HVAC TECHNICAL SPECIFICATION

DESIGN PARAMETERS

Dry bulb	: 24.0 ^{0}C+/- 1.0 ^{0} C
RH	: 55 %, +/- 5% (Uncontrolled)
Occupancy Level	: As per ASHRAE/ISHRAE Standard/ Architectural
Lighting load	: As per ECBC 2007.
Fresh air load	: As ECBC 2017 / ASHRAE.
Assumed Equipment Load	: As per Architectural Drawing.

The HVAC System design base with reference to the Latest ASHRAE standard.

Ideal 'air conditioning' equipment should sanities cool, heat, humidify / dehumidify, evenly distribution air through the area and all; cost effectively.

The world focus has shifted **to the 'Environment'**. This is a new terminology,being used increasingly to focus on the **Indoor Air Quality (IAQ)** and its effect on human health.

CODES / STANDERDS

The design is based on the following standards, codes and/or regulations.

AMCA	:	Air Movement and Control Association
	-	Publication 200 "Air System"
	-	Publication 2011-90" Fans & Systems"
	-	Publication 301-90 Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
ASHRAE	:	American Society of Heating, Refrigeration and Air Conditioning Engineers.
	-	Fundamentals
	-	Refrigeration
	-	Applications
	-	Systems & Equipment
	-	Standard 52.1-92 Methods of Testing Air Cleaning Devices Used in General Ventilation.
SMACNA	:	Sheet Metal and Air Conditioning Contractors National
	-	Association. HVAC Duct Construction Standards "Metal &
	-	Flexible"
		Round Industrial Duct Construction Standards
	-	Rectangular Industrial Duct Construction Standards.

1.0 SCOPE OF WORK

The scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Schedule of quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Owner's site representative. The contractor shall furnish all labour, materials and equipment as listed under schedule of quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete air conditioning system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The Ventilation and Air-Conditioning system shall comprise of following:

- Variable Refrigerant Flow/Volume System
- Sheet metal ducts inclusive of external insulation, acoustic lining, canvas connections, silencers, volume control dampers and Fire dampers as required.
- Supply and return air diffusers, Grilles
- Insulation of pipes
- Vibration isolators for all HVAC equipment
- Wiring and earthing from MCC panels to various refrigeration, air conditioning and mechanical
  Ventilation equipment, control wiring and interlocking
- Cutting holes, chases and the like through all types of nonstructural walls, and finishing for all services crossings, including sealing, frame work, fire proofing, providing sleeves, cover plates, making good structure and finishes to an approved standard
- Balancing, testing and commissioning of the entire HVAC and mechanical ventilation installation
- Test reports, list of recommended spares, as-installed drawings, operation and maintenance manual for the entire HVAC installation
- Complete co-operation with independent commissioning agent (if any) and corrective actions on snag list points prepared by such independent commissioning agent
- Training of Owner's Staff.

2.0 DRAWINGS:

The HVAC Drawings issued with tenders, are diagrammatic only and indicate arrangement of

Various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of equipment, controls, grilles and diffusers. The contractor shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed. Maximum headroom and space conditions shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify the Architect/Consultant/Owner's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost.

The contractor shall examine all architectural, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the Owner's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Owner's site representative without additional cost to the Owner. The data given in the Drawings and Specifications is as exact as could be procured, butits accuracy is not guaranteed.

3. SHOP DRAWINGS

All the shop drawings shall be prepared on computer through Autocad System based on Architectural Drawings, site measurements and Interior Designer's Drawings.

4.0 TECHNICAL SUBMITTAL

It is the responsibility of the contractor to meet the entire intent & functional performance detailed in these specifications. Approved submittal shall only allow the contractor to proceed with material procurement and the installation and shall not be construed to mean that the contractor has satisfied the requirements of these specifications. The contractor shall submit three complete sets of documentation after award of the contract. Each submittal shall include a compliance statement mentioning any deviation taken from original specification. In addition, the contractor shall provide relevant calculation, technical data sheet, relevant catalogue, selection of equipment, installation manual etc for review and approval.

5.0 VARIABLE REFRIGERANT FLOW/VOLUME SYSTEM EQUIPMENT

5.1 SCOPE

The Scope of this section comprises the supply, erection, testing and commissioning of Variable Refrigerant Flow Air conditioning unit, conforming to these Specifications and in accordance with requirements of drawings and of the bill of quantities.

5.2 VRF/VRV SYSTEM

The system selected is a modular system, with number of indoors connected to centrally located outdoor units, as per detail designing given in the tender. The outdoor units for all the system shall be air cooled type and mounted on the same floor/ terrace of the building. Indoor units in various areas shall be as per enclosed drawings / Bill of Quantities.

All the VRF/VRV air conditioners shall be fully factory assembled, wired, internally piped & tested. The outdoor unit shall be pre charged with first charge of **R 410A** refrigerant. Additional charge shall be added as per refrigerant piping at site. All the units shall be suitable for operation with 415 V + 10%, 50 Hz + 3%, 3 Phase supply for outdoor units & 220 V + 10%, 50 Hz + 3%, 1 Phase supply for in door units.

The VRF/VRV system shall provide stable, trouble free & safe operation, with flexibility of operating desired indoor units. The outdoor units must be capable of delivering exact capacity proportional to the number of indoor units switched on & the heat load in the air conditioned area. The proportional operation shall be achieved by varying speed of the compressor in the outdoor units / charge in compressor configuration or capacity as per load.

5.3 SPECIFICATION OF OUTDOOR UNITS

Outdoors units of the VRF/VRV system shall be compact air-cooled type.

All the compressors of the out-door units must be hermetically sealed scroll / Rotary type. Each module of outdoor unit must have all inverter compressor, suitable to operate at heat load proportional to indoor requirement / or by change in compressor configuration or capacity as per load.

"Anti-Corrosive" treatment for Al fins of Condenser Coils is mandatory. The treatment should be suitable for areas of high pollution and salt laden air.

Bidder has to furnish the Rated / De-rated capacity of the Indoor units, considering the refrigerant piping of respective outdoor units.

Back up operation, in case of failure of one of the compressors of outdoor unit, for single module outdoor units or failure of one of the modules in case of multiple module outdoor units shall be possible. The VRF outdoor unit shall always be supplying at least 33% of back up operation, of the full load capacity.

The entire operation of outdoor units shall be through independent remotes of indoor units. No separate Start/ Stop function shall be required.

Starter for the Outdoor Unit compressor shall "Direct on Line" type. Inverter compressor / or equivalent system of the unit shall start first & at the minimum frequency / capacity, to reduce the inrush current during starting.

Refrigerant control in the outdoor unit shall be through Electronic Expansion Valve. Complete refrigerant circuit, oil balancing/ equalizing circuit shall be factory assembled & tested.

Noise level of outdoor units shall not exceed 60 To 65 dB(A) measured horizontally 1 m away and 1.5 m above base level.

Outdoor units shall be complete with following safety devices:

- High pressure switch
- Fan driver overload protector
- Over current relay
- Inverter Overload Protector / Digital Protector
- Fusible Plug

Unit shall be supplied with

- Installation manual
- Operation Manual
- Connection Pipes
- Clamps

Units will use R-410 as Refrigerant / Equivalent Refrigerant gas.

5.4 INDOOR UNITS

CEILING SUSPENDED / HI-WALL UNIT

- In ceiling suspended unit use suitable supports to take care of operating weight of the unit, without causing any excessive vibration & noise. The cold air suppliedby these units will be supplied to the area to be air conditioned, through duct system specified in the tender.
- Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling/ heating as per the heat load of the room.
- The unit casing shall be Galvanized Steel Plate.
- Unit must be insulated with sound absorbing thermal insulation material, Glass Fiber. The noise level of unit at the highest operating level shall not exceed 45 dB (A), at a vertical distance of 1.5 m below the units with duct connected to the unit.
- The unit must be able to develop external static pressure of 25 mm, at the specified air quantities.
- Unit must have Thermal Fuse for fan motor protection, in case of motor heating.
- The unit will be connected in series to a suitable out door unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the bill of quantities.
- All units should be BMS compatible.
- The unit shall have automatic force shut down provision in case of fire on receiving signal from BMS System.

TREATED FRESH AIR UNIT

Treated Fresh Air Units (TFA) are also known as Fresh Air Handling Units (FAHU). Unlike Air Handling Units that are used to recirculate the air in an enclosed space, TFAs cater to large, fresh airflow and recovery needs by treating outdoor air using MERV-8 filters and condition it some degree using a cooling system.

5.5 REMOTE CONTROLLER

- Wired remote controller shall be supplied as specified in the “Bill of Quantities”
- The controller must have large crystal display screen, which displays complete operating status.
- The digital display must allow setting of temperature with 1 Deg C interval.
- Remote shall be able to individually program by timer the respective times for operation start and stop
- Within a maximum of 72 hours.
- Remote must be equipped with thermostat sensor in the remote controller that will make possible more comfortable room temperature control.
- The remote shall be able to monitor room temperature & preset temperature by microcomputer & can select cool/ heat operation mode automatically.

- The remote must constantly monitor malfunctions in the system & must be equipped with a "self-diagnosis function" that let know by a message immediately when a malfunction occurs.
- It shall be possible to wire the remote up to 500 RMT.

DX HI-WALL UNIT WITH SEQUENCIAL TIMER

DX Hi Wall Type indoor unit with Outdoor unit. The condensing outdoor unit shall be scroll / rotary type compressor operation on refrigerant R- 410A suitable for operation on 230v / 415 v, 50Hz, 1Phase Phase AC supply. Unit shall comprise of Air cooled condenser, condenser fan-motor unit, integral refrigerant copper piping, controls and accessories such as refrigerant shut off valves at compressor and liquid refrigerant outlet, filter dryer, minimum 3 to 4 row deep copper tube and Aluminium fin type cooling coil, factory provided insulated copper piping, cabling between split unit and air cooled condenser, condensate drain, centrifugal blower with motor, HDPE washable return air filters, Electrical / electronic operating control module with all accessories, safety controls - HP/LP, overload protection, including all copper, power / control wiring, earthing, company provided cordless remote and unit should be compatible with sequential timer in 6 Hrs time interval. all other accessories etc complete**.**

5.6 WIRELESS REMOTE CONTROLLER

- Wireless remote controller shall be supplied as specified in the "Bill of Quantities"
- The same operation modes & settings as with wired remote controllers must be possible.
- Compact light receiving unit to be mounted into wall or ceiling shall be included.
- Units shall be supplied with followings:

a. Operation Manual

b. Installation Manual

c. Paper Pattern for installation

d. Drain hose / Clamp metal / Insulation for fitting / Sealing Pads / Clamps / Screws

5.7 HANDING OVER OF THE VRF/VRV SYSTEM

Following reading/ data shall be generated as a part of handing over of the VRF/VRV air conditioning system, apart from the handing over data for air side & indoor design conditions.

OUT DOOR UNITS

- Inlet temperature
- Discharge pipe temperature
- Suction pipe temperature
- Oil pressure
- Condensing Pressure
- Evaporating Pressure
- Power supply voltage
- Inverter compressor frequency

- Inverter current
- Fan operating current
- Total ODU current

INDOOR UNITS

- Indoor unit operation – On/ off from remote
- Indoor unit operation – On/ off from thermostat
- Remote control presser temperature
- Suction temperature
- Indoor liquid pipe temperature
- Indoor gas pipe temperature
- Electronic expansion valve opening
- Fan operating current

NOTE: Bidders are requested to submit power consumption details separately for Indoor & outdoor

5.8 REFREGERENT

We used R-410A is **a chlorine-free refrigerant** that meets the U.S. EPA's newest, most stringent environmental guidelines. R-410A was developed as an alternative to R-22 (Freon), which will be phased out over the coming years in response to international environmental concerns. R-410A is one of the most popular refrigerants on the market. This type of refrigerant is a hydro-fluorocarbon (HFC), which **does not deplete or damage the ozone layer**. Therefore, R-410A is used for the vast majority of residential air conditioners.

5.9 REFREGERENT PIPE

We used Soft and Hard copper pipe for refrigerant flow. Before filling the R-410A Refrigerant.it is Nitrogen testing of following nominal sizes of soft /hard drawn copper refrigerant piping for VRV/VRF system, complete with fittings, with suitable adjustable ring type hanger supports, jointing/brazing including accessories, insulated with XPLE Class-O tubular insulation/with Class-O closed cell elastomeric nitrile rubber tubular sleeves sections of specified thickness.

5.10 DRAIN PIPE

PVC Drain Piping Duly Insulated with Nitrile Rubber And BOPP Tape Of Following required size. Drain pipe installed with proper slop and leak testing.

6.0 SHEET METAL WORK

a) CODES AND STANDARDS

Ducts shall be made of Galvanized sheets & shall confirm to IS: 277. The duct construction shall be as follows:

b) RECTANGULAR / ROUND DUCT CONSTRUCTION

Max. Side	Type of joint	Bracing	
	GSS		
Up to 750	24 (0.63mm)	25mm QSS flanges	None
751 to 1500 MS angle	22 (0.80mm)	25 mm x 3 mm MS angle flange.	25 mm x 3 mm
1501 to 2250 MS angle	20 (1.00mm)	40 mm x 3 mm MS angle flange.	40 mm x 3 mm at 1.25 m centers.
2251 and above MS angle	18 (1.25mm)	40 mm x 3 mm MS angle flange.	40 mm x 3 mm at 1.25 m centers.

c) **HANGERS FOR DUCT** (as per SMACNA)

Duct size (mm)	Spacing (m)	Size of MS angle (mm x mm)	Sizeof Rod dia. (mm)
Up to 750	2.5	40 x 40 x 3	10
751 to 1500	2.5	50 x 50 x 3	12
1501 to 2250	2.5	50 x 40 x 3	12

d) DUCT INSTALLATION

All ducts shall be fabricated by using lock forming machine and installed in workman like manner, generally confirming to SMACNA 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 by using silicon sealant of Dow corning RTV 732 or equivalent make.

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 ceilingspaces, 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 and braced 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 confined the flow of air to and through the filters and fans, shall be constructed of 18 G GSS / 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 for beams, pipes, or other obstructions in the building shall make all necessary provisions and allowances, whether or not the same are shown on the drawings. Where necessary 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 asper 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 ofsite engineer.

All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of G.I. rods and angle iron.
Ducting over furred ceiling shall be supported from beams, after obtaining approval of site engineer. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other contractors work on the building.

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.

All straight ducts shall be factory fabricated & bend, tapers etc. to be done at site as per requirements.

Leak test for Duct work – Smoke/Light test shall be done to ensure the minimum duct leakage after completing the installation work. Also, this test shall be verified by Client representative at site. Silicon based sealant shall be used to seal the leakage in the duct.

Flexible Duct

Flexible round duct of insulated type shall be factory fabricated with an outer jacket enclosing 38 mm thick, glass fiber insulation around a continuous inner liner.

I Reinforcement: steel-wire helix encapsulated in the inner liner
ii. Outer jacket: polyethylene film
iii. Inner liner: polyethylene film

e) DAMPERS

Material – G.I.

All dampers shall be louver dampers of robust construction (MIN 16 G) 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.

g) SUPPLY AND RETURN AIR DIFFUSERS/GRILLES

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:
It 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:
It 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.

Linear Grille:

- Linear grille shall be extruded aluminium, powder coated, fixed blade type
- Grille shall be 6.5mm wide blade on a 15.5mm pitch, with blades available in 3 deflection angles 0°, 15°, 45°
- Grill shall be 25 mm of flange surface mounted
- Colour shall be as per approval of Architect
- Sample shall be approved by Architect before installation

Opposed blade damper (Box type):

- Opposed blade volume control damper shall be of light weight extruded aluminium frame & blade construction of powder coated type
- It shall be operable by key or screw driver
- It shall be of suitable size to fit into supply air grille/diffuser

6.1 METHOD OF MEASUREMENTS FOR AIR DISTRIBUTION SYSTEM

a) Sheet Metal work: Duct Length Shall be measured along the centre line from flange face to face unless otherwise stated. For tapered section duct, the average width & height shall be used to measure perimeter. Ductwork shall be measured on the basis of external surface area (length as measured above, multiply by duct perimeter) of ducts includingthe joints for each duct section. Duct measurement shall be taken before application ofthe 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 centre line. The quoted unit ratefor 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, straighteningvanes, and all other accessories required to complete the duct installation as per the specifications. These accessories shall not be separately measured nor paid for.

c) Testing and 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 restore 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.

d) Selection of Grilles/Diffusers shall be max. of 500 fpm / db 30.

DUCT INSULATION:

Duct acoustic lining: Acoustic material shall be fiberglass panel of 32Kg /cum density and thickness in BOQ.

Acoustic duct lining shall be applied inside the duct for a minimum distance of 3 meter or up to first outlet whichever is more. 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.

Or

ii) 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.

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

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

Or

iv) The aluminum perforated sheet shall be screwed along with G.I nut to give smooth inside surfaces. Use of nails shall not be permitted.

Thermal insulation on HVAC ducts shall be with:

Duct Insulation with class O Anti-Microbial Type Nitrile rubber having following Specification:
Insulation material shall be closed cell Elastomeric Nitrile rubber. Density of material shall be between 32 to 60 kg/m3. Thermal conductivity of elastomeric Nitrile rubber shall not exceed 0.033 W/mk at mean temperature of 0°C. Insulation material shall have anti-microbial product as an integral part of insulation that can be washed off or worn off. It shall give enhanced level of protection against harmful microbes such as bacteria, fungi. The Insulation materials should be with self-adhesive type & with Al.
Foil faced to protect against mechanical damage.

CABLE TRAY

Cable Tray with top cover for Terrace Level Refrigeration Piping are Hot Dipped G.I Perforated cable trays with GI Suspenders including couplers, Bends, Reduces and other accessories as required, and duly suspended from the ceiling with suspenders/Angle supports, fixed on ceiling/walls/false flooring on fasteners etc as per specifications complete as required. Size.

DISC VALVE

Supply/Exhaust air vent disc valve is preferable for small rooms/Toilet as a supply/exhaust air device, can be installed into ceilings. Ready-to-install component which consists of a frame ring with a linear bar, a core connected to the bar by with threaded spindle, and an installation subframe.

VENTILATION WORK

A - IN-LINE FAN:

1. Fans shall be single / double inlet, non-overloading type in line fans. The fan CFM, Static pressure, class, arrangement, width, direction of rotation, mode of discharge etc. shall be as indicated in the Drawings, Schedule of Quantities or as required.
2. Fan housing shall be constructed of at least 14 gauge sheet steel with angle stiffeners and base angles to ensure freedom from drumming and shall be suitable for operation at the maximum static pressure of the system.
3. wire mesh insect screen of 50 mm selves shall be provided at the fan suction, whenever the suction side is not ducted.
4. Impeller shall be keyed to the shaft and the impeller with shaft shall be statically and dynamically balanced.

B - CABINET FAN:

1. Fan shaft shall be constructed of SAE 1040 steel, turned ground and polished. Fan shaft shall provide excellent shaft to race fit for increased bearing life. Shaft shall not pass through first critical speed through the full range of specified fan speeds.
2. Shaft bearings of belt driven single inlet fans shall be truly aligned and rigidly mounted on a pedestal common to both bearings.
3. Double inlet double width fans should have a pedestal mounted bearing at each side of the fan. Bearings shall be ring oiling sleeve / ball / roller type designed for quite operation and shall be self aligning grease packed pillow block type.
4. Fans shall be driven by squirrel case including motor. Motor ratings are only tentative and where a fan requires a higher capacity motor, the Contractor shall clearly point out the requirements and make his offer accordingly. Motor ratings shall be at least 15% over limit load plus transmission losses.
5. Vibration isolation base shall be provided for all fans. Base for both fan and motor shall be built as an integral part of fan if required and shall be mounted on vibration isolating springs. The entire assembly shall be rested on PCC pads minimum 50 mm thick.

6. Heavy concrete foundations shall be provided if so recommended by manufacturers for purpose of dampening the vibrations. Prior approval of Engineer-in-Charge shall be obtained before ordering equipment if heavy concrete foundations are required.

7. Fans shall be tested for the performance and test results shall tally with the offered rating. Following test shall be carried out inside factory/ at site (witnessed by the Engineer-in-charge or his authorized representative.
   a. Fan capacity in CFM
   b. Static and total pressure at fan suction and discharge side.
   c. Fan speed.
   d. Fan motor power consumption.

C – WALL MOUNTED PROPELLER FAN

Wall-mount Propeller ventilation fans pull air outside from inside spaces. The fans help maintain indoor air quality by pulling in fresh air or exhausting out stale air from indoor spaces. They also may help regulate the indoor air temperature since they circulate the air. Louver's mount exhaust fans have built-in shutters that close when the fans turn off, which blocks out outside dust and other particles to enter the inside space.