

*MODULAR
OPERATION
THEATRE
CONCEPT*

Ensuring a 100% Bacteria free environment

- Why is there a need for ***Modular Operating Rooms***?
- What are ***Modular Operating Rooms***?

Need For Modular Operating Rooms

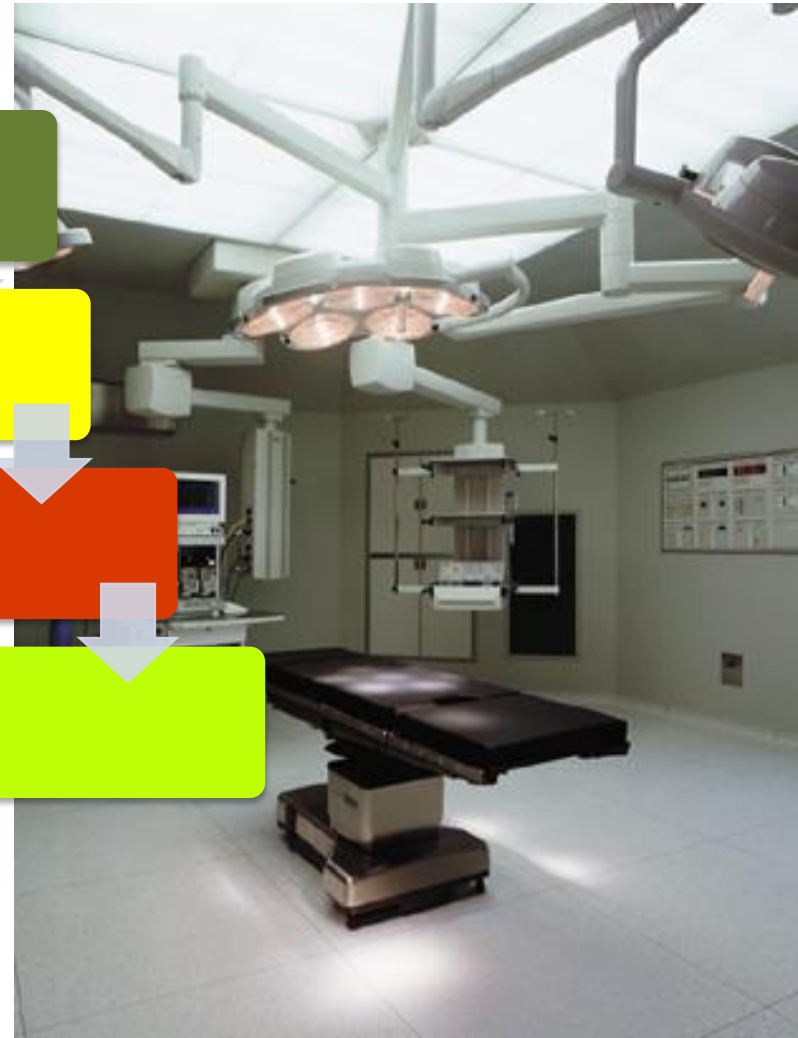
- **Sterility-** “To have complete infection free cases”

Bacteria count less than 10 carrying particles per m³ through state of the art laminar airflow system with air purity of 99.99%

Non- porous, Seamless, easily cleanable surfaces to prevent the build up of contaminants.

Reduction in the need or repetitive fumigation of MOT's.

Increase in Turn around time i.e. revenue generation for the hospital.



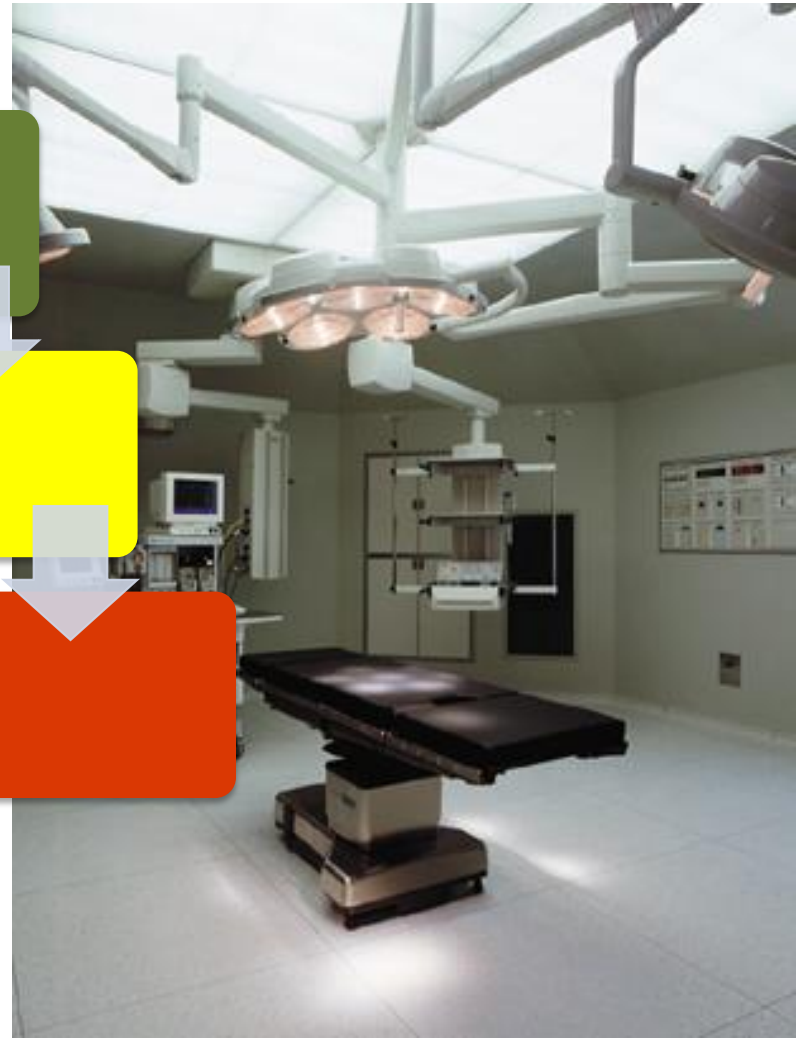
Need For Modular Operating Rooms

- **Work- Flow Management-** *“Surgery under controlled conditions”*

Concealed Wiring and Medical pipeline system.

All equipment mounted on ceiling suspended pendant units.

Complete clean- floor area leading to enhanced equipment and personal movement.



Need For Modular Operating Rooms

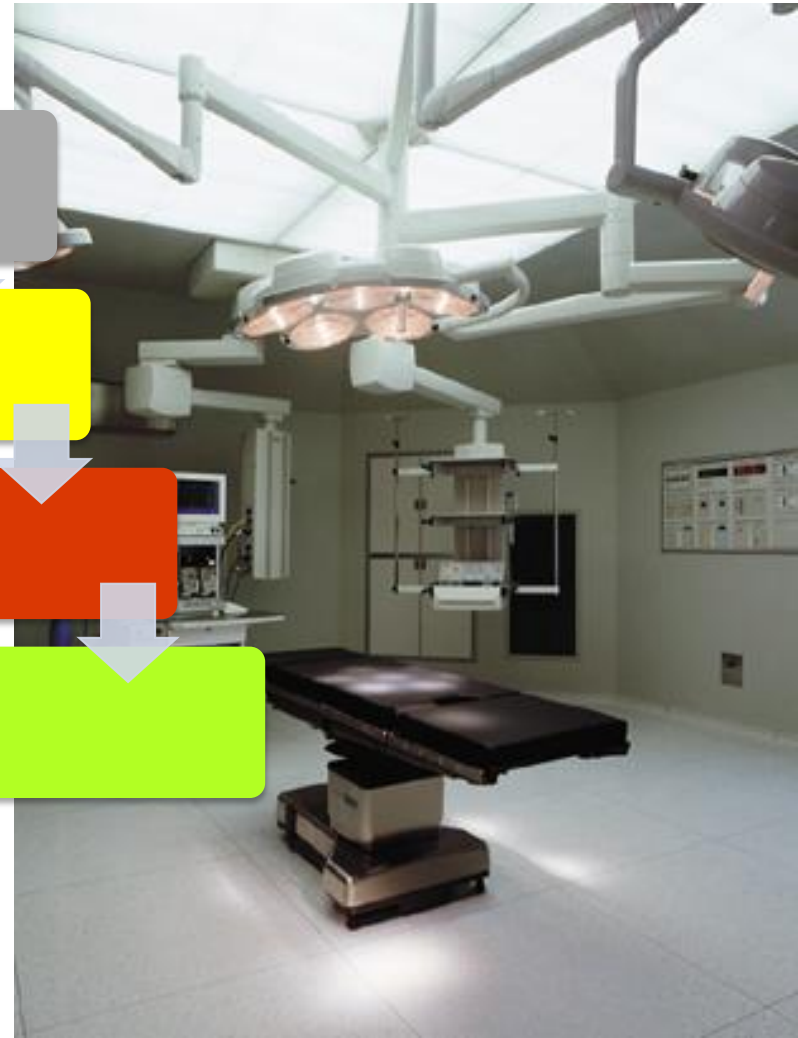
- **Aesthetics-** *“Pleasing work environment”*

Effective lighting by maintaining LUX levels through OT Light, Plannair and peripheral lights in the OT.

Clean air quality and effective ventilation in the OT.

Pleasing work environment through the use of different wall and floor colors.

Strong attraction value for top Doctors/ Surgeons.



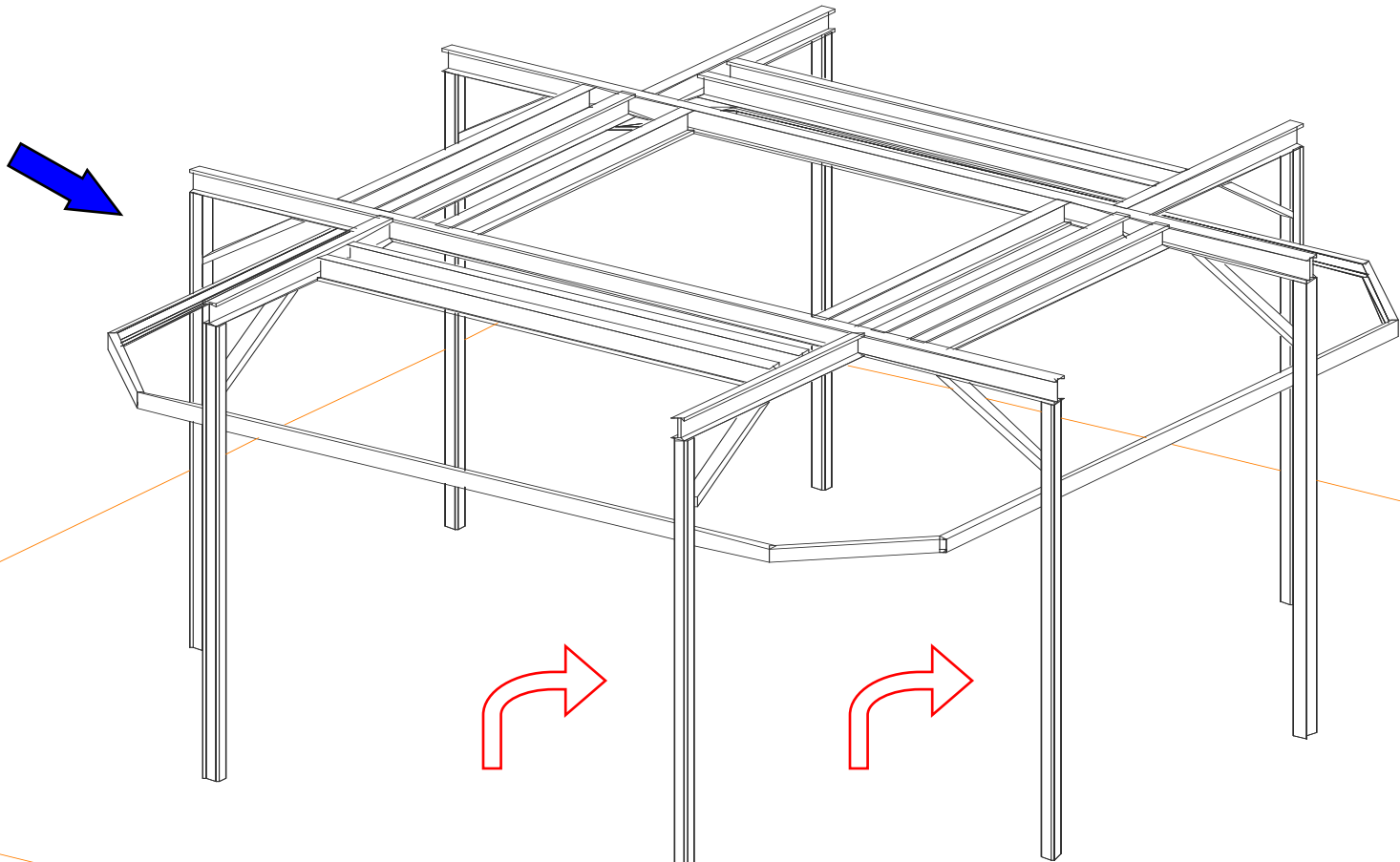
What are Modular Operating Rooms

“THIS IS HOW TO BUILD FOR THE FUTURE”

“This modular operating room adapts to fit whatever space might be available; it is equally suited for new construction and for rebuilding and expansion projects. The system is cost effective in the long run, and that has a significant economic impact for hospitals over the long run. Examples of this sustainability include flexibility, time saving and confidence for investments”

The Foundation for OT's: The Wall

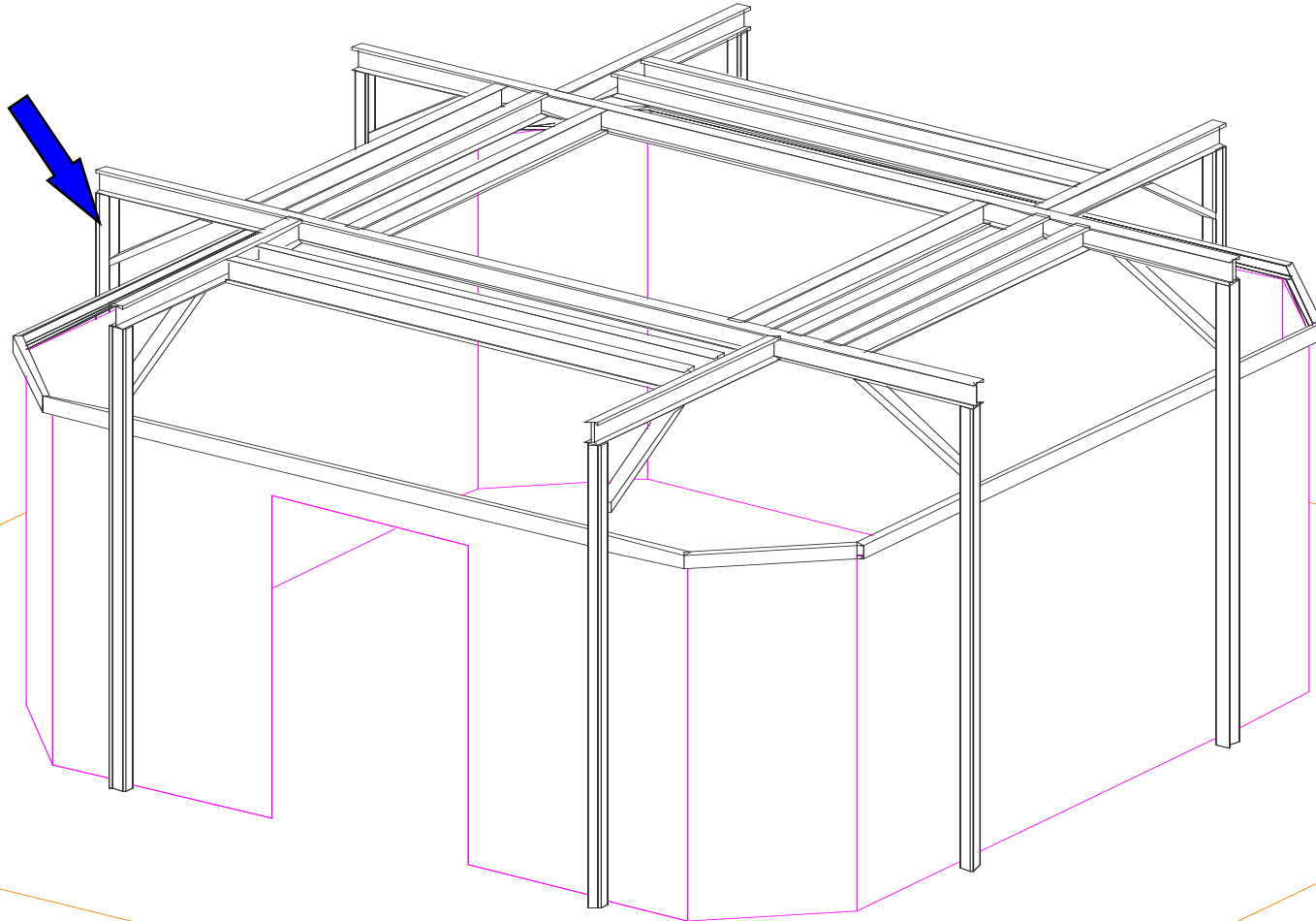
Free Standing Steel frame work



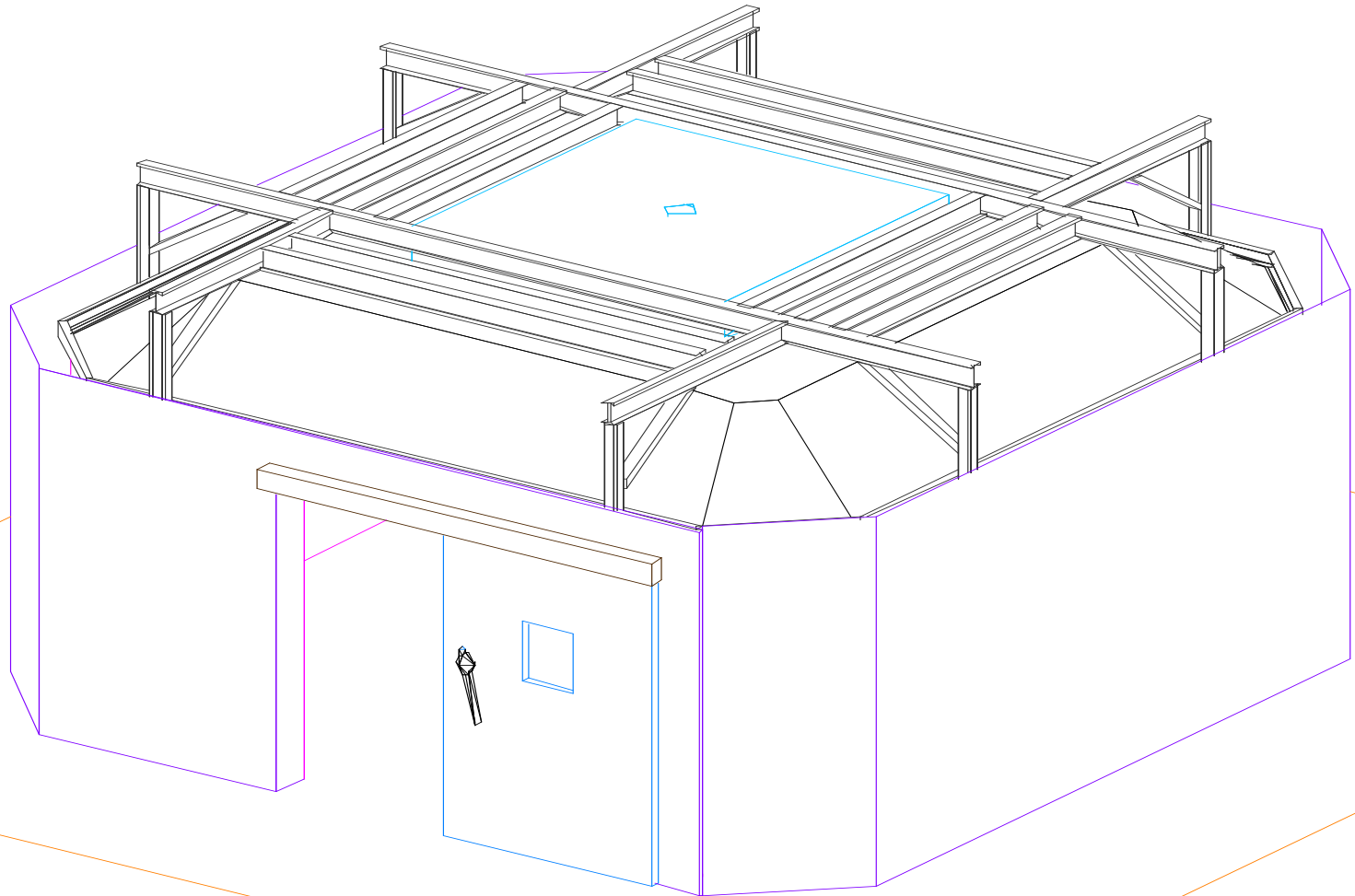
Alternatively: Brick Walls may be used in place of Vertical Steel Frame

The Foundation for OT's: The Wall

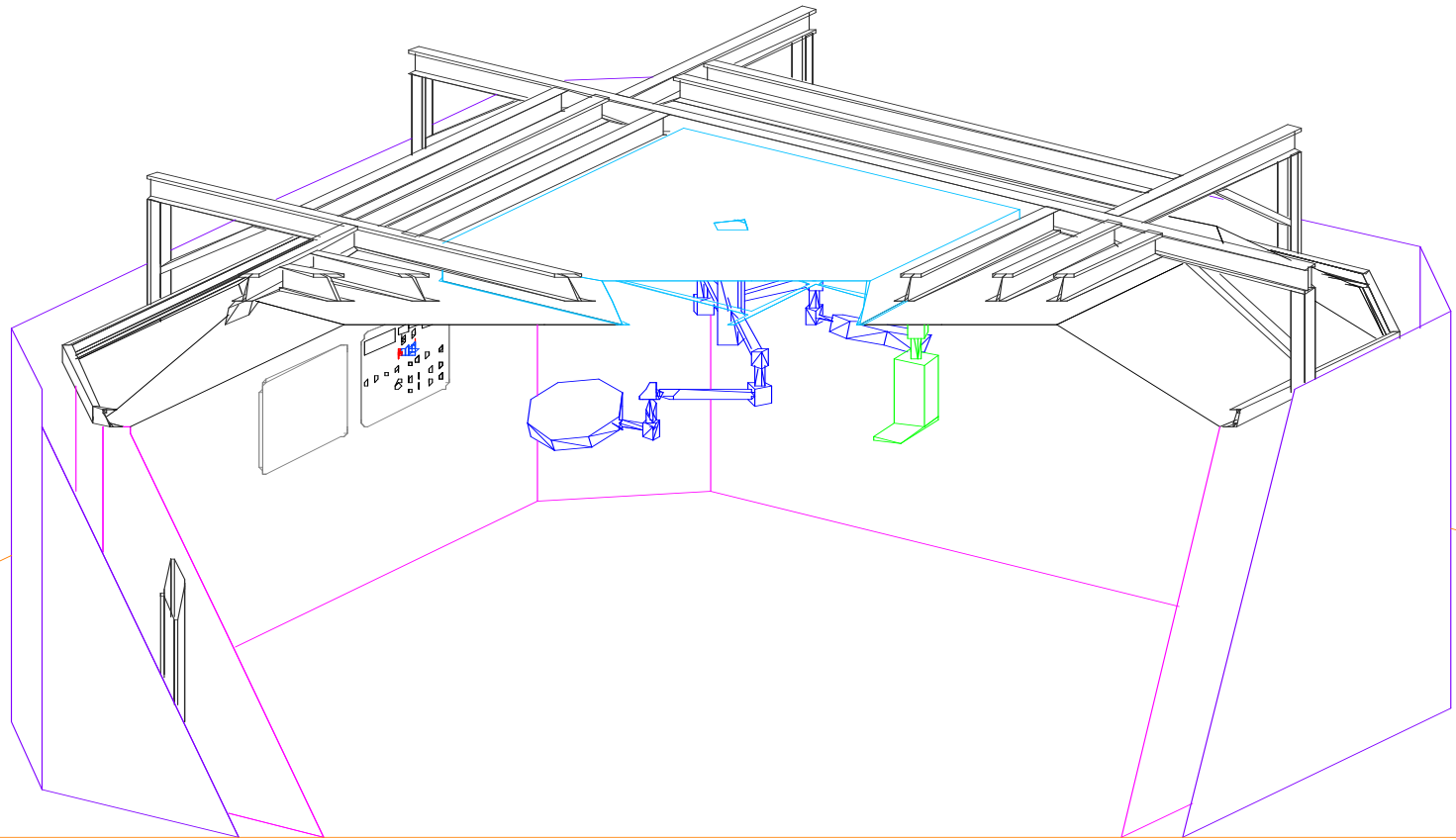
PU Injected Sandwich panel with .8mm GI/SS on both sides.



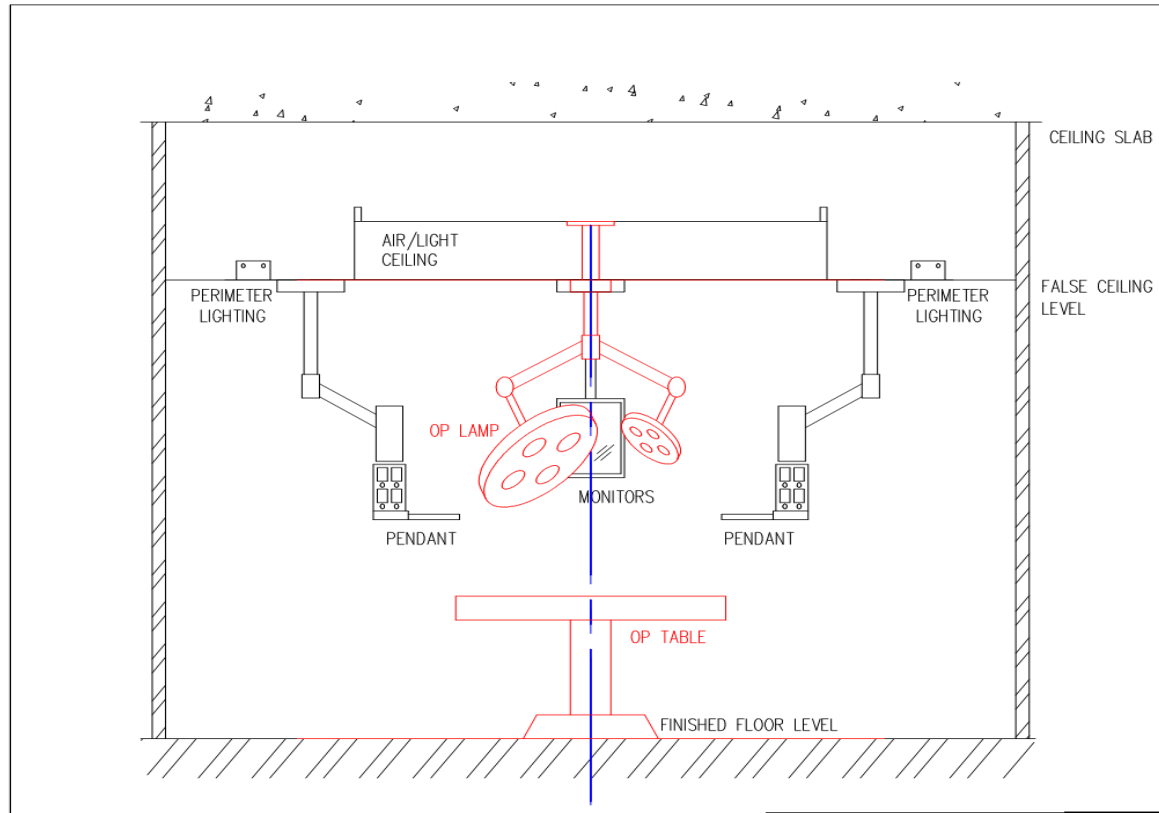
The Foundation for OT's: The Wall



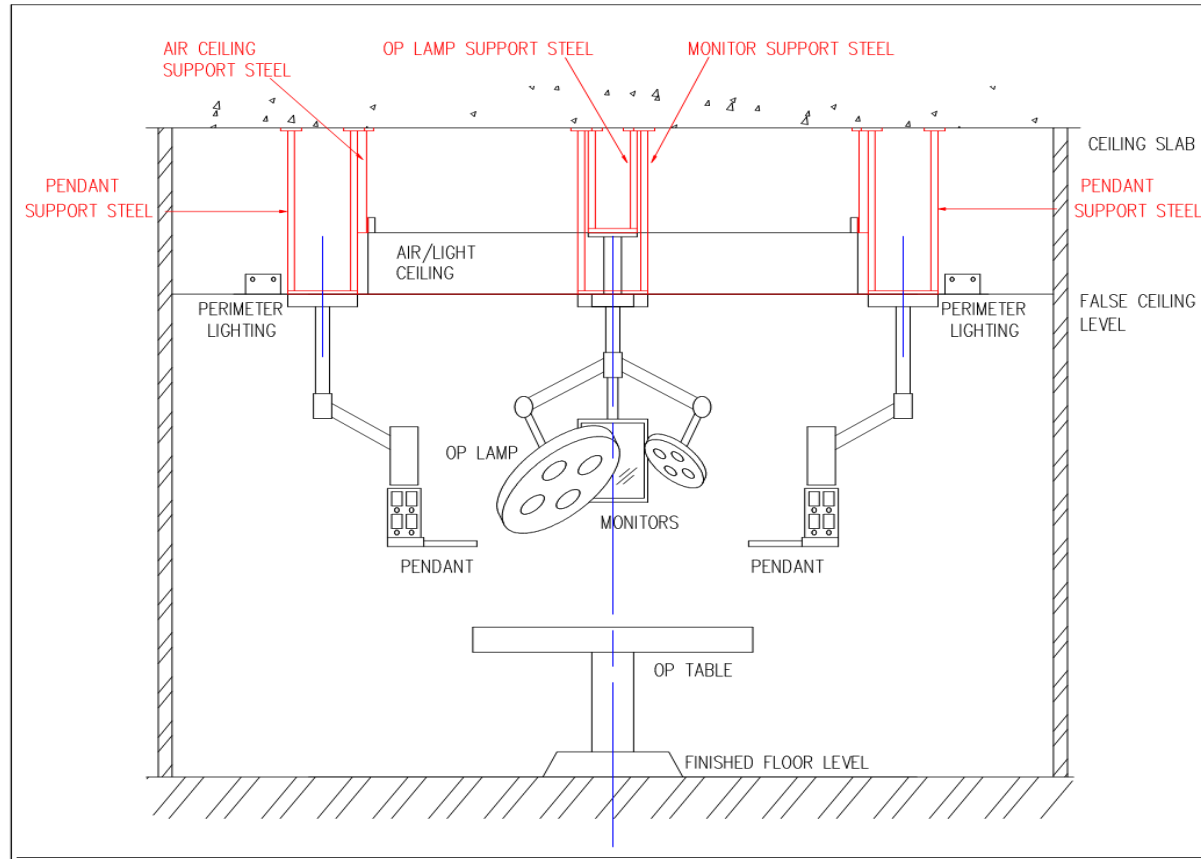
The Foundation for OT's: The Wall



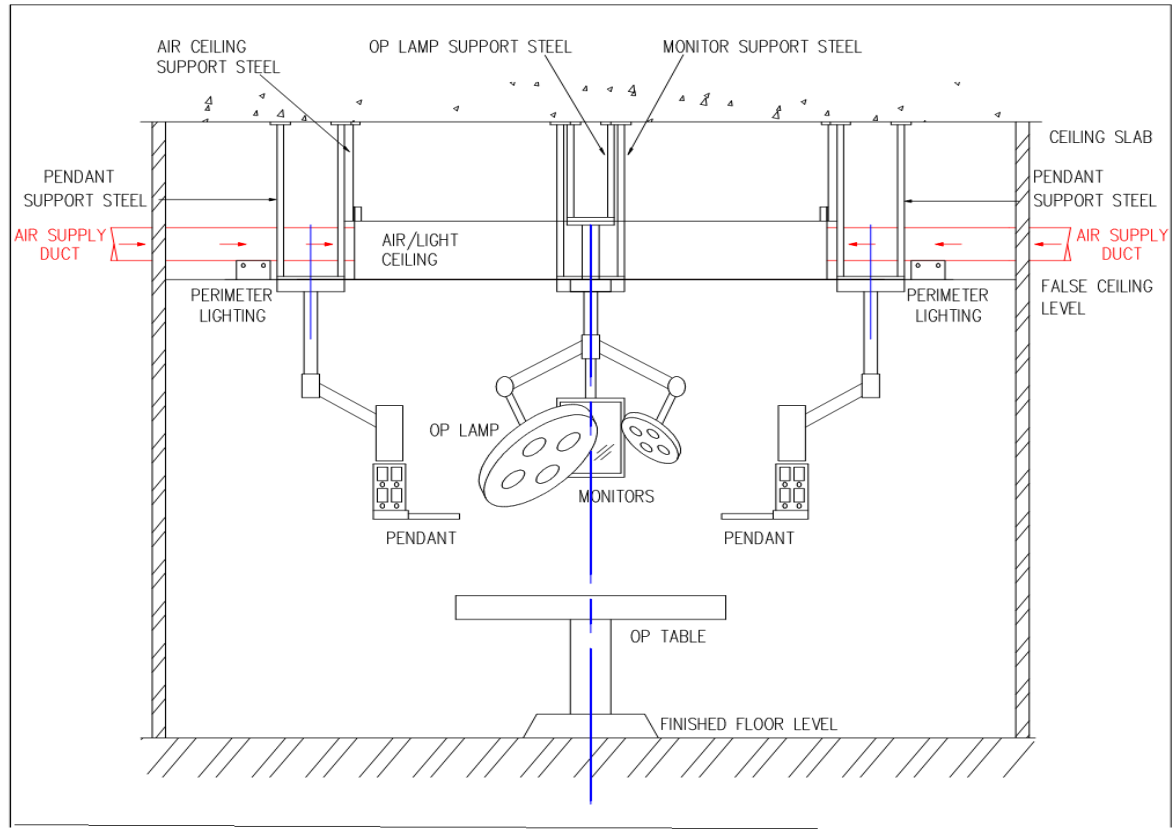
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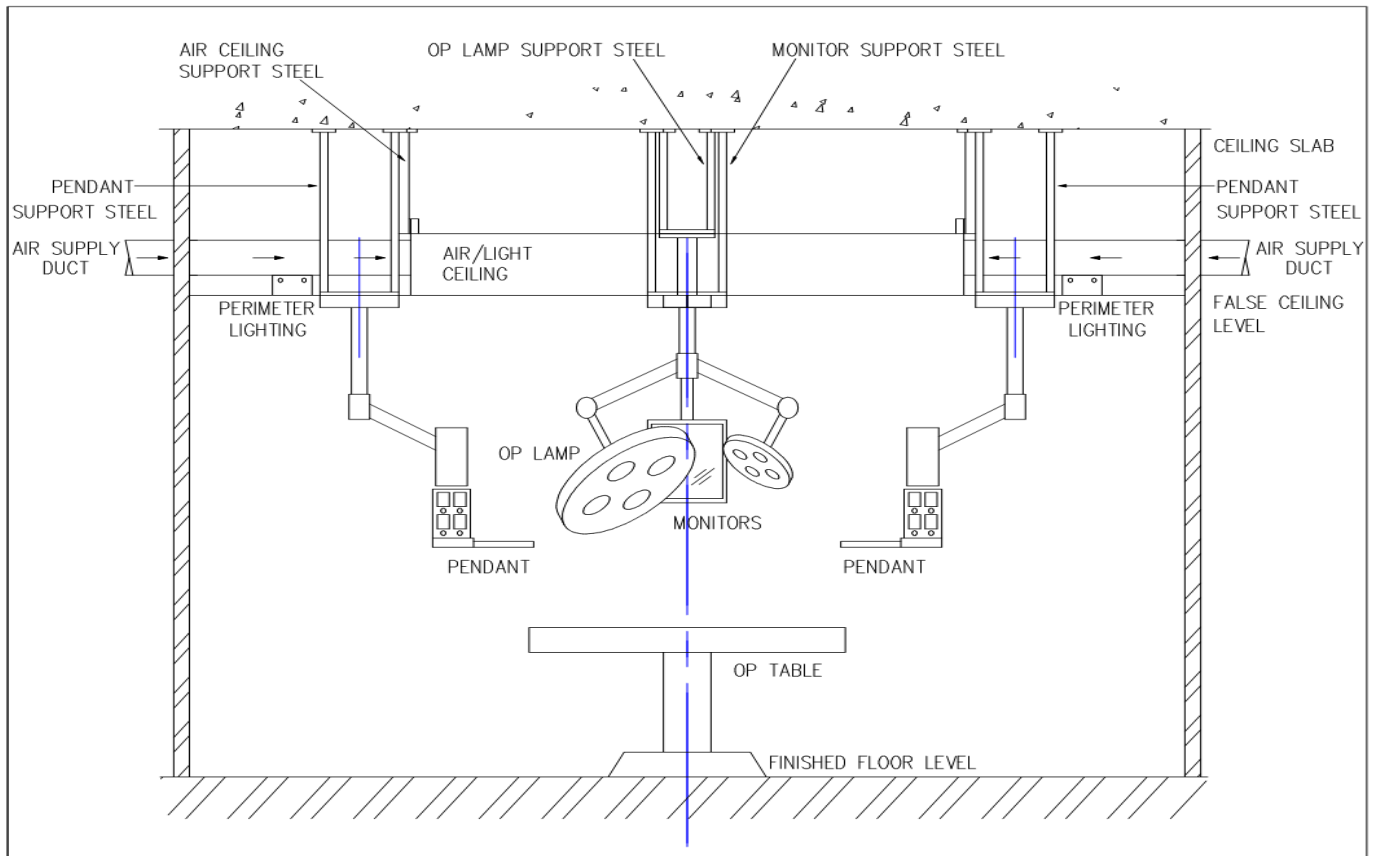
The Foundation for OT's: The Wall



The Foundation for OT's: The Wall



The Foundation for OT's: The Wall



The key elements of a modular OT

WALL AND CEILING SYSTEM

Puff injected panels 50mm thick with .8mm GI/SS sheet both sides with antibacterial paint coating of 400 microns.

High Pressure Laminate

Thermoplastic Corion

The key elements of a modular OT

WALL AND CEILING SYSTEM

COMPARISON CHART . . . VARIOUS TYPES OF WALL PANELLING

| PROPERTIES / WALL PANEL TYPE | HPL | STEEL | CORIAN® |
|---|------------|--------------|----------------|
| Impact Resistance | Average | Excellent | Good |
| Joint less / Seamless Finish Of Wall | No | Yes | Yes |
| Anti-Bacterial / Micro organisms Growth | Average | Excellent | Good |
| Resistance To Solvents & Chemicals | Good | Excellent | Excellent |
| Corrosion Protection/ Porosity | Excellent | Excellent | Excellent |
| Delaminating Of Panels/ Cracking | YES | NO | YES |
| Time Saving | Good | Excellent | Poor |
| Thermal Insulation | Average | Excellent | Average |
| Tested Performance under Indian conditions | NEW | YES | NEW |
| Cost | Good | Average | Expensive |

The key elements of a modular OT

AIR VENTILATION SYSTEM- Plenum



The key elements of a modular OT

AIR VENTILATION SYSTEM- Plenum

- The supply of air to an operating room should have four main functions;
- To control the temperature and humidity of the space.
- To assist in the removal and dilution of waste anesthetic gases.
- To dilute airborne bacterial contamination
- To control the movement of air within the department, such that the transfer of airborne bacteria from clean to sterile areas is minimized

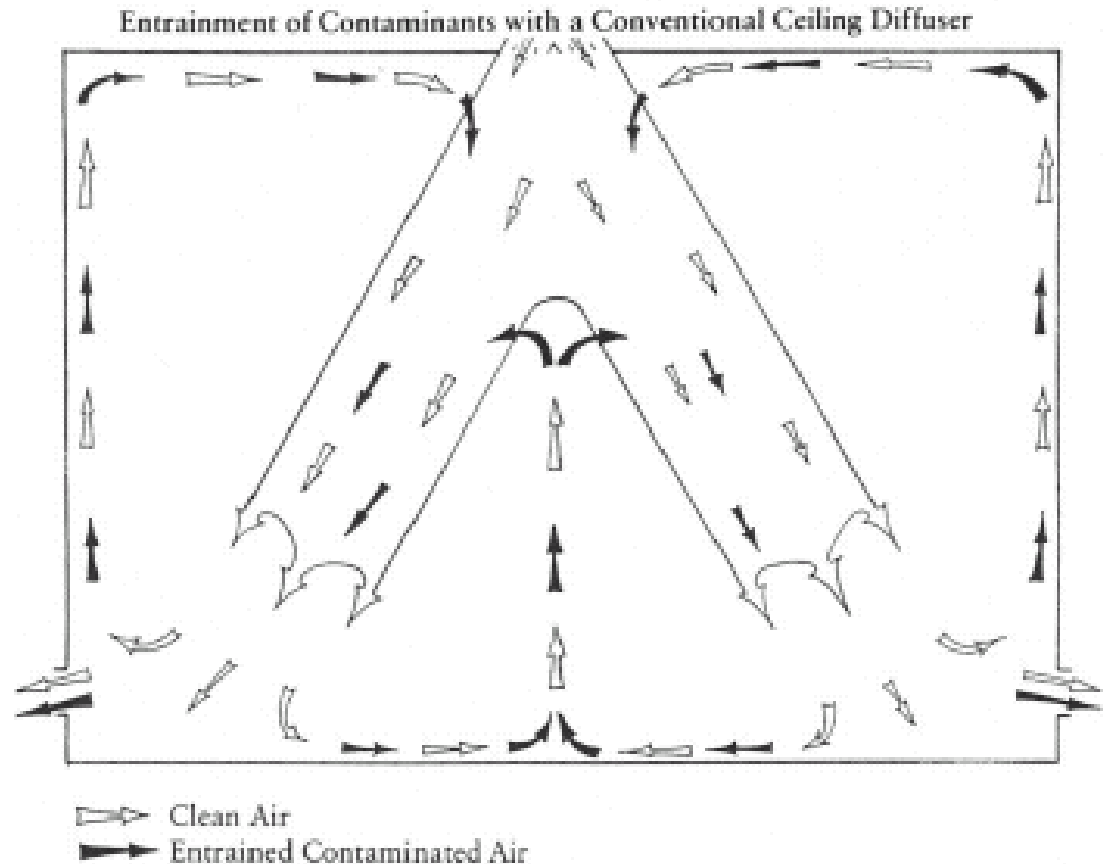


Laminar flow is defined as airflow in which the entire body of air moves with steady, uniform velocity along parallel flow lines with a minimum of eddies.

The key elements of a modular OT

AIR VENTILATION SYSTEM- Plenum

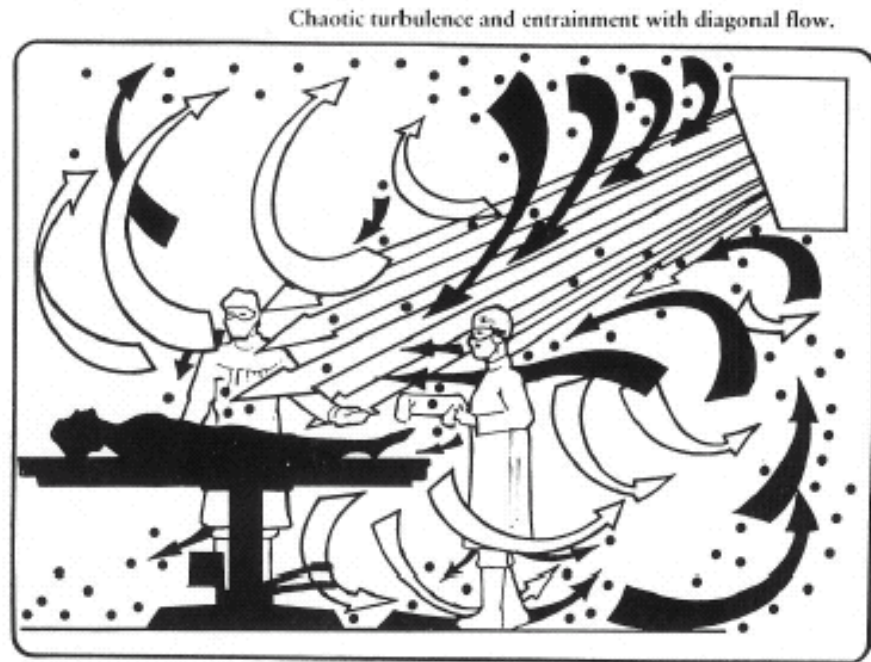
- Ceiling mounted diffusers are turbulent in nature and have a tendency to entrain the surrounding contaminated air



The key elements of a modular OT

AIR VENTILATION SYSTEM- Plenum

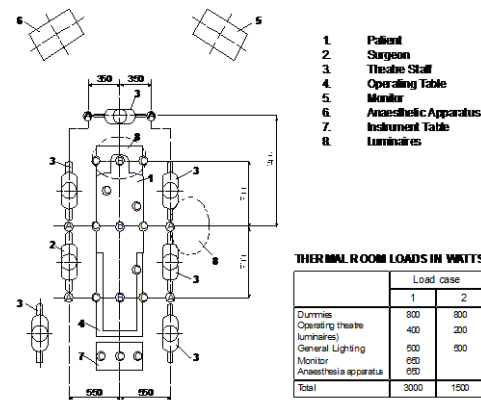
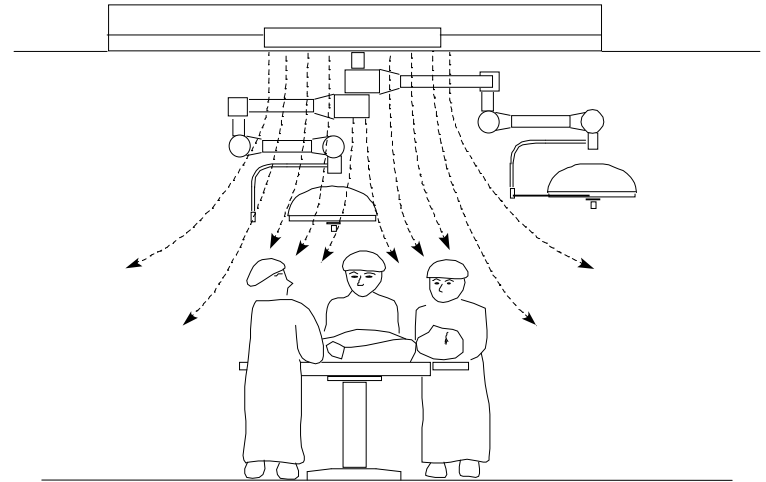
- Diagonal flow systems are the most turbulent of all available systems and have a tendency to entrain the surrounding contaminated air and pick up contaminants from objects within their path,



The key elements of a modular OT

AIR VENTILATION SYSTEM- Plenum

- Exponential airflow systems provide the highest level of proven performance, without the cost of additional airflow.
- The Exponential airflow system is the only unit to pass the DIN 4799 – Herman Rietschel Institut tests.



a) Temperature/Velocity measured at 600, 1200 and 1800 AFFL

b) Temperature/Velocity measured at 1200 and 1800 AFFL

c) Tracer Gas Concentration measured at 1200 AFFL

The key elements of a modular OT

AIR VENTILATION SYSTEM- Plenum

Planair Ceiling Performance Tests



Client: MGI International Ltd. Scheme 1800mm x 1800mm
 File Number 78840 Date 13/09/98

Summary of Tests

This is to certify that the following tests have been carried out

Report No. DIN4799 / HRI MGI - 1 - L - B

Processing. FI / FS

Thermal Load:

Persons 800W
 OT Lamps 400W
 Gen. Lighting 500W
 Monitor 650W
 Anaesthetic App. 650W **Total Load: 3000W**

Theoretical Free Area: 0.82

Theoretical Air Volume @ 0.38m/s Max & 0.30m/s Min. = 3634 / 2889CMH

| Surface | °C On Surface Of Test Room | °C Beyond Surface Of Test Room |
|-------------------|----------------------------|--------------------------------|
| Wall - Head Side | 23.6°C | 21.9°C |
| Wall - Right Side | 23.1°C | 19.5°C |
| Wall - Foot Side | 22.2°C | 20.6°C |
| Wall - Left Side | 23.6°C | 22.9°C |
| Flooring | 24.3°C | 20.3°C |
| Ceiling | 24.1°C | 19.1°C |

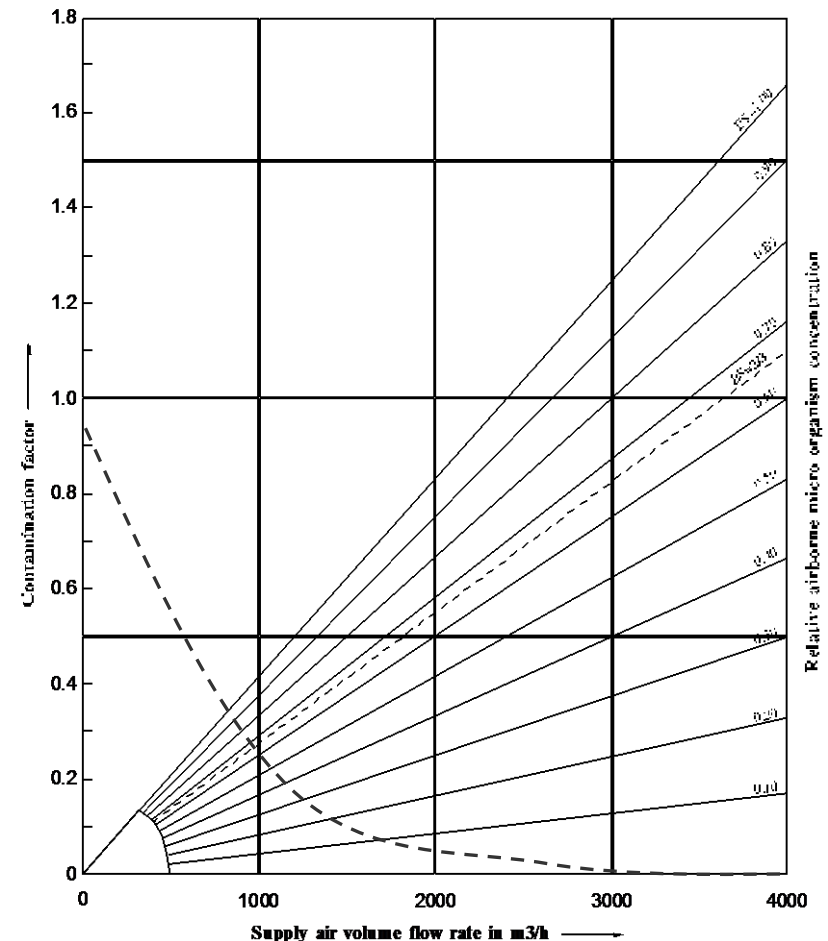
Ambient temperature on average: TR = 20.7°C

Air supply: Volume flow VZU = 3600CMH

Value of contamination (μ s) ± 1 = Less than 0.10 μ s

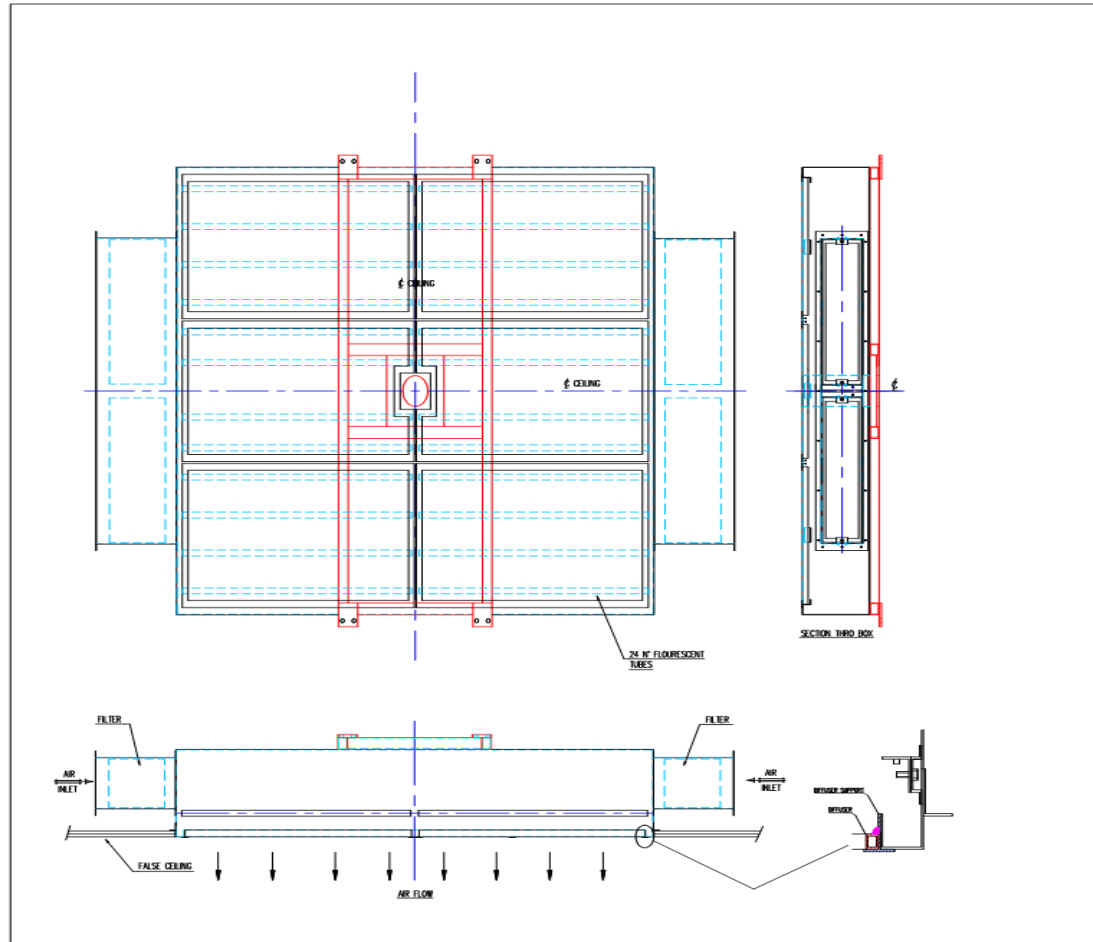
DIN 4799

Determination of the optimal supply air volume flow rate in terms of concentration of airborne micro-organisms



The key elements of a modular OT

AIR VENTILATION SYSTEM- Plenum

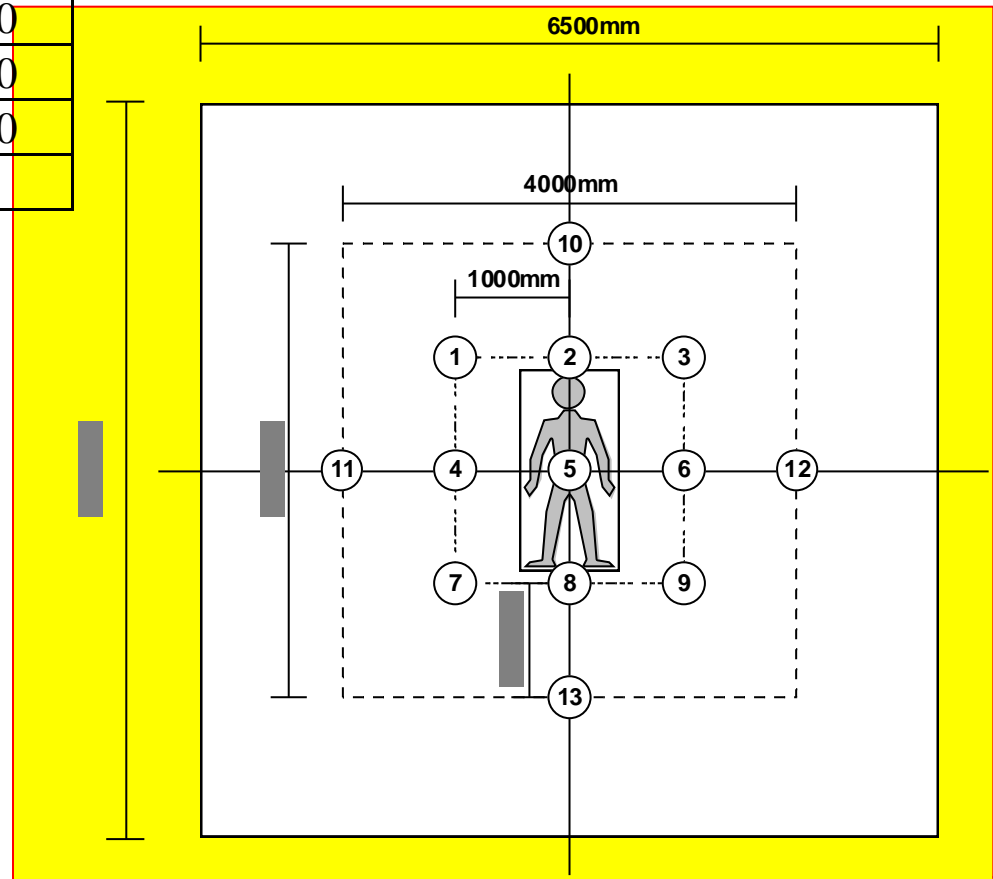


The key elements of a modular OT

AIR VENTILATION SYSTEM- Plenum

| Position | Lux | Position | Lux |
|----------|------|----------|------|
| 1 | 1150 | 8 | 1245 |
| 2 | 1245 | 9 | 1150 |
| 3 | 1150 | 10 | 1000 |
| 4 | 1245 | 11 | 1000 |
| 5 | 1500 | 12 | 1000 |
| 6 | 1245 | 13 | 1000 |
| 7 | 1150 | | |

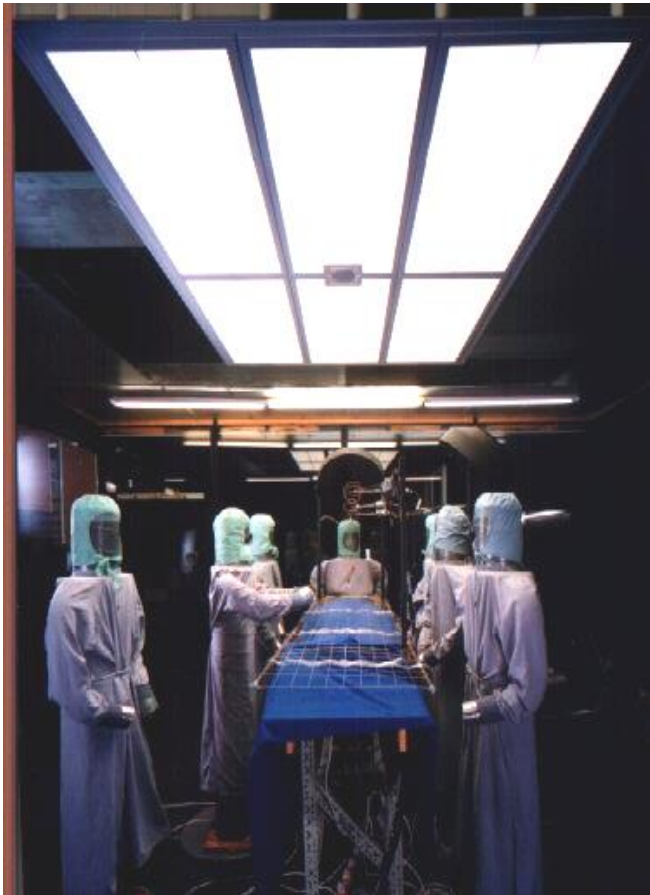
- General lighting is required to provide both horizontal and vertical illuminance. Vertical being required for good visibility of swab count/list boards, wall mounted equipment and life support systems.
- Lighting should be dimmable to a level of 10-Lux
- Surfaces should not be glossy, or reflective.



The key elements of a modular OT

AIR VENTILATION SYSTEM- Plenum

Airflow Verification



The key elements of a modular OT

Anti Bacterial Coating - Fungicidal action

- The Premier coating System, not only meets the previously mentioned criteria, it actively kills bacteria and fungus

| Description | Plain Plates Survival Time | Premier Coating Killing Time |
|---------------------------------|----------------------------|------------------------------|
| Staphylococcus Aureus Type 80/8 | 24Hrs | 1Hr |
| Eschericia Coli NCTC 10418 | 24Hrs | 1-2Hrs |
| Pseudomonas Aeruginosa | 24Hrs | 4-5Hrs |
| Beta Haemolytic Streptococcus | 5-24Hrs | 3Hrs |
| Salmonella Typhimurium | 24Hrs | 4-5Hrs |
| Candida Albicans (Fungus) | 24Hrs | 2-3Hrs |



The more correct name would be fungistat as the action is to neutralise micro-organisms which come into contact.

Advantages . . . Anti Bacterial Coating

- ❖ **Seamless and easy to clean**
- ❖ **Can be steam cleaned**
- ❖ **Chemical resistant**
- ❖ **Hard wearing - will withstand aggressive cleaning regimes**

Advantages . . . Anti Bacterial Coating

- ❖ **Durable - life expectancy in excess of 10 years**
- ❖ **Long-term savings - need not be replaced at the end of design lives**
- ❖ **Cost-effectiveness - last 3 to 4 times longer than fungicidal paints**
- ❖ **Track record - coatings available backed by an international track record spanning 30 years**

ESD FLOORING

❖ ESD VINYL

- **Vinyl is the oldest effective ESD flooring material. Solid vinyl tile (SVT) can give a facility that hospital look of cleanliness and shine**
- **Facilities managers often favour vinyl floor because vinyl has a reputation for being inexpensive, simple to repair and easy to clean**
- **The joints between individual tiles are welded by heat fusion process to get a seamless floor**

The key elements of a modular OT

Vinyl Flooring

Features

- Electrostatic conductive vinyl covering
- High resistance against chemical & mechanical strains
- Homogeneous installation at wall connections
- Wide color range

Benefits

- Easy to install
- Easy to repair
- Easy to clean
- Wide color selection



ESD FLOORING

❖ Epoxy

- **Epoxies are effective in meeting ESD standards. In facilities where constant heavy loads and high traffic are the norm, epoxies are the recommended flooring**
- **However, one should also note that colour of an epoxy floor is not 100% stable**
- **Repairs are always conspicuous because the newly coated areas never match the adjacent aged surface**
- **Because of the rigidity and shiny sleekness of its surface, it can present noise & slipperiness issues**

The key elements of a modular OT

COMPARISON CHART . . . DIFFERENT TYPES OF ESD FLOORING

| CATEGORY PRODUCT TYPE | ESD VINYL TILE (Conductive) | ESD EPOXY (Conductive) |
|-----------------------------------|-----------------------------------|-----------------------------------|
| Cost | Lowest | Moderate |
| Cost of Maintenance | Low - Moderate | Low |
| Durability | Excellent | Excellent |
| Ease Of Repair | Easy | Most Difficult |
| Long Term Appearance | Excellent - resurfaced by buffing | Difficult to hide micro-scratches |
| Colour throughout Thickness | Yes | No |
| Handle / Withstand Rolling Loads | Excellent | Excellent |
| Maintenance | Sweep, Damp Mop & Buff | Sweep and Damp Mop |
| Installation | Average | Difficult |
| Slip Resistance | 0.5 - 0.6 | 0.4 - 0.6 (depends on texture) |
| Chemical Resistance | Excellent | Excellent |
| Acid, Alkali & Solvent Resistance | Good | Excellent |
| Sound Absorption | 4 dB | Not Sound Resistant |

Hermitically SEALED DOORS

Sliding



Vs.

Hinged



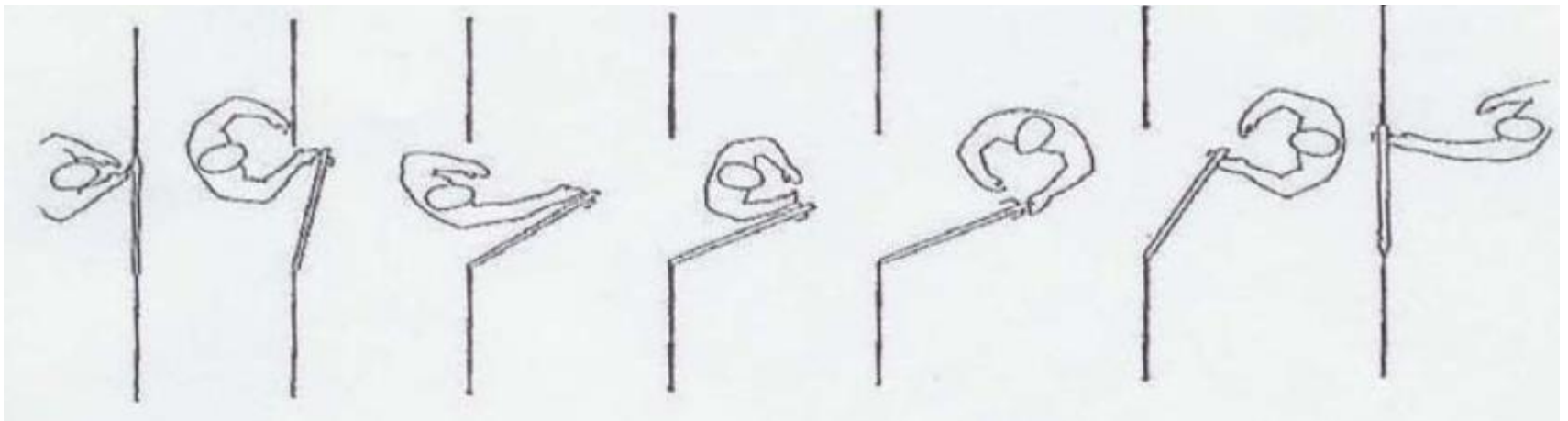
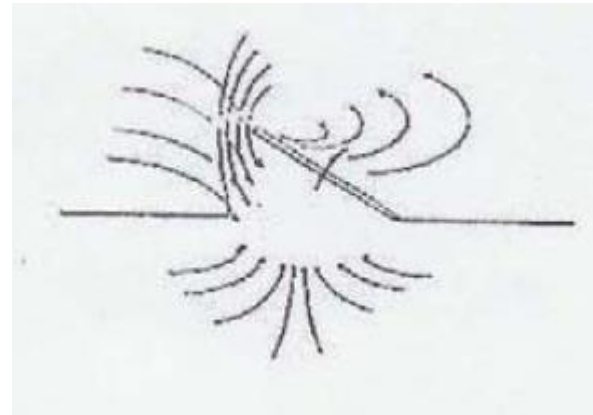
The key elements of a modular OT

HINGED DOOR

Escaping Air & Turbulence

Loss in Pressure

Contamination by Direct Contact



The key elements of a modular OT

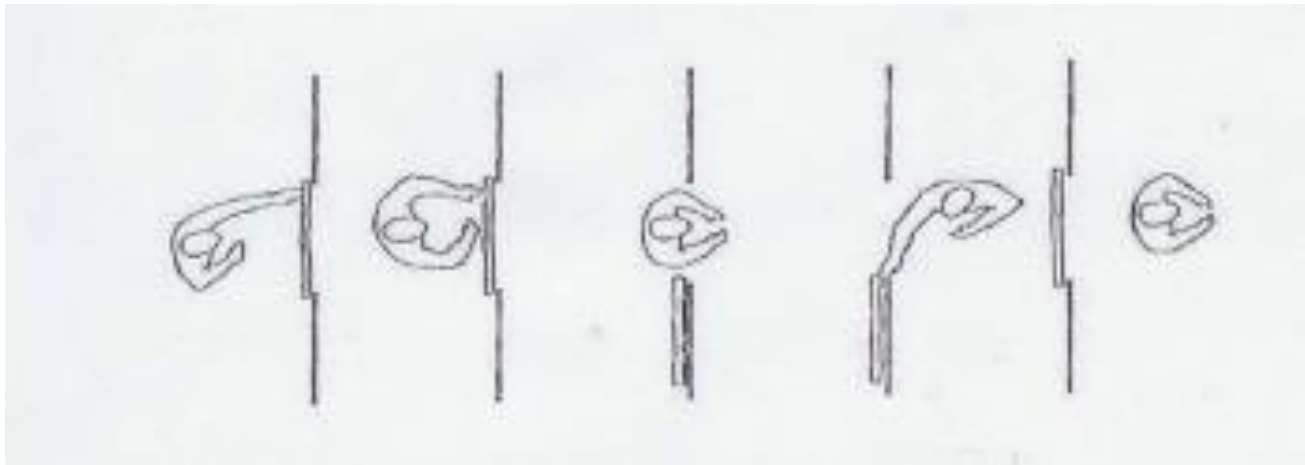
SLIDING DOOR

Hermetically Sealing Sliding Doors,

Increase usable floor space.

Provide positive air seals.

Prevent cross contamination



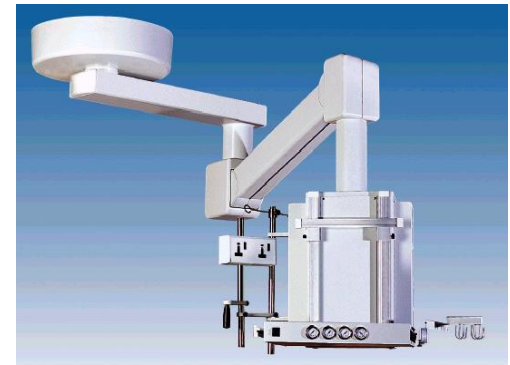
DOORS . . . HERMETICALLY SEALED TYPE

❖ Why A Hermetic Sealing Sliding Door . . .?

- **Contamination risks in the room are under control**
- **Disinfecting is quicker & safer**
- **Control the positive pressure in the room**
- **The number of air changes and amount of clean air required is reduced, saving money**
- **Less clean air is necessary with hermetic doors**
- **Controlled theatre atmosphere: constant temperature of 18°C - 24°C and a humidity of 40 – 60% can be easily controlled**
- **In case of fire, prevents smoke from spreading**
- **Creating a quite environment in & outside the theatre**

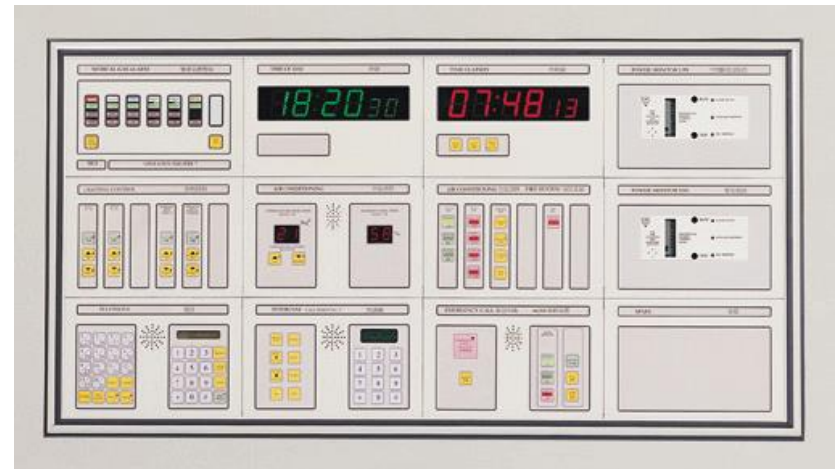
Medical Gas Systems

- Medical gas supplies and equipment should be incorporated into one easily accessible unit.
- Trailing leads or hoses which restrict movement within the department, should be avoided.
- All equipment should be attached via short connecting hoses or cables to integral hook up points.
- Single or two piece arm ceiling mounted pendants, motorised or static, which allow equipment to be located at point of use, are encouraged.



Electrical Services

- All mechanical & electrical services should be located at one delivery point.
- This tact negates the confusion in finding particular services that may otherwise be scattered around the theatre walls.
- Thus theatre staff may move between theatres and continue to locate the pertinent services at a glance
- This 'Modular' principal allows individual components to be replaced at any time with minimal disruption to the theatre staff.



The key elements of a modular OT

TOUCH SCREEN CONTROL PANEL

EACH CONTROL PANEL WILL CONTAIN :-

- TIME ELAPSE CLOCK
- STANDARD CLOCK
- CUT OUT FOR TEMP / HUMIDITY INDICATORS
- CONTROL FOR PERIPHERAL/ PLANAIR LIGHTS
- INTERCOM / TELEPHONE
- MEDICAL GAS ALARM – VISUAL & AUDIO

Pixel Grid is a state-of-the-art touch-LCD control system capable of displaying and maneuvering electrical controls and displaying sensor parameters on a high-grade touch-LCD screen.

It combines solid reliability with an innovatively designed ergonomic touch panel, enabling an exuberant user experience.

The touch-LCD panel displays the parameters read from an integrated PLC and transmits touch-clicked user inputs to the electrical relays and a DSP based signaling system.

The parameters controls are pre-configured to order.

It includes up to 6 pressure sensor readings,

1 temperature/humidity sensor readings and 4 ventilation sensor readings.

The user can operate up to 5 lights and 3 brightness controls.

The temperature and humidity set-points can be increased/decreased using the up/dn keys.

The screen's smooth surface ensures easy to clean and dirt free interface.



Screen snapshot of the touch panel (Indicative - actual may vary)

The key elements of a modular OT

X-RAY VIEWING SCREEN

- TWIN PLATE X-RAY VIEWING SCREEN.
- HIGH FREQUENCY FLUORESCENT LAMPS CONTROLLED BY DIMMING BALASTS.
- CONTROL LUMINANCE WITHOUT FLICKER.
- UNIFORM LEVEL OF ILLUMINATION ACROSS THE ENTIRE FRONT PANEL.
- SEALED FLUSH WITH THE INSIDE FACE OF THE OPERATING THEATRE WALL.
- SPRING LOADED CLIPS TO SECURE THE X-RAY WHEN IN USE.



CASCADE PRESSURE STABILISERS

- ✦ MULTI-BLADED UNITS, SPECIFICALLY DESIGNED TO CONTROL O.T. ROOM AIR PRESSURES.
- ✦ UNIT COMPRISES OF CARBON STEEL HOUSING WITH GRADE 304 STAINLESS STEEL BLADES.
- ✦ BALANCING IS CARRIED OUT UTILIZING A PROVEN BALANCE WEIGHT ASSEMBLY.
- ✦ ACCURATE TO A RANGE OF 1 PASCAL OVER THEIR WORKING RANGE OF 5-35Pa.
- ✦ ADJUSTMENT CAN EASILY BE CARRIED OUT ON SITE, SHOULD THE NEED ARISE.





LATEST GUIDELINES FOR MODULAR OPERATION THEATRE & AIR CONDITIONING



Design considerations for Planning New Operation Theatres

OT Construction:

- a) The AHU of each OT should be **dedicated one** and should not be linked to air conditioning of any other area for all OT constructed.
- b) Window & split A/c **should not** be used in any type of OT because they are pure re circulating units and have convenient pockets for microbial growth which cannot be sealed.
- c) Paint- antibacterial, anti-fungal
- d) OT door – automatic/ Hermitically Sealed/Touch free (preferable)
- e) General Lights – Clean room lights
- f) Provision of safety against static charge.
- g) Separate power circuit for equipment like Laser.
- h) The anti-static flooring, walls and ceiling should be non-porous, smooth, seamless without corners (coving) and should be easily cleanable repeatedly. The material should be chosen accordingly. Anti-static Flooring – seamless, including skirting, should not be of porous stone as it absorbs moisture and could be a source of bio-burden.



Air Conditioning in OT

- A. The air conditioning requirements for Operation Theatre in a HCO have been deliberated at length with manufacturers, engineers, technical committee members and other stake holders and the following guidelines have been finalized.
- B. For this purpose operation theatres have been divided into groups:
1. **Super specialty OT:** Super specialty OT means operation theatres for Neurosciences, Orthopaedics (Joint Replacement), Cardiothoracic and Transplant Surgery (Renal, Liver etc.).
 2. **General OT:** This includes operation theatres for **Ophthalmology**, District hospital OTs, FRU OT and all other basic surgical disciplines.
- Day care centre:** Day surgery is the admission of selected patients to hospital for a planned surgical procedure, returning home on the same day, would fall under the category of general OT.
- C. The following basic assumptions have been kept in view:
- **Occupancy:** Standard occupancy of **5-8** persons at any given point of time inside the OT is considered.
 - **Equipment Load:** Standard equipment load of **5-7 kW** and lighting load of **1 kW** to be considered per OT. For super specialty OT the equipment load can be taken as **7 – 9KW**.
 - **Ambient temperature & humidity at each location** to be considered while designing the system.



REQUIREMENTS – General OT

1. **Air Change Per Hour:**
 - Minimum total air changes should be **20** based on international guidelines although the same will vary with biological load and the location.
 - The fresh air component of the air change is required to be minimum **4** air changes out of total minimum **20** air changes.
2. **Air Velocity:** should be same as per previous guide.
3. **Positive Pressure:** There is a requirement to maintain positive pressure differential between OT and adjoining areas to prevent outside air entry into OT. The minimum positive pressure recommended is **2.5** Pascal (0.01 inches of water).
4. **Air handling/Filtration:** It should be same as previous. When not possible, the OTs should be well ventilated with **2** levels of filtrations with efficiencies as specified previously (**pre** and **micro vee** filters should be in position at the AHU).
5. **Temperature and Humidity:** The temperature should be maintained at **21C +/- 3 Deg C** inside the OT all the time with corresponding relative humidity between **20 to 60%**. Appropriate devices to monitor and display these conditions inside the OT may be installed.



Maintenance of the system

- During the non-functional hours AHU blower will be operational round the clock (may be without temperature control). Variable frequency devices (VFD) may be used to conserve energy. Air changes can be reduced to **25%** during non-operating hours thru VFD provided positive pressure relationship is not disturbed during such period.
- **Validation of system** to be done as per ISO 14664 standards and should include:
 - ✓ Temperature and Humidity check
 - ✓ Air particulate count
 - ✓ Air Change Rate Calculation
 - ✓ Air velocity at outlet of terminal filtration unit /filters
 - ✓ Pressure Differential levels of the OT wrto ambient / adjoining areas
 - ✓ Validation of HEPA Filters by appropriate tests like **DOP** (Dispersed Oil Particulate) /**POA**(Poly Alpha Olefin) etc.; repeat after **6month** in case HEPA found healthy.
- **Preventive Maintenance of the system:** It is recommended that periodic preventive maintenance be carried out in terms of cleaning of pre filters, micro vee at the interval of **15 days**. Preventive maintenance of all the parts of AHU is carried out as per manufacturer recommendations.

















STERILE ZONE

OPERATION
THEATRE

3

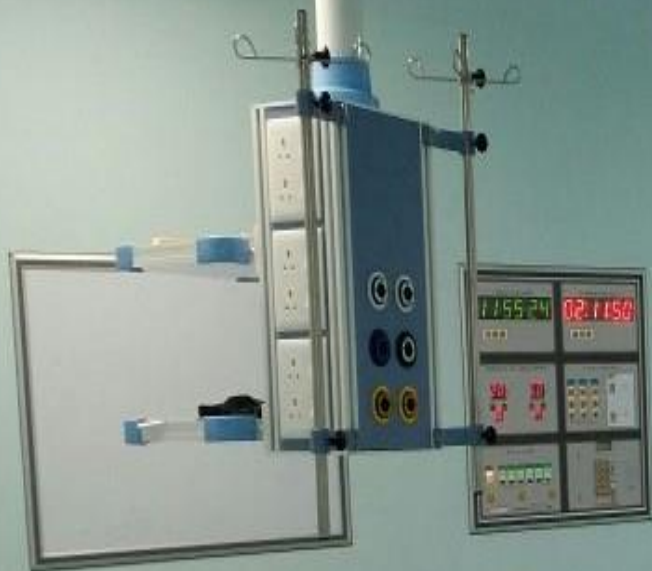
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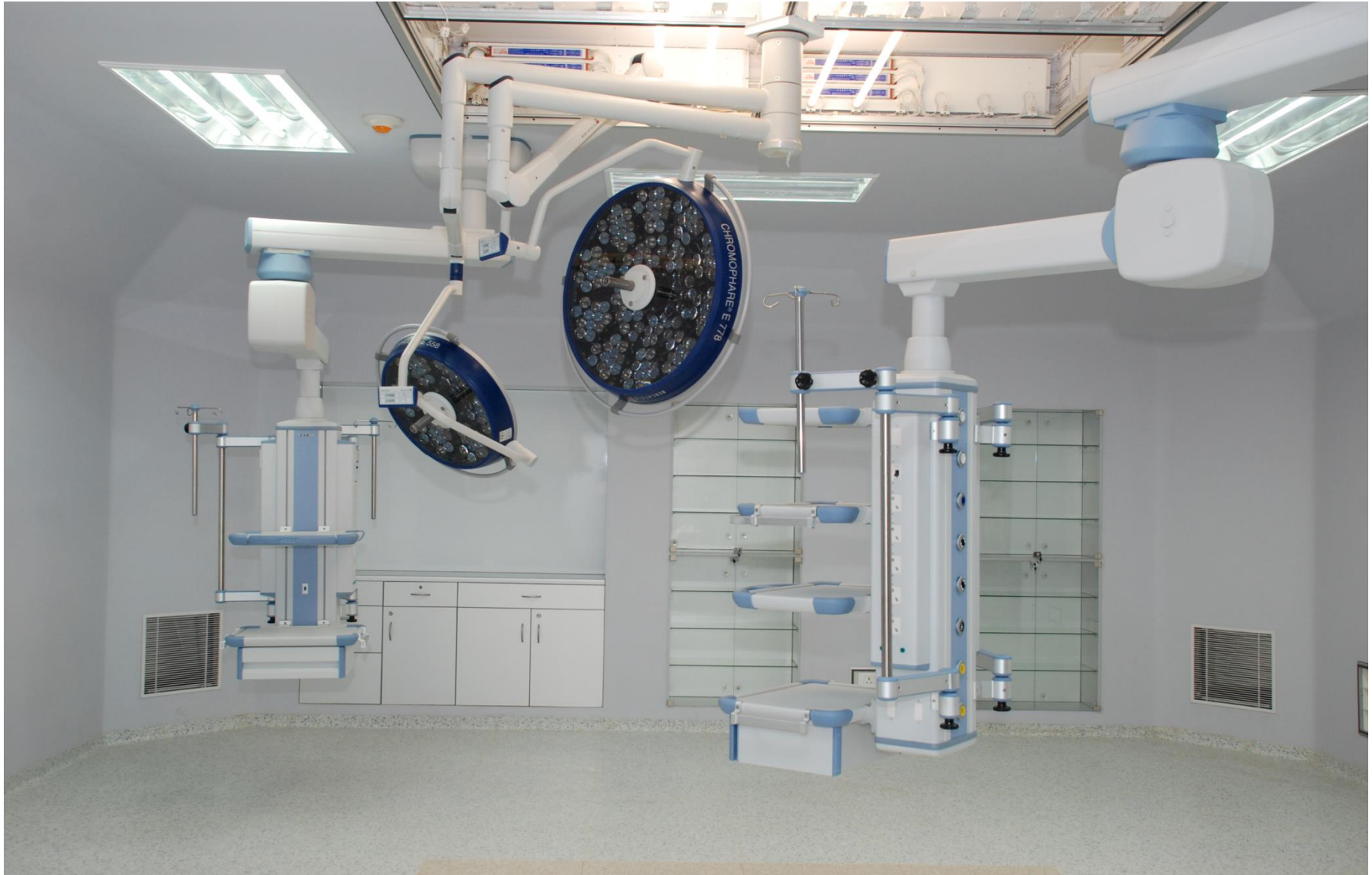








Ensuring a 100% Bacteria free environment





Thank You