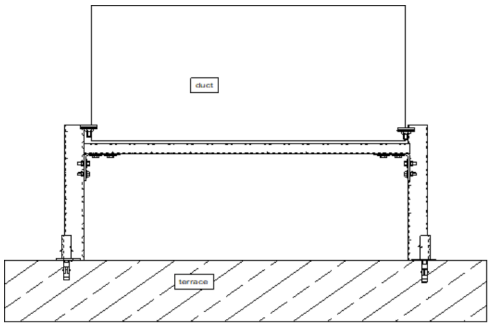
It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.

Supporting DETA (European Technical Approval)ils for low pressure systems are given below

Larger Side of Duct mm	Support Channel mm	Vertical Rod Dia mm	Maximum Spacing between supports mm
0-600	27x18x1.2	M8	2400
601-1250	38x24x2	M8	2400
1250-2100	38x40x2	M10	2400
2100 and above	40x60x2.5	M12	2400

Fig J. Typical Arrangement for drain pipe support on terrace



17.3.2 **CHW pipe / ref. pipe support:**
Description

The CHW Pipes should be simply supported by **Split Clamps with rubber support insert.**

Split Clamps should be as per **DIN 3567** pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

Rubber support insert should be made from **EPDM or NR/SBR Rubber**

The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp and rubber support insert should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1.**

The Support channel should be **pre-galvanised with minimum GSM of 120** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.
The Threaded Rods used for the connecting clamp and channel that should be made up of partially annealed medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard**.

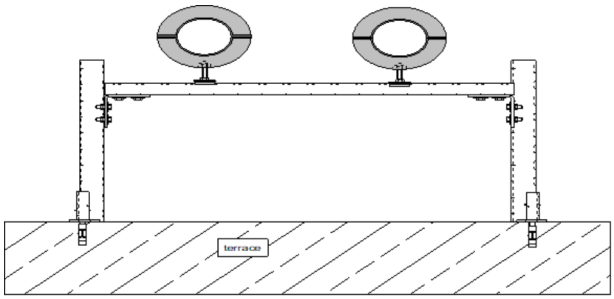
The Drop-in anchors used for the fixing channel with terrace that should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

Maximum Support Spacing (m)					
Nominal Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	1.8	65	3.7	250	5.0
20	2.4	80	3.7	300	6.1
25	2.4	100	3.7	350	10.0
32	2.7	125	3.7	400	10.5
40	3.0	150	4.5	450	11.0
50	3.0	200	5.6	500	12.0

Fig K. Typical Arrangement for CHW pipe support from on terrace



17.4 **Drain pipe support**

Description

The Drain Pipes should be simply supported by **Split Clamps**.

Split Clamps should be pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

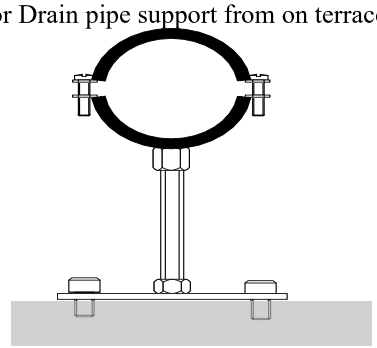
The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard**.
The Drop-in anchors used for the Fixing base plate, should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

Maximum Support Spacing (m)					
Pipe Dia (mm)	**Support Distance M)**	**Nominal Pipe Dia (mm)**	**Support Distance M)**	**Nominal Pipe Dia (mm)**	**Support Distance M)**
Upto 15	1.0	32	1.0	65	1.2
20	1.0	40	1.0	90	1.4
25	1.0	50	1,1	80	1.5

Fig L. Typical Arrangement for Drain pipe support from on terrace



17.5 **Support from WALL**

17.5.1 **DUCT SUPPORTS**

Description

The Duct should be simply supported by Support Channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1**

The Support channel should be **pre galvanised with minimum GSM of 120** and should have universal mounting

slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.
The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.
The Threaded Rods used for the suspension of the Duct should be made up of **partially annealed** medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard.**

The Drop-in anchors or stud anchor used for fixing with wall that should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

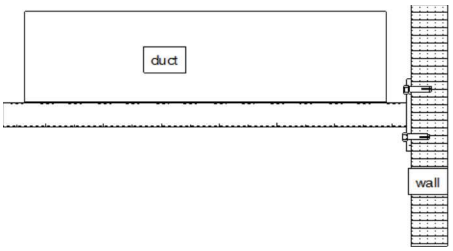
It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.

Supporting DETA (European Technical Approval) ils for low pressure systems are given below

Larger Side of Duct mm	Support Channel mm	Vertical Rod Dia mm	Maximum Spacing between supports mm
0-600	27x18x1.2	M8	2400
601-1250	38x24x2	M8	2400
1250-2100	38x40x2	M10	2400
2100 and above	40x60x2.5	M12	2400

Fig M. Typical Arrangement for Duct support from wall



17.5.2 **CHW pipe / ref. pipe support:**

Description

The CHW Pipes should be simply supported by **Split Clamps with rubber support insert.**
Split Clamps should be as per **DIN 3567** pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

Rubber support insert should be made from **EPDM or NR/SBR Rubber**

The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp and rubber support insert should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1.**

The Support channel should be **pre-galvanised with minimum GSM of 120** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.

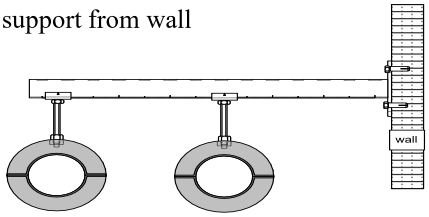
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard**.
The Drop-in anchors or stud anchor used for Fixing with wall that should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

Maximum Support Spacing (m)					
Nominal Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	1.8	65	3.7	250	5.0
20	2.4	80	3.7	300	6.1
25	2.4	100	3.7	350	10.0
32	2.7	125	3.7	400	10.5
40	3.0	150	4.5	450	11.0
50	3.0	200	5.6	500	12.0

Fig N. Typical Arrangement for CHW pipe support from wall



17.5.3 **Drain pipe support**

Description

The Drain Pipes should be simply supported by **Split Clamps**.

Split Clamps should be pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.

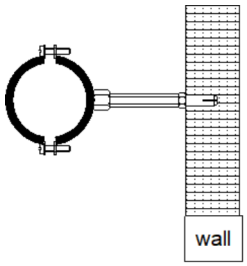
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard**.

The Drop-in anchors or stud anchor used for fixing with wall that should be **ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

Maximum Support Spacing (m)					
Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	1.0	32	1.0	65	1.2
20	1.0	40	1.0	90	1.4
25	1.0	50	1,1	80	1.5

Fig O. Typical Arrangement for Drain pipe support from Wall



18.0 PVC CONDUIT

All non-metallic PVC conduits shall conform to IS: 9537(Part - 3) and of FRLS type. The conduit shall be planed and of type as specified in IS: 9537 and shall be used with the corresponding accessories (Refer IS: 3419 specification for fittings for rigid nonmetallic conduits). Refer below table for detail specification of PVC conduit.

S. NO.	Characteristics	Reference 'IS'	Specified Requirement	Bidder to Fill
1	Construction	IS:9537 Part-3(1983)	Both the surfaces should be clean and free from burrs	
2	Durability of Marking	IS:9537 Part-3(1983)	It should be legible & durable & should not come out after rubbing with piece of cloth soaked in petrol.	
	Dimension	IS:9537 Part-3(1983)	Maximum OD: - need to be specified	
			Minimum OD: - need to be specified	
			Minimum ID: - need to be specified	
3	Compression Test	IS:9537 Part-3(1983)	% of Comp. Under load less than 25%	
			% of Comp. Without load less than 10%	
4	Impact Test	IS:9537 Part-3(1983)	There should be no crack and no sign of disintegration.	
5	Resistance to Heat	IS:9537 Part-3(1983)	Resistance of heat (Diameter of Ball Impression in MM at 60°C for 2 hours) less than 2.0mm	
6	Resistance to Burning	IS:9537 Part-3(1983)	Resistance to burning (Period of burning after removal of flame 30 sec) Flame dies out in time less than 30 sec.	
7	Electrical Strength	IS:9537 Part-3(1983)	Shall withstand 2000V AC for 15 minutes	
8	Insulation Resistance	IS:9537 Part-3(1983)	Applied Voltage: 500V DC for 60 sec and IR Min 100 Mega ohms.	
9	Temperature Index	Not applicable	Should be minimum 250˚ C	
10	Oxygen Index	Not applicable	Should be more than 21%	
11	Smoke Density	Not applicable	Should be less than 55%	

19.0 Make List

Sr.	Details Of Material / Equipment	Approved Manufacturers Name
1	Dx Ductable Split Ac / Wall Mount Split Ac	O-General / Daikin / Mitsubishi Electric/ Toshiba / Samsung /Blue Star
1	Air Curtain	Euronics / Eureka / VTS / Dolphy India
2	GI Ducting	SAIL / Tata / Jindal / Essar
3	MS Ducting	Tata / Jindal / Surya / SAIL / ALP Apollo
4	Insulation Material	
a	Nitrile Rubber	Aramacell / K Flex / ALP Aeroflex
b	Closed cell Nitrile rubber/EPDM	ALP Aeroflex/Armaflex/Aerocell/INNER flex
c	Open Cell Nitrile Rubbre Insulation	Aramacell / K-Flex / ALP Aeroflex
d	Expanded Polysterene / Extruded Polysterene	Owens Croning / Supreme Insuboard / Inner
5	Grilles / Diffusers / Dampers	Carryaire / Systemaire / Cosmos / Greehheck / Air Flow
6	Vibration Isolation.	Dunlop / Cori / Resistoflex / Easyflex / Vibrosolve
7	Refrigerant Pipe	Mandev / Mexflow / Totaline / Rajco
8	Drain Pipe / Pvc Pipe	Finolex / Ashirwad/ Supreme / Astral
9	Inline Fans / Centrifugal Fans	Kruger / System Air / Greenhec / Air Flow
10	Propeller Fans	Systemair/Kruger/Greenheck / Flaktswood / Air Flow
11	Tube Axial Flow Fan	Systemair/Kruger/Greenheck/Flaktswood / AirFlow
12	Dry Scrubber For Kitchen Exhaust Unit	Rydair / Trion / Halton
13	Air Washer Units	DRI / HMX / Ambiator
14	Flexible Canvass Connection	Airflow / Easyflex / Hira
15	Adhesive	Pidilite / ALP Aerostick / Inbond/Inner
16	Engineered Support	Mupro / Gripple / Valraven / Easy Flex / Inner
17	Anchor Fastner	Hilti / Fischer / Eq. Approved
18	PLC / DDC Controllers And Co Sensors	Siemens / Tac / Honeywell / Mitshubishi / Allen Bradly / Johnson Control
19	Jet Fans	Systemair/Kruger/Greenheck/Flaktswood / AirFlow
IMPORTANT NOTE		
1	1. THE SUCCESSFUL CONTRACTOR HAS TO OBTAIN APPROVAL FOR ALL THE SAMPLES / MAKES FROM THE CLIENT/CONSULTANT BEFORE USE. WITHOUT APPROVAL CLIENT HAS THE RIGHT TO ASK TO REMOVE THAT MATERIAL FROM THE SITE.	
2	2. THE APPROVED MAKES GIVEN ABOVE ARE APPLICABLE IN GENERAL. **HOWEVER FINAL APPROVAL HAS TO BE TAKEN FROM THE AMC & Consultants BEFORE EXECUTION OF ANY ITEM**.	
3	3. CLIENT HAS THE RIGHT TO CHOOSE ANY OF THE ABOVE MAKE OR ANY EQUIVELLENT MAKE OTHER THEN THIS AT THE TIME OF EXECUTION.	
4	4. THE SUCCESSFUL CONTRACTOR HAS TO PRIOR INFORM TO AMC IN ANY TENDER ITEM EXCESS FROM BOQ.	

20.0 Air Conditioning & Ventilation Annexures:-

Annexure I_ AC Annexure

Sr no.	Floor	Area Name	Sq Mtr.	Sq Ft.	Height Ft.	Occupancy	Fresh Air CFM	Cooling Load		HVAC System Proposed	Unit Type(Provision Only)	Capacity		Qty	Total CFM	Total TR	Ele. Load KW	VRF ODU SELECTION				
								CFM	TR			CFM	TR					VRV ODU Calculated (HP)	Qty	Selected total HP	VRF ODU System Tag	Ele. Load KW
1	Ground	Restaurant 1 (left)	109.52	1178	19.0	24	189	6101	11.9	VRV	Ceiling Suspended Unit	2800	8	2	5600	16	3.2	20	1	20		23.10
2	Ground	Restaurant 2 (left)	199.14	2143	19.0	43	343	5545	12.0	VRV	Ceiling Suspended Unit	2800	8	2	5600	16	3.2	20	1	20		23.00
3	Ground	Mercantile 1 (Left)	98.3	1058	19.0	21	169	2839	6.1	VRV	Ceiling Suspended Unit	2800	8	1	2800	8	1.6	10	1	10		11.50
4	Ground	Mercantile 2 (Left)	148	1592	19.0	32	255	3811	8.3	VRV	Ceiling Suspended Unit	2100	6	1	2100	6	1.2	8	1	14		9.20
												1400	4	1	1400	4	0.8	6				
5	First	Restaurant 3 (left)	121.07	1303	19.0	26	208	6456	12.6	VRV	Ceiling Suspended Unit	2100	6	3	6300	18	3.6	12	2	24		27.60
6	First	Mercantile 4 (Left)	181.69	1955	19.0	39	313	7563	15.3	VRV	Ceiling Suspended Unit	2800	8	1	2800	8	1.6	10	1	26		11.50
												2100	6	2	4200	12	2.4	16				
7	First	Mercantile 5 (Left)	111.42	1199	19.0	24	192	3429	7.3	VRV		2100	6	1	2100	6	1.2	8	1	14		9.20

Sr no.	Floor	Area Name	Sq Mtr.	Sq Ft.	Height Ft.	Occupancy	Fresh Air CFM	Cooling Load		HVAC System Proposed	Unit Type(Provision Only)	Capacity		Qty	Total CFM	Total TR	Ele. Load KW	VRF ODU SELECTION				
								CFM	TR			CFM	TR					VRV ODU Calculated (HP)	Qty	Selected total HP	VRF ODU System Tag	Ele. Load KW
											Ceiling Suspended Unit	1400	4	1	1400	4	0.8	6				
8	First	Mercantile 6 (Left)	135	1453	19.0	29	232	4647	9.6	VRV	Ceiling Suspended Unit	2100	6	2	4200	12	2.4	16	1	16		18.40
9	Second	Mercantile 7 (Left)	98.3	1058	19.0	21	169	3283	6.8	VRV	Ceiling Suspended Unit	2800	8	1	2800	8	1.6	10	1	10		11.50
10	Second	Mercantile 8 (Left)	148	1592	19.0	32	255	4381	9.3	VRV	Ceiling Suspended Unit	2100	6	2	4200	12	2.4	16	1	16		18.40
		TOTAL	**1350.4**	**14530.7**		**291**	**2325**	**48054**	**99.2**					**20**	**45500**	**130**	**26.3**		**11**	**170**		**163.4**
1	Ground	Restaurant 1 (Right)	109.52	1178	19.0	24	189	3320	7.0	VRV	Ceiling Suspended Unit	2800	8	1	2800	8	1.6	10	1	10		11.50
2	Ground	Restaurant 2 (Right)	199.14	2143	19.0	43	343	9537	18.9	VRV	Ceiling Suspended Unit	2800	8	3	8400	24	4.9	16	2	32		36.80
3	Ground	Mercantile 1 (Right)	98.3	1058	19.0	21	169	2839	6.1	VRV	Ceiling Suspended Unit	2800	8	1	2800	8	1.6	10	1	10		11.50
4	Ground	Mercantile 2 (Right)	148	1592	19.0	32	255	3811	8.3	VRV	Ceiling Suspended Unit	2100	6	2	4200	12	2.4	16	1	16		18.40

Sr no.	Floor	Area Name	Sq Mtr.	Sq Ft.	Height Ft.	Occupancy	Fresh Air CFM	Cooling Load		HVAC System Proposed	Unit Type(Provision Only)	Capacity		Qty	Total CFM	Total TR	Ele. Load KW	VRF ODU SELECTION				
								CFM	TR			CFM	TR					VRV ODU Calculated (HP)	Qty	Selected total HP	VRF ODU System Tag	Ele. Load KW
5	First	Restaurant 3 (Right)	121.07	1303	19.0	26	208	6456	12.6	VRV	Ceiling Suspended Unit	2800	8	2	5600	16	3.2	20	1	20		23.00
6	First	Mercantile (Right)	181.69	1955	19.0	39	313	7563	15.3	VRV	Ceiling Suspended Unit	2800	8	1	2800	8	1.6	10	1	26		11.50
												2100	6	2	4200	12	2.4	16				
7	First	Mercantile 1 (Right)	111.42	1199	19.0	24	192	3429	7.3	VRV	Ceiling Suspended Unit	2100	6	1	2100	6	1.2	8	1	14		9.20
												1400	4	1	1400	4	0.8	6				
8	First	Mercantile 2 (Right)	135	1453	19.0	29	232	4647	9.6	VRV	Ceiling Suspended Unit	2100	6	2	4200	12	2.4	16	1	16		18.40
9	Second	Mercantile 1 (Right)	98.3	1058	19.0	21	169	3283	6.8	VRV	Ceiling Suspended Unit	2800	8	1	2800	8	1.6	10	1	10		11.50
10	Second	Mercantile 2 (Right)	148	1592	19.0	32	255	4381	9.3	VRV	Ceiling Suspended Unit	2100	6	2	4200	12	2.4	16	1	16		18.40
		TOTAL	**1350.4**	**14530.7**		**291**	**2325**	**49265**	**101.3**					**19**	**45500**	**130**	**26.3**		**11**	**170**		**170.2**
		One Cluseter	**2700.9**	**29061.5**		**581**	**4650**	**97319**	**200.5**					**39**	**91000**	**260**	**52.7**		**22**	**340**		**333.6**

Sr no.	Floor	Area Name	Sq Mtr.	Sq Ft.	Height Ft.	Occupancy	Fresh Air CFM	Cooling Load		HVAC System Proposed	Unit Type(Provision Only)	Capacity		Qty	Total CFM	Total TR	Ele. Load KW	VRF ODU SELECTION				
								CFM	TR			CFM	TR					VRV ODU Calculated (HP)	Qty	Selected total HP	VRF ODU System Tag	Ele. Load KW
		Total for Three cluster	8102.6	87184.4		1744	13950	29195	61.6					117	273000	780	158.1		66	1020		1000.8

Annexure II_ Ventilation Annexure

Sr no.	Floor	Area Name	Ac / Non Ac	Sq Mtr.	Sq Ft.	Ht. Ft.	ACPH	Vent CFM	FA CFM	Total Numbers of Merchantile	Fan Selection	CFM	QTY.	Ele. Load KW	Total Ele. Load KW	Phase
1	Ground	Kitchen 1 (Left)	Vent	31	334	19.02	50	5288		3	Exhaust Fan with Dry Scrubber	5500	3	2.6	7.9	3P
									4230	3	Air Washer	4500	3	2.1	6.4	3P
2	Ground	Kitchen 2 (Left)	Vent	40.96	441	19.02	50	6987		3	Exhaust Fan with Dry Scrubber	7000	3	3.3	10.0	3P
									5590	3	Air Washer	5500	3	2.6	7.9	3P
3	First	Kitchen 3 (Left)	Vent	23.6	254	19.02	50	4026		3	Exhaust Fan with Dry Scrubber	4200	3	2.0	6.0	3P
									3221	3	Air Washer	3200	3	1.5	4.6	3P

Sr no.	Floor	Area Name	Ac / Non Ac	Sq Mtr.	Sq Ft.	Ht. Ft.	ACPH	Vent CFM	FA CFM	Total Numbers of Merchantile	Fan Selection	CFM	QTY.	Ele. Load KW	Total Ele. Load KW	Phase
4	Ground	Female TOI (Left)	Vent	19.5	210	19.02	10	665		3	Cabinet Type Exhaust Fan	6000	3	2.9	8.6	3P
5	Ground	Male TOI (Left)	Vent	27.1	292	19.02	10	925								
6	Ground	PH TOI (Left)	Vent	4.1	44	19.02	10	140								
7	First	Female TOI (Left)	Vent	19.5	210	19.02	10	665								
8	First	Male TOI (Left)	Vent	27.1	292	19.02	10	925								
9	First	PH TOI (Left)	Vent	4.1	44	19.02	10	140								
10	Second	Female TOI (Left)	Vent	19.5	210	19.02	10	665								
11	Second	Male TOI (Left)	Vent	27.1	292	19.02	10	925								
12	Second	PH TOI (Left)	Vent	4.1	44	19.02	10	140								
13	Ground	Electrical (left) - Upper	Vent	23.9	257	19.02	10	815		3	Propeller Type Fan	300	9	1.3	11.6	1P
14	Ground	Electrical (left) - Lower	Vent	14	151	19.02	10	478		3	Propeller Type Fan	300	6	0.9	5.1	1P
15	Ground	Kitchen 1 (Right)	Vent	31	334	19.02	50	5288		3	Exhaust Fan with	5500	3	2.6	7.9	3P

Sr no.	Floor	Area Name	Ac / Non Ac	Sq Mtr.	Sq Ft.	Ht. Ft.	ACPH	Vent CFM	FA CFM	Total Numbers of Mercha ntile	Fan Selecti on	CFM	QTY.	Ele. Load KW	Total Ele. Load KW	Phase
											Dry Scrub ber					
									4230	3	Air Washe r	450 0	3	2.1	6.4	3P
16	Groun d	Kitchen 2 (Right)	Vent	40.96	441	19.0 2	50	6987		3	Exhau st Fan with Dry Scrub ber	700 0	3	3.3	10.0	3P
									5590	3	Air Washe r	550 0	3	2.6	7.9	3P
17	First	Kitchen 3 (Right)	Vent	23.6	254	19.0 2	50	4026		3	Exhau st Fan with Dry Scrub ber	420 0	3	2.0	6.0	3P
									3221	3	Air Washe r	320 0	3	1.5	4.6	3P
18	Groun d	Female TOI (Right)	Vent	19.5	210	19.0 2	10	665		3	Cabin et Type Exhau st Fan	600 0	3	2.9	8.6	3P
19	Groun d	Male TOI (Right)	Vent	27.1	292	19.0 2	10	925								
20	Groun d	PH TOI (Right)	Vent	4.1	44	19.0 2	10	140								

Sr no.	Floor	Area Name	Ac / Non Ac	Sq Mtr.	Sq Ft.	Ht. Ft.	ACPH	Vent CFM	FA CFM	Total Numbers of Merchantile	Fan Selection	CFM	QTY.	Ele. Load KW	Total Ele. Load KW	Phase
21	First	Female TOI (Right)	Vent	19.5	210	19.02	10	665								
22	First	Male TOI (Right)	Vent	27.1	292	19.02	10	925								
23	First	PH TOI (Right)	Vent	4.1	44	19.02	10	140								
24	Second	Female TOI (Right)	Vent	19.5	210	19.02	10	665								
25	Second	Male TOI (Right)	Vent	27.1	292	19.02	10	925								
26	Second	PH TOI (Right)	Vent	4.1	44	19.02	10	140								
27	Ground	Electrical (Right)-Upper	Vent	23.9	257	19.02	10	815		3	Propeller Type Fan	300	9	1.3	11.6	1P
28	Ground	Electrical (Right) - Lower	Vent	14	151	19.02	10	478		3	Propeller Type Fan	300	6	0.9	5.1	1P
29	Ground	HT Panel Room	Vent	30	323	13.12	15	1059		1	Propeller Type Fan	300	3	0.4	1.3	1P
30	Ground	LT Panel Room	Vent	20	215	13.12	15	706		1	Propeller Type Fan	300	2	0.3	0.6	1P

Sr no.	Floor	Area Name	Ac / Non Ac	Sq Mtr.	Sq Ft.	Ht. Ft.	ACPH	Vent CFM	FA CFM	Total Numbers of Merchantile	Fan Selection	CFM	QTY.	Ele. Load KW	Total Ele. Load KW	Phase
31	Basement	PHE Pump Room Ventilation	Vent	189.6	2040	16.40	15	8364		1	Cabinet Type Exhaust Fan	8500	1	4.0	4.0	3P
									6692	1	Fresh air fan with Filter	7000	1	3.3	3.3	3P
		TOTAL		**811**	**8723**								**79**	**47**	**145**	

Annexure III_ Road Tunnel Ventilation Annexure

Sr.	Floor	Area Name	Area (Sq.Ft)	Height (Ft)	Ventilation CFM		Fresh Air Selection	Jet Fans	CO Sensors (Qty)	Exhause Fan Selection	Normal kW	Fire Mode KW
					Mormal Mode	Fire Mode	Normal /Fire Mode			Normal /Fire Mode		
					6 ACPH	12 ACPH						
1	Tunnel	Tunnel Area	64560	18.040	116466	232932	FA Through Ramp	30 Nos. 450mm Dia Jet Fans (1.7 KW during fire mode & 0.34 KW during normal mode)	15 Nos.	Exhaust Through Ramp	10.2	25.5
		Total	**64560**								**10**	**26**

Make of Material

Sr.	Details Of Material / Equipment	Approved Manufacturers Name
1	Dx Ductable Split Ac / Wall Mount Split Ac	O-General / Daikin / Mitsubishi Electric/ Toshiba / Samsung /Blue Star
1	Air Curtain	Euronics / Eureka / VTS / Dolphy India
2	GI Ducting	SAIL / Tata / Jindal / Essar
3	MS Ducting	Tata / Jindal / Surya / SAIL / ALP Apollo
4	Insulation Material	
a	Nitrile Rubber	Aramacell / K Flex / ALP Aeroflex
b	Closed cell Nitrile rubber/EPDM	ALP Aeroflex/Armaflex/Aerocell/INNER flex
c	Open Cell Nitrile Rubbre Insulation	Aramacell / K-Flex / ALP Aeroflex
d	Expanded Polysterene / Extruded Polysterene	Owens Croning / Supreme Insuboard / Inner
5	Grilles / Diffusers / Dampers	Carryaire / Systemaire / Cosmos / Greehheck / Air Flow
6	Vibration Isolation.	Dunlop / Cori / Resistoflex / Easyflex / Vibrosolve
7	Refrigerant Pipe	Mandev / Mexflow / Totaline / Rajco
8	Drain Pipe / Pvc Pipe	Finolex / Ashirwad/ Supreme / Astral
9	Inline Fans / Centrifugal Fans	Kruger / System Air / Greenhec / Air Flow
10	Propeller Fans	Systemair/Kruger/Greenheck / Flaktswood / Air Flow
11	Tube Axial Flow Fan	Systemair/Kruger/Greenheck/Flaktswood / AirFlow
12	Dry Scrubber For Kitchen Exhaust Unit	Rydair / Trion / Halton
13	Air Washer Units	DRI / HMX / Ambiator
14	Flexible Canvass Connection	Airflow / Easyflex / Hira
15	Adhesive	Pidilite / ALP Aerostick / Inbond/Inner
16	Engineered Support	Mupro / Gripple / Valraven / Easy Flex / Inner
17	Anchor Fastner	Hilti / Fischer / Eq. Approved
18	PLC / DDC Controllers And Co Sensors	Siemens / Tac / Honeywell / Mitshubishi / Allen Bradly / Johnson Control
19	Jet Fans	Systemair/Kruger/Greenheck/Flaktswood / AirFlow
IMPORTANT NOTE		
1	1. THE SUCCESSFUL CONTRACTOR HAS TO OBTAIN APPROVAL FOR ALL THE SAMPLES / MAKES FROM THE CLIENT/CONSULTANT BEFORE USE. WITHOUT APPROVAL CLIENT HAS THE RIGHT TO ASK TO REMOVE THAT MATERIAL FROM THE SITE.	
2	2. THE APPROVED MAKES GIVEN ABOVE ARE APPLICABLE IN GENERAL. **HOWEVER FINAL APPROVAL HAS TO BE TAKEN FROM THE AMC & Consultants BEFORE EXECUTION OF ANY ITEM**.	
3	3. CLIENT HAS THE RIGHT TO CHOOSE ANY OF THE ABOVE MAKE OR ANY EQUIVELLENT MAKE OTHER THEN THIS AT THE TIME OF EXECUTION.	
4	4. THE SUCCESSFUL CONTRACTOR HAS TO PRIOR INFORM TO AMC IN ANY TENDER ITEM EXCESS FROM BOQ.	

Signature of Bidder