# HVAC GUIDELINES FOR COMMERCIAL PROJECTS

## 1.0 OBJECTIVE & SCOPE OF DOCUMENT

These guidelines are intended to:

- Standardize 'HVAC' design process on commercial buildings.
- Achieve high energy efficiency.
- Low life cycle cost (with continued emphasis on optimizing capex (all paybacks within 2/3 years).
- Sustainable environment for building occupants

## 2.0 BASIS OF DESIGN

| | | | |
|---|---|---|---|
| 2.1 | Inside Temperature & Humidity | : | Indoor design conditions |
| | Office | - | 24 +/-1 ℃, 50% +/-10% RH. |
| | Conference/Meeting rooms | - | 24 +/-1 ℃, 50% RH. |
| | Corridor/Lobby | - | 25 +/-1 ℃, 50% RH. |
| | Banquet Hall / Pre function | - | 22 +/-1 ℃, 50% RH. |
| | Restaurant/Bar Lounge | - | 24 +/-1 ℃, 50% RH. |
| | Tel/IDF/MDF/AV room | - | 22 +/-2 ℃, 50% RH. |
| | Electrical (LT) room | - | 27 +/-1 ℃, 50% RH. |
| | Mechanical Plant rooms | - | 27 +/-1 ℃, 50% RH. (if AC provided) |
| 2.2 | Outside ambient conditions | : | ISHRAE Weather Data handbook |
| 2.3 | Occupancy | : | 55ft²/Person of P-line area of air-conditioned space |
| | | be | Occupancy in Food Courts and F&B to considered as per number of seats. |
| 2.4 | a) Equipment Loads | : | Please refer MEP -07 Policy (electrical Networking) |
| | b) Server Room | : | 45 W/ft² of server area (concept stage) |
| | c) Lighting load | : | Please refer MEP -07 Policy (electrical networking) |

2.5 Ventilation : Refer Below table

| Sr. No. | Description | Parameter | Standard Reference |
|---|---|---|---|
| 1 | Basement Ventilation[i] | Mechanical Ventilated 6 ACPH (Normal) & 12 ACPH in case of fire | NBC2016 |
| 2 | Smoke evacuation | 12 ACPH | |
| 3 | Mechanical plant room ventilation | 15 ACPH | |
| 4 | Pump Room Ventilation | 12 ACPH | |
| | | | |
| 5 | DG Room | 60 CFM / KVA rating of the Diesel generator (Air-Cooled) set | Manufacturer-based on maximum rise of 10ºC above ambient temperature |
| 6 | Transformer and other electrical panel rooms | 15 ACPH or air flow to maintain room temperature 5℃ above ambient (this should be based on the equipment heat load) | ASHRAE |
| 7 | Fresh air for office blocks | 5 cfm person + 0.06 cfm/ft² | ASHRAE 62.1 |
| 8 | Exhaust air rate from toilets in the core | 6-10 ACPH or 50 cfm per unit | ASHRAE 62.1 -2013/ NBC 2016 |
| 9 | Stairwell Pressurization | 50 Pa | NBC 2016 |
| 10 | Lift Well Pressurization | 50 Pa | NBC 2016 |
| 11 | Lift lobby pressurization | 30 Pa / 0.75 m/sec | NBC 2016 |

## 3.0 **Heat Load Calculation:**

3.1.1 Software-based Cooling load calculations must be performed for all projects. Manual calculations may be considered for concept level load estimations only. Internationally accepted software's such as IES, HAP, TRACE etc. or equivalent shall be used for the Detailed Design calculations.

3.1.2 The building envelope design parameters such as U-Value, Shading Coefficient etc. shall be obtained from Architect and a detailed Envelope Thermal Calculations sheet shall be prepared prior to finalizing the HVAC load calculations, during Detailed Design stage.

3.1.3 Following U values are to be achieved (recommended) with define scope of works and layer details along with R value for each layer.

| Sr. No. | Description | Value | Standard Reference |
|---|---|---|---|
| 1 | Exterior Wall Construction: | 2 W / (m²-°K) | ASHRAE 90.1-2010.( Please Note Design engineering consultant to submit the layer section along with R value to achieved said U value) |
| 2 | Exterior Wall Construction: Insulated wall | 0.705 W / (m²-°K) | |
| 3 | Roof Construction : Insulation above /Under deck | U-Value 0.26W / (m²-°K) | |
| 4 | Window to Gross wall ratio (Uniformly distributed on all sides) | 40% | Compulsory shading device for WWR if WWR>40% - if day lighting criteria not met |
| 5 | Maximum U-Value of the glazing | U-Value 2.2 W / (m²-°K) | Super ECBC |
| 6 | Maximum SHGC of the glazing | 0.25 | Super ECBC |

3.1.4 If dedicated Treated Fresh Air (TFA) units are provided to cool and dehumidify the outdoor fresh air to neutral conditions (indoor design conditions) or better, the fresh air heat load shall not be included in the cooling coil sizing of floor space air-conditioning units.

3.1.5 Air leakage/infiltration heat load should be included in the building/space load calculations if the building/space is not kept positively pressurized. The actual air infiltration load shall be calculated based on the fenestration/door designs, however shall be kept within a maximum of an equivalent of 0.75 L/s/m2 of building envelope area or 0.1 ACH whichever is smaller.

3.1.6 The design safety factor in calculations shall not exceed 10% for sensible load and 10% for latent load, for system sizing.

3.1.7 90% diversity to be applied in overall heat load calculations for individual floor /area.

## 4 SYSTEM DESIGN GUIDELINES

### 4.1.1 Selection of Cooling Plant:

a. The Design Basis Report (DBR) developed at the concept design stage shall include a techno-commercial comparison between various plant options such as air-cooled chillers, water-cooled chillers, VRF systems etc. to substantiate the selected plant type. Both the CAPEX and OPEX shall be analyzed along with other factors such as environmentally friendliness prior to finalizing the type of cooling plant.

b. It is recommended to avoid DX air-conditioning for larger developments/buildings i.e. more than 10,000 SQM excluding small spaces viz. guard room, server room, plant room etc.,

c. Water-cooled chillers are preferred over Air-cooled ones due to their better energy performance; however Air-cooled chillers may be specified for projects with a cooling load of 150 TR or less.

d. Chiller selection may be based on the following guidelines based on tonnage:

i. 50 TR – 200 TR - Scroll chillers

ii. 150 TR – 400 TR - Screw chillers

iii. 300 TR – 2500+ TR - Centrifugal chillers

Evaluation of cost savings in case of low rating Centrifugal chillers as compared to Screw Chillers shall be explored on case to case basis.

e. For large development projects consisting of multiple buildings, a feasibility study of Centralized Chiller Plant should be carried out during the concept design stage. Peak load sharing strategies such as Thermal Energy Storage (TES) also needs to be analyzed for its impact on CAPEX and OPEX savings.

f. Equipment configuration for chilled water plant to be N+1. Ideal chiller capacity selection shall be 25 to 33% of total load. Same to be verified w.r.t nearest standard model and space availability w.r.t specific application.

g. Dedicated chiller capacity to cater server load in night time operation to be considered if standby outdoor units are not allow at façade or building elevation.

**h.** All chillers should be specified with a minimum CHW design delta-T of 12 ℉. With 56 deg F as evaporative entering and 44 deg F as Evaporating exit temperature.

**i.** The chillers shall be specified with refrigerants having zero ODP and <2100 GWP. R-134a, R-410a, R-407C can be specified. For low pressure chillers R123 (and its variants) shall be acceptable.

**j.** Equipment certifications :-

**i.** Chillers - AHRI (ARI)

**ii.** Cooling Towers - CTI

**iii.** Fans - AMCA

**iv.** Sound attenuators – AMCA

**v.** AHUs – AHRI/EUROVENT

**vi.** Fire Dampers - UL

k. Evaporator fouling factor shall be limited to 0.0001 h.ft2.℉/Btu and the condenser fouling factor to 0.00025 h.ft2.℉/Btu. (AHRI Guidelines), for all water-cooled chiller systems.

l. Automatic chemical dosing for cooling tower make up water to be proposed for all commercial towers at design stage and the system to be proposed on Rental basis.

m. For chillers with capacities lower than 450TR the COP can be 5.8, and for capacities equal or higher than 450TR the COP shall be 6.3.

n. Condenser operating pressure to be limited to 12 bars.

o. All motors shall be minimum IE3 to get maximum efficiency. (Not applicable to emergency ventilation motors)

p. Standard I/O summary to be referred BMS compatibility of individual equipment for monitoring, controlling, and data points.

4.1.2 **Guidelines for Air Handling Equipment and Ducting Network:**

a) For large open plan offices, it is recommended to provide central Air Handling Units (AHU) in the respective floors within dedicated AHU rooms. Location and quantity of AHU rooms' needs to be determined based on the floor layout and total dehumidified air flow requirements.

b) Ceiling mounted Fan Coil Units (FCU) or dedicated terminal AC units may be provided for small spaces such as private office cabins, lift lobby conference/meeting rooms, retail units etc. Alternative use of VAV can be considered if one AC unit is feeding multiple offices/area in a zoned manner.

c) Pressure Independent Balancing & Control Valves (PIBCV) shall be used for all air handling units.

d) For large open offices with relatively large fenestration heat gain, it is recommended to provide a dedicated supply air ducting network for the floor perimeter area. VAV-controlled dedicated perimeter cooling allows the core area to have a lesser dense ducting network in addition to its offered operational energy savings.

e) Treated Fresh Air (TFA) shall be mixed with the space return air either in a mixing box or direct duct connections located before the cooling coil section of AHU. TFA shall not be fed directly into the space unless it is reheated to above room dew point levels.

f) The AHU fan selection shall be strictly based on ESP calculations. Necessary scope of works shall be included in the tender and contract documents.

g) Maximum allowable design duct velocities should be as follows:

| | | |
|---|---|---|
| Horizontal ducting (Main Duct) | - | 1200 -1500 FPM |
| Horizontal ducting (Branch Duct) | - | 800-1000 FPM |
| Vertical risers (Supply Air) | - | 1200-1500 FPM |
| Vertical risers (Extract/Pressurization Air) | - | 2000 FPM |
| Air terminal (should be select on DB level) | - | 400 FPM |
| HVAC Duct Friction | - | 0.08 inch / 100 feet |

h) AHUs installed in plant rooms and/or exposed to ambient conditions shall be of double-skin type with PUF- 50mm +/- 10 mm insulation and thermal break profile.

i) AHUs (where multiple offices are planned per floor) should be selected for 10% extra capacity on Air and chilled water side to have redundancy of using same AHU in case of change in Arch. Plans.

j) AHU room should be acoustic insulated with acoustic door; the noise level at 1m outside the AHU room should be 60 dBA..

k) In **Supremus** offices tenant AHUs or FCUs will not be provided by Lodha. The outdoor units or chilled water connectivity is provided by Lodha.

l) In **Signet** buildings Indoor and Outdoor units both will not be provided by Lodha, and a dedicated space to keep the Outdoor unit (suitably screened by Façade) will be provided to the owner/customer.

m) In **Excelus, iThink** office unit AHU will not be provided to tenants. The supply and installation of AHUs and room acoustic by respective tenant. However, if any of the project demands to provide AHUs to tenants then, The strategy of AHU deployment shall be as follows:

   i. We should exclude the supply and installation of AHUs from the main HVAC contract of a typical commercial building.

   ii. AHUs should be procured and installed by a separate contractor aligned with the fitout dates of the tenant. Cost of these works can be built in the tenancy.

      - No sunk cost due to changes
      - Deferred capex deployment - spend near use

- Right sizing as per tenant

iii. AHU typically require a 6 weeks delivery post order + 2 weeks ordering and 2 weeks
   - installation shall ideally overlap within the fitout duration (risk of delay, coordination with
   - fitout team, etc. shall be kept in mind)

iv. The building commissioning can happen without the AHUs.

v. We should maintain the AHUs of all leased assets (covered in CAM).

vi. Lodha shall provide the AHU room insulation, but engage another agency through a rate contract under the building facility management team who can do it as a last mile activity during the fit out stage.

vii. All AHUs and TFAs part of landlord scope to be provided with Ultraviolet germicidal irradiation (**UVGI**) system to disinfect the air from microorganisms.

4.1.3 **Cooling Tower Design Guidelines:**

a) The cooling tower approach shall be specified between 5.4 ℉ – 7.0 ℉.

b) Make sure the cooling tower's structural design meets the right standards to withstand local conditions and that the product is NBC (National Building Code) compliant. Cooling towers should be certified by an independent approval agency to confirm they meet specified design conditions such as wind load and seismic forces.

c) Specify induced-draft type counter-flow cooling towers with axial fan units, consider super low sound fans when specific low noise levels are needed.

d) Forced draft cooling towers can be installed in buildings without direct free vertical exhaust (i.e. where terrace or open to sky spaces are not available for cooling towers) .

e) Select or specify efficient cooling towers with power consumption of **<0.059** kW/TR.

f) Cooling towers with FRP casing are recommended owing to their excellent corrosion resistance, and structural integrity. FRP cooling towers also offer lesser maintenance costs and longer life span.

g) The fan motor shall be TEFC/TEAO direct-drive induction motors, IP55, IE3. Cooling towers fans shall be with VFD.

h) Makeup water tank shall be design for maximum 10 lits /Tr /hour for makeup water storage.

4.1.4 **Guidelines for Chilled Water Pumping Design:**

a) Variable Primary Flow (VPF) system shall be employed for all chilled water system. If other pumping systems are used, this shall be with prior approval from HOD Design-MEP.

b) Dedicated primary pumps should not be provided for each chiller in VPF systems, thereby offering potential OPEX and CAPEX savings. At part loads, this arrangement helps meeting the cooling load by running the optimum minimum number of pumps.

c) Since the control logic of VPF systems could be complex, this should be formulated at the earlier design stages itself with Pump OEM, design consultant and coordinated with the BMS/Controls design philosophy.

d) For chilled water piping networking, flow, Velocity, Valve station White paper on how to reduce friction loss in Chilled water to be referred.

| Sub Head | Unit | ECBC | ECBC+ | Super ECBC | Recommended |
|---|---|---|---|---|---|
| Variable Flow Primary pumps rated consumption | iKW/TR | 0.064 | 0.059 | 0.052 | 0.062 |
| Constant flow Primary pumps rated consumption + Secondary pumps rated consumption | iKW/TR | 0.064 | 0.059 | 0.052 | 0.064 |
| Constant flow Primary pumps rated consumption + Secondary pumps rated consumption | iKW/TR | 0.064 | 0.059 | 0.052 | 0.064 |

e) Select pumps on the ascending side of the efficiency curve. All pumps shall be non-overloading.

f) Pump selection shall be based on evaluation of system conditions, flow, efficiency and pump characteristics:

- In-line circulating pumps / close-coupled end suction pumps - </= 50 GPM
- Base-mounted end suction pumps - >50 and <500 GPM.

- Horizontal split case, double-suction pumps - >500 GPM.

g. Vertical in-line pumps may be used in applications with significant space constraint, however shall require prior approval from HOD Design-MEP.

h. Inert base-mounted pumps on minimum of 4" high concrete base equal or greater than 3 times total weight of pump and motor, with anchor bolts poured in place. Inertia bases can be considered for floating foundations. The selection of pumps shall be done considering the following table:

i. Differential Pressure Sensor (DPS) shall be located between the supply/return loops of the most remote (in terms of piping pressure drop) air handling unit. This arrangement also allows having the optimum control head for better operational savings. If the chilled water system has more than one network (e.g. tertiary) then DPS shall be provided in each network.

j. Provide pipe escutcheons with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish cast brass or sheet brass pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

k. Following table to be referred for chilled water piping sizing.

4.1.5 **Guidelines for Condenser Water Pumping Design:**

a. The condenser water pumps should be fixed flow type.

b. The operational control logic between condenser pumps, cooling tower fans and chilled water pumps should be finalized prior to developing the control diagrams of individual equipment's.

c. The design condenser water ΔT (range) shall be 10 ℉ with a condensing water supply temperature of 90 ℉ and a leaving condenser water temperature of 100 ℉.

d. Wet bulb temperature reset should be employed to control the condensing water supply temperature thereby providing better operational energy savings.

e. Only provision shall be made in piping for Automatic Tube Cleaning System (ATCS).

4.1.6 **Thermal Insulation:**

a. Recommended types of thermal insulation based on dia. of the chilled water pipes:

    a. <250mm – Nitrile Rubber

    b. >250mm – Phenolic Foam

b. Refrigerant pipes and air-conditioning ducts exposed to ambient conditions should be applied with vapor barrier coating and antifungals coating.

c. Temperature thereby providing better operational energy savings.

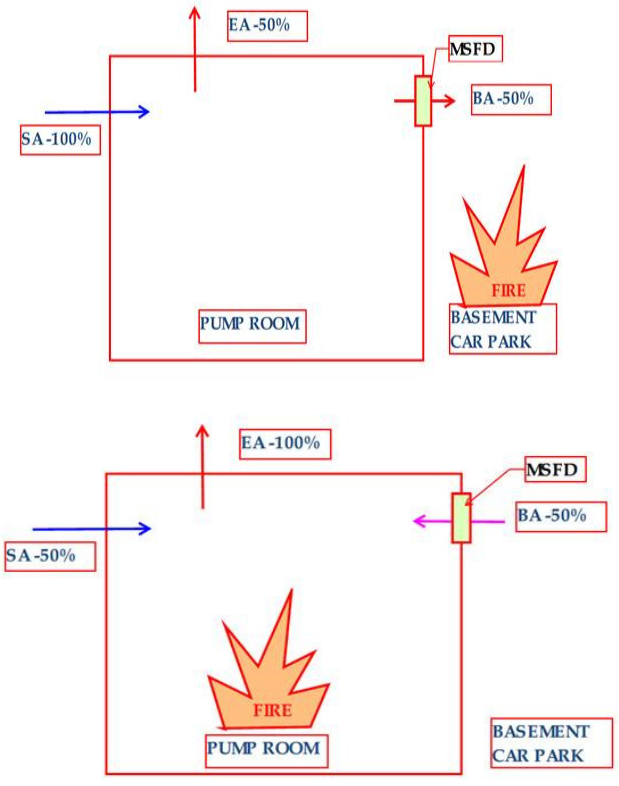
4.1.7 **Plate heat exchanger (in high rise buildings only):**

Hydraulic pressures due to height of commercial tower will impose standing pressure at the bottom most point. Added to this, would be pump pressures and dynamic pressures created by flow velocity (dynamic pressure). Thus it becomes essential to break chilled water circuit at appropriate elevation, so that system pressures are not excessive.

It is recommended to break this circuit with PHE and tertiary pump set at mechanical floor Mechanical floor would provide standing pressure of approx.10 to 12 kg/cm2g. Pumps, values etc. shall be selected so that their mechanical design ensures pressure withstanding capacity. Chillers would also be selected with care. Plate type heat exchanger will be designed for close $\Delta$T of 1.8 degF (1degC) to avoid penalty on chiller power consumption.

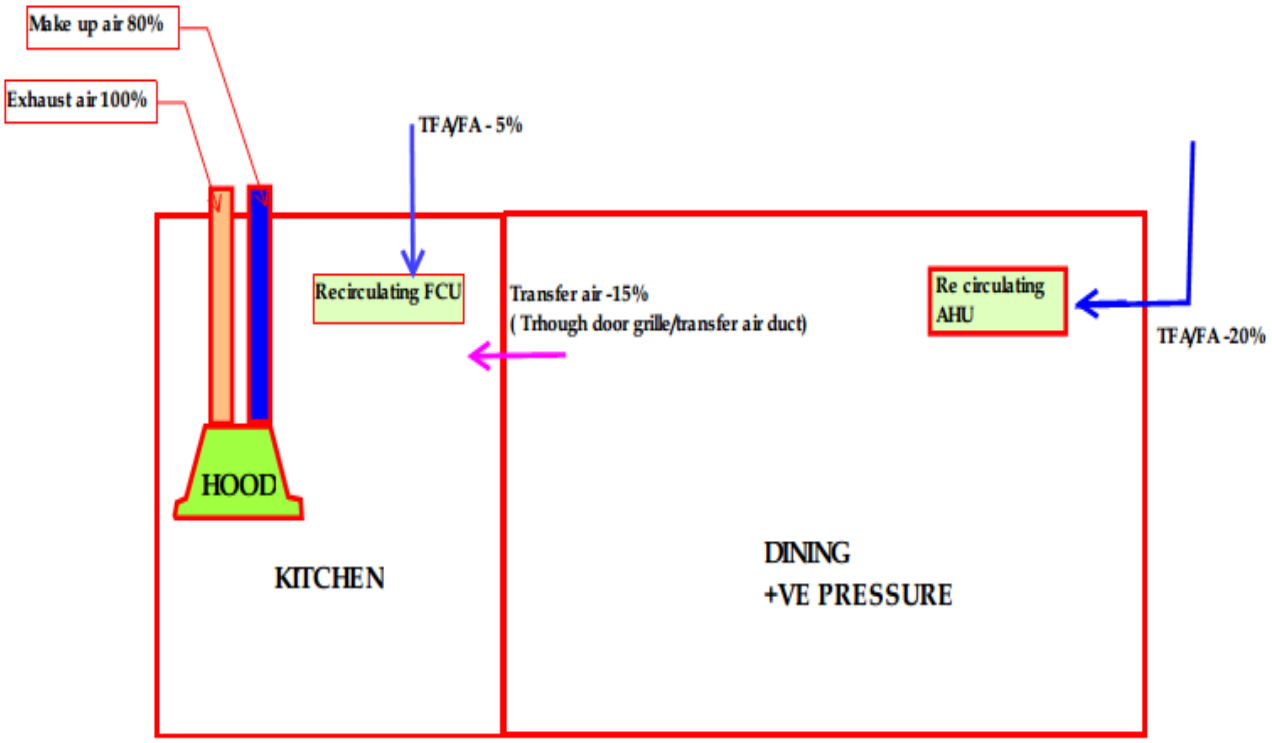
4.1.8 **General Points:**

1. Maximum velocity and friction loss for CHW pipe sizing to be specified.
2. Vibration isolators to be provided for pipe hangers/supports in plant rooms.
3. Channel drainage shall be provided in all chilled water pump rooms.
4. Ventilation of CHW plant room shall be ensured, however if the plant room envelope is exposed to atmosphere then air conditioning shall be provided via fan coil units with inside conditions of 27 degrees C.
5. Floating floor is suggested for the plant room located above KCAs.
6. Treated Fresh Air provisions shall be kept for the toilets, branch shall be taken from the central TFA duct.
7. It is recommend to consider two speed fans in pump room ventilation (where the pump rooms are in car parking basements) to operate in following scenarios, with MSFD. Pump room exhaust fans to be rated for smoke exhaust.



8. Basement ventilation fans are recommended to provide VFDs to reduce the noise level and energy conservations. VFDs can be avoided in GCP car parks, subject to proportionate cost increase in electrical infra limited within the VFD costs savings
9. Pressurization ducts can be of non-fire rated ducts. But if the duct is passing through different fire zones then same to fire rated for Type – A fire rating as per BS 476 pt 24 (1987) and ISO 6944 (1985).
10. Fire dampers to be located on the fire rated wall partition. Fire dampers away from the wall to be avoided. Fire damper shall never be rated less than the fire rating of the partition.
11. All equipment's to be ensured for bypass connection with valve to facilitate chilled water flushing.
12. CHW riser drain valve shall be provided at the bottom and shall be connected to the nearest storm drain.
13. BTU meters shall preferably be installed in common areas/easily accessible by FM team.
14. Type of air terminal to be agreed with architect/ID at concept/SD stage to avoid rework at later date. It is recommended to considered slit in cove for return air to minimize the diffuser/grille requirement in false ceiling.
15. Air curtain to be considered for the doors b/w conditioned and outdoor spaces to avoid condensation. It's also recommended to avoid supply air terminals near to windows and doors instead return air terminal is suggested.
16. Access door for indoor units to be sized as per the equipment size and additional allowance for filter and valve package accessibility during maintenance.
17. Outdoor units shall be located in well ventilated areas and same to be coordinated with architect during early stage of design.
18. Temporary access doors to be requested to access VCDs for initial balancing of the system.
19. Two speed impulse type Jet fans are recommended for basement ventilation system. Induction type can be used for height constrained areas with approval from HOC.
20. Starter for pressurization fans shall be DOL/Star delta type. Barometric pressure relief damper shall be considered to release the excess pressure from the zone.
21. For KCAs Roof Top package units can be explored to eliminate the need of AHU rooms, Access doors, and to achieve higher ceiling height, ease of maintenance access and reduced/no noise condition in conditioned space.
22. All masonry shaft which are used as pressurization shaft to be finished with cement plaster

23. Scrubber shall be considered for kitchen exhaust system. The motor shall be outside the air stream for exhaust air fan. The air balancing can be as suggested below. In case of leased F&B spaces Scrubber shall be in the scope of the tenant, same shall be covered in the tenant guidelines.




Note: - This policy updation (Rev15) shall be implemented as per Architectural policy no 122.