



Air Distribution for the Modern O.R.
Presented by: Kelli Dahl

Agenda

- ASHRAE 170 Requirements
- Operating Room Designs
- Modern Operating Room Challenges
- Modern OR strategies
- Case Study – Common plenum
- Ultrasuite

Critical Environments

Operating Room Air Distribution Systems

Importance of Air Distribution Systems



*Procedure-associated Module
SSI*

Surgical Site Infection (SSI) Event

Introduction: In 2010, an estimated 16 million operative procedures were performed in acute care hospitals in the United States¹. A recent prevalence study found that SSIs were the most common healthcare-associated infection, accounting for 31% of all HAIs among hospitalized patients². The CDC healthcare-associated infection (HAI) prevalence survey found that there were an estimated 157,500 surgical site infections associated with inpatient surgeries in 2011³. NHSN data included 16,147 SSIs following 849,659 operative procedures in all groups reported, for an overall SSI rate of 1.9% between 2006-2008⁴. A 19% decrease in SSI related to 10 select procedures was reported between 2008 and 2013⁵.

While advances have been made in infection control practices, including improved operating room ventilation, sterilization methods, barriers, surgical technique, and availability of antimicrobial prophylaxis, SSIs remain a substantial cause of morbidity, prolonged hospitalization, and death. SSI is associated with a mortality rate of 3%, and 75% of SSI-associated deaths are directly attributable to the SSI⁶.

ASHRAE 170 Requirements for OR

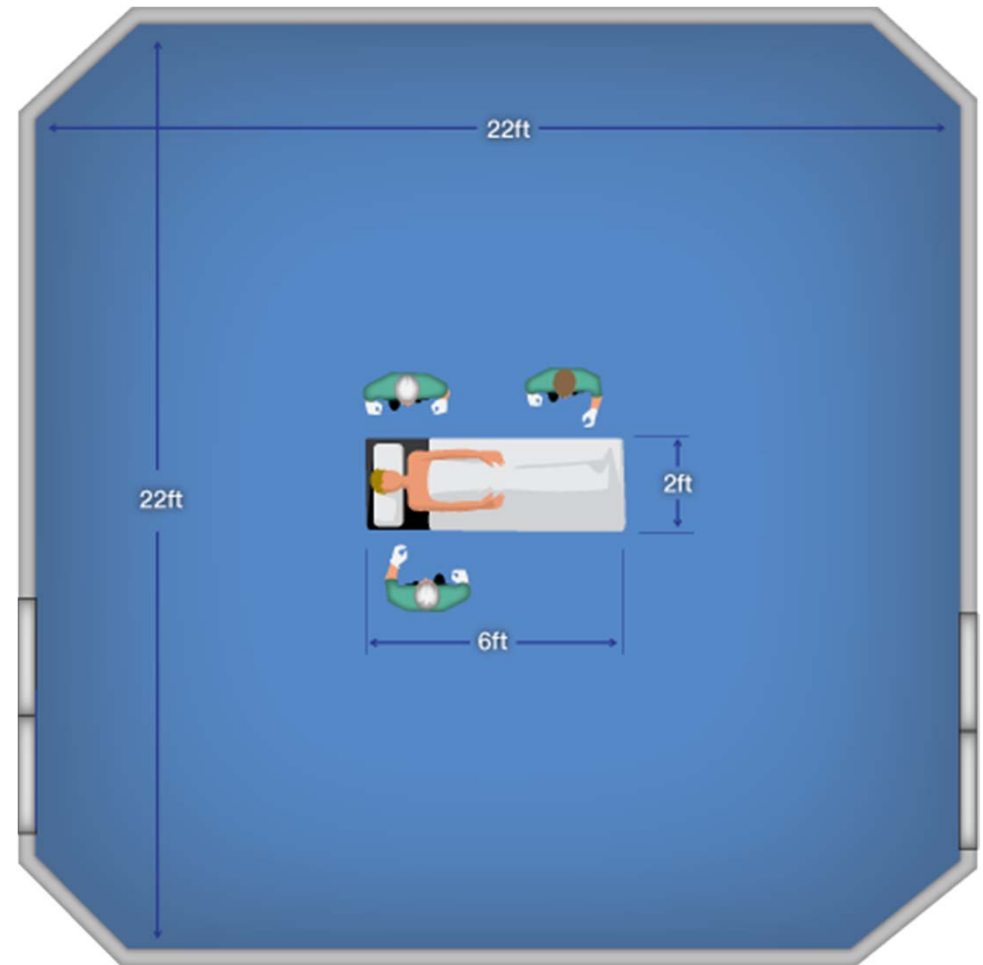
8.4.1 Operating Rooms (ORs), Operating/Surgical Cystoscopic Rooms, and Caesarean Delivery Rooms. These rooms shall be maintained at a positive pressure with respect to all adjoining spaces at all times. A pressure differential shall be maintained at a value of at least +0.01 in. of water (2.5 Pa). Each room shall have individual temperature control. These rooms shall be provided with a primary supply diffuser array that is designed as follows:

- a. The airflow shall be unidirectional, downwards, and the average velocity of the diffusers shall be 25 to 35 cfm/ft² (127 to 178 L/s/m²). The diffusers shall be concentrated to provide an airflow pattern over the patient and surgical team. *Informative Note:* For more information, see Memarzadeh and Manning (2002) and Memarzadeh and Jiang (2004) in Appendix B.
- b. The coverage area of the primary supply diffuser array shall extend a minimum of 12 in. (305 mm) beyond the footprint of the surgical table on each side. Within the portion of the primary supply diffuser array that consists of an area encompassing 12 in. (305 mm) on each side of the footprint of the surgical table, no more than 30% of this portion of the primary supply diffuser array area shall be used for nondiffuser uses such as lights, gas columns, equipment booms, access panels, sprinklers, etc.

- 25-35 CFM/ft² laminar flow
- 70% coverage with diffusers
- 20 ACH

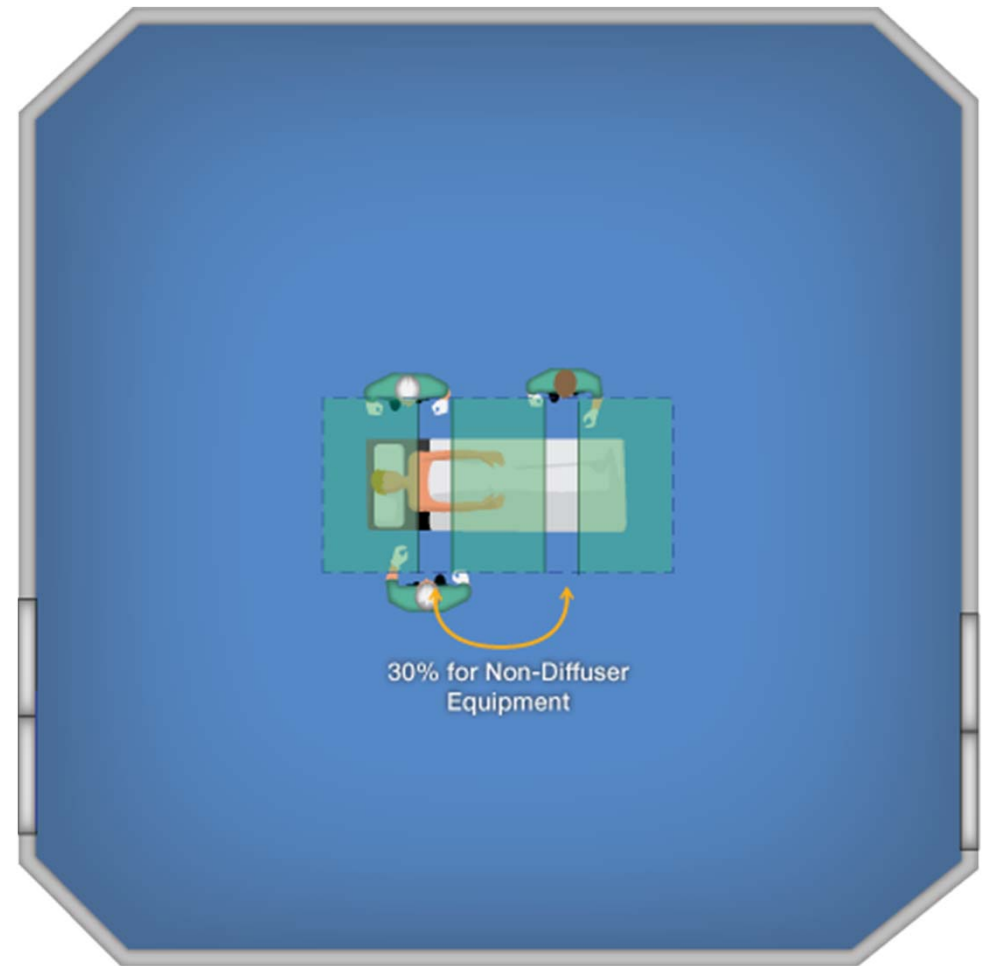
ASHRAE 170 Requirements

- System Sizing Example:
 - 480 ft² O.R.
 - 10ft ceiling
 - 20 ACH = 1600cfm



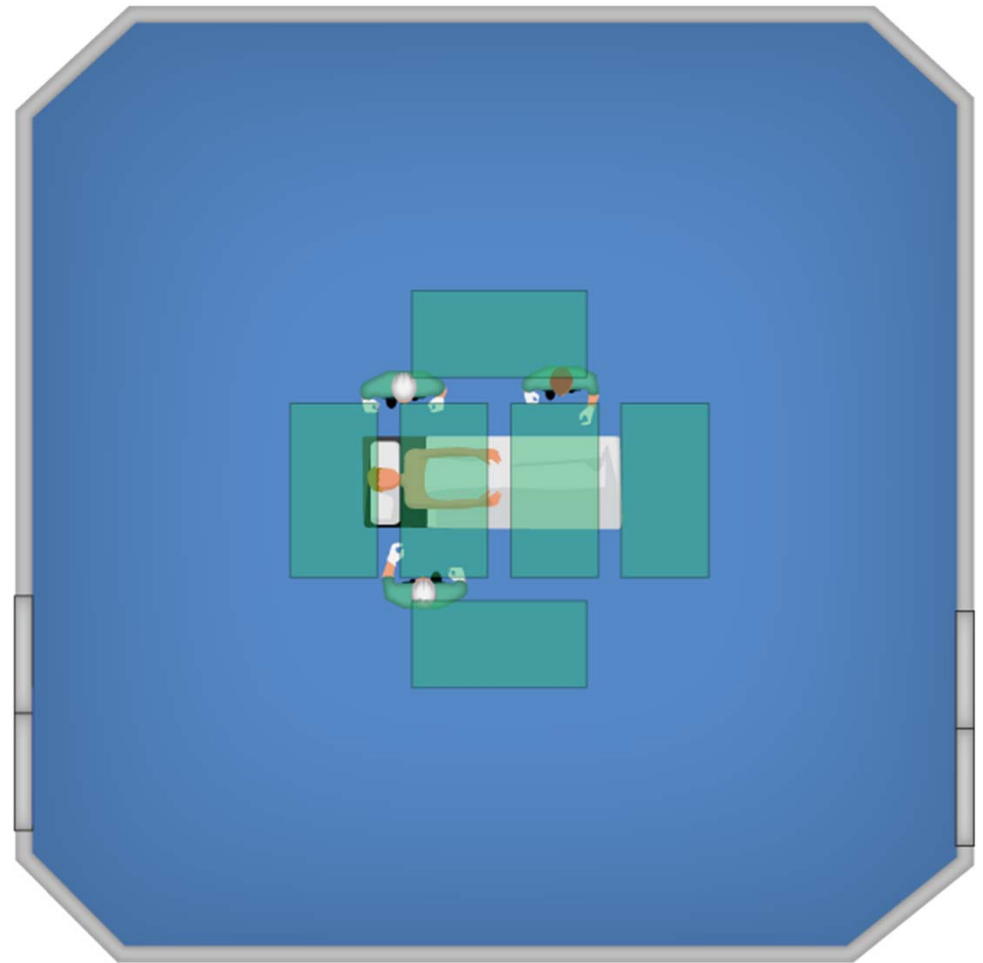
ASHRAE 170 Requirements

- Maximum of 30% non-diffuser equipment
- (3) 24"x48" diffusers
 - 25 cfm/ft² = 600 cfm
 - 30 cfm/ft² = 720 cfm
 - 35 cfm/ft² = 840 cfm
- Need more than just (3) diffusers for 20 ACH and 1600 cfm



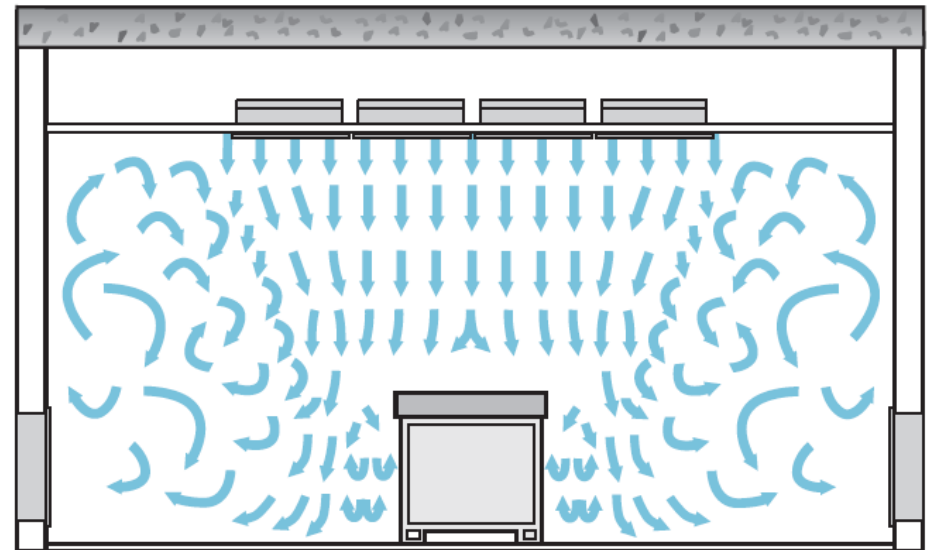
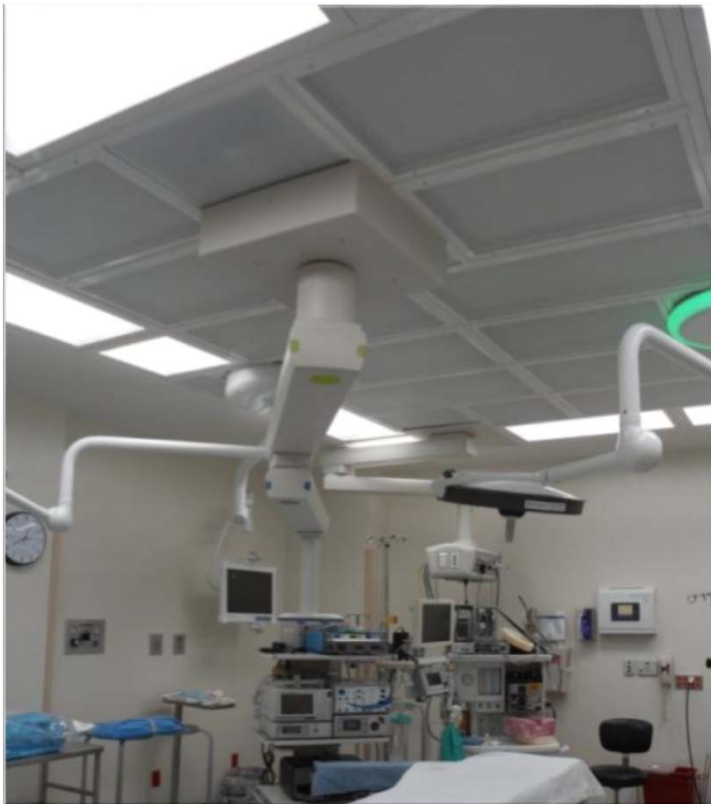
ASHRAE 170 Requirements

- Need more than just (3) diffusers for 20 ACH and 1600 cfm
- Add 4 additional diffuser for seven total



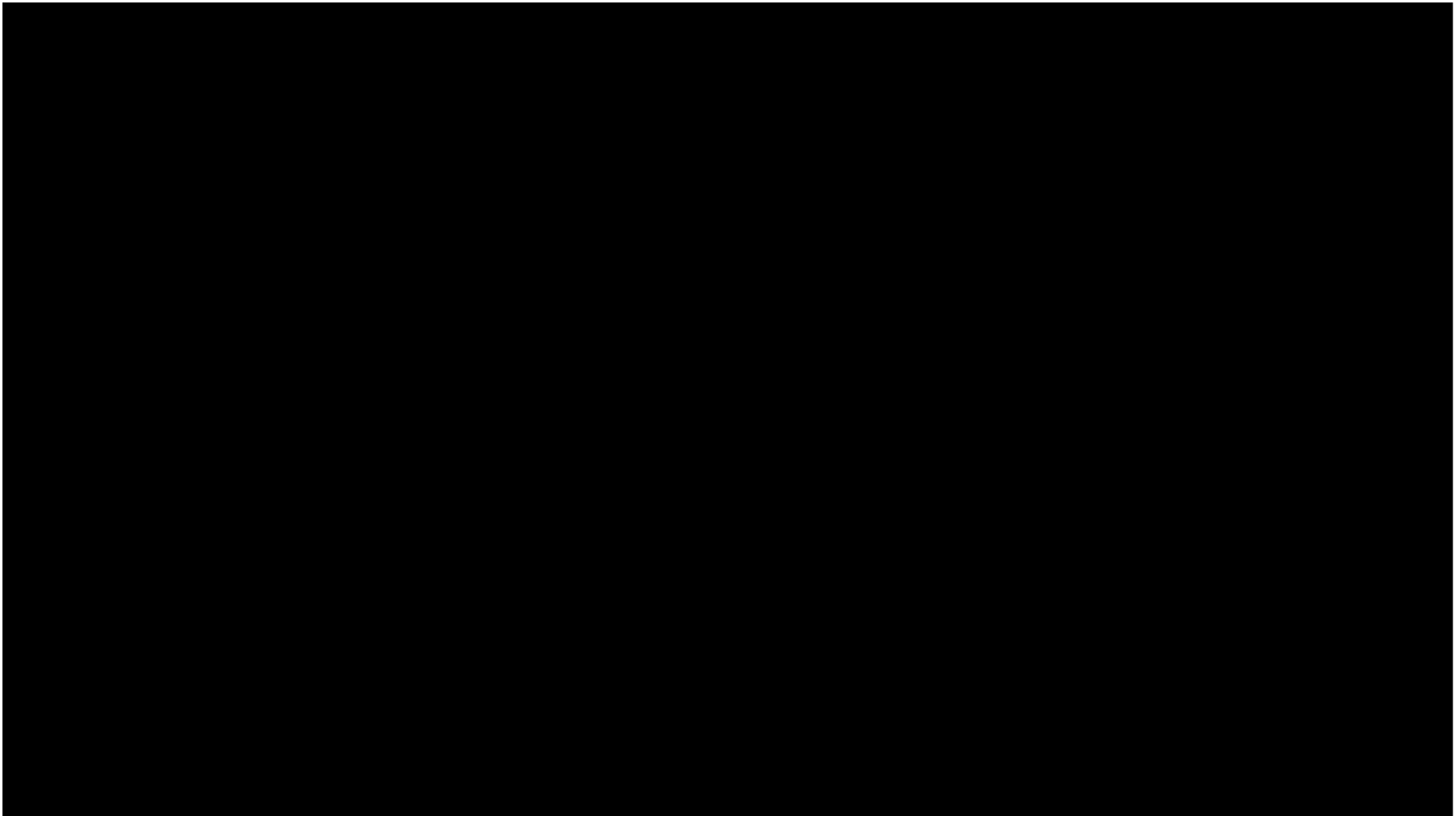
Operating Rooms

- Laminar Flow Systems
 - Laminar diffuser array concentrated above surgical zone
 - Displace particulates to low-level returns



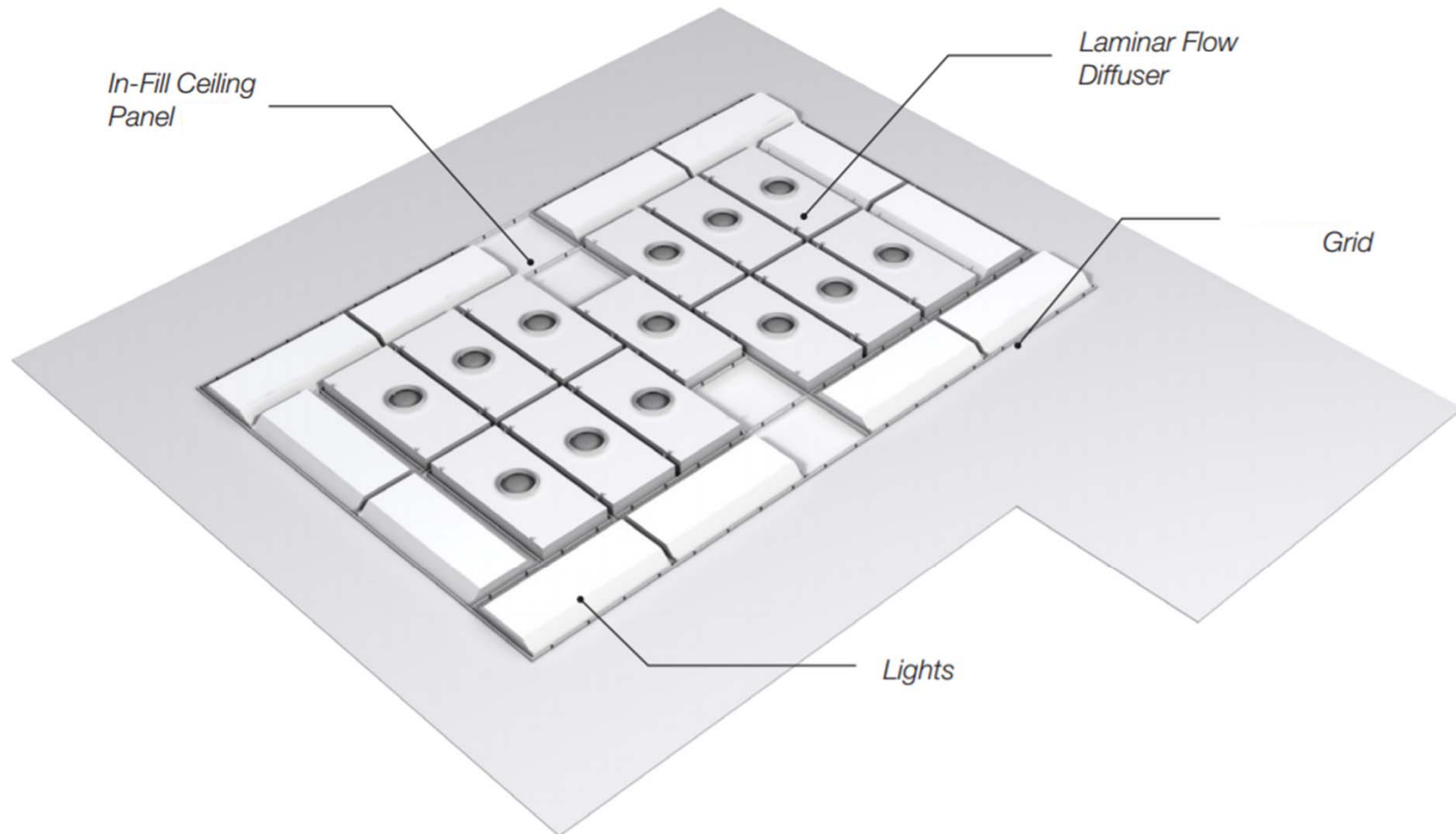
Operating Rooms

- Laminar Flow Systems



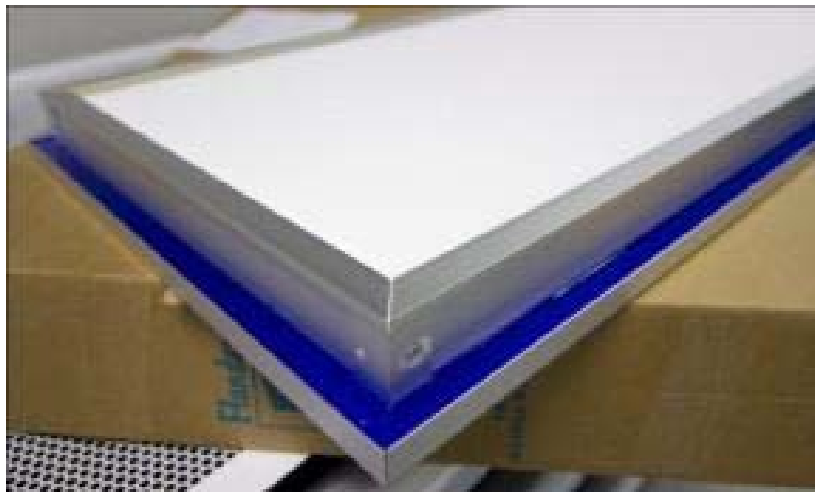
Operating Rooms

- Typical Laminar Diffuser Layout



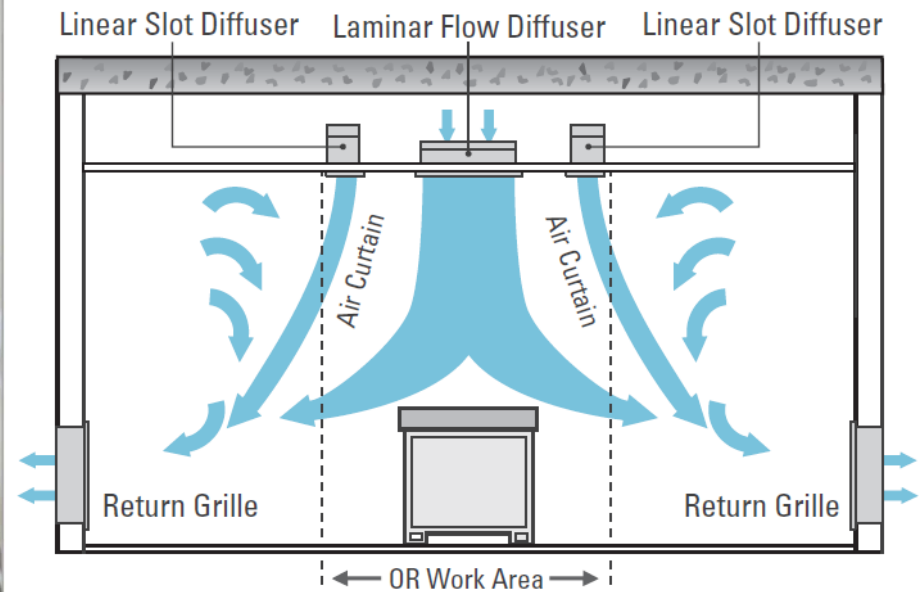
Operating Rooms

- Diffuser mounted HEPA filters
 - Room-side replaceable with gel seal
 - Eliminates concern of upstream duct cleanliness
 - Lower pressure drop vs. HEPA in Air Handler



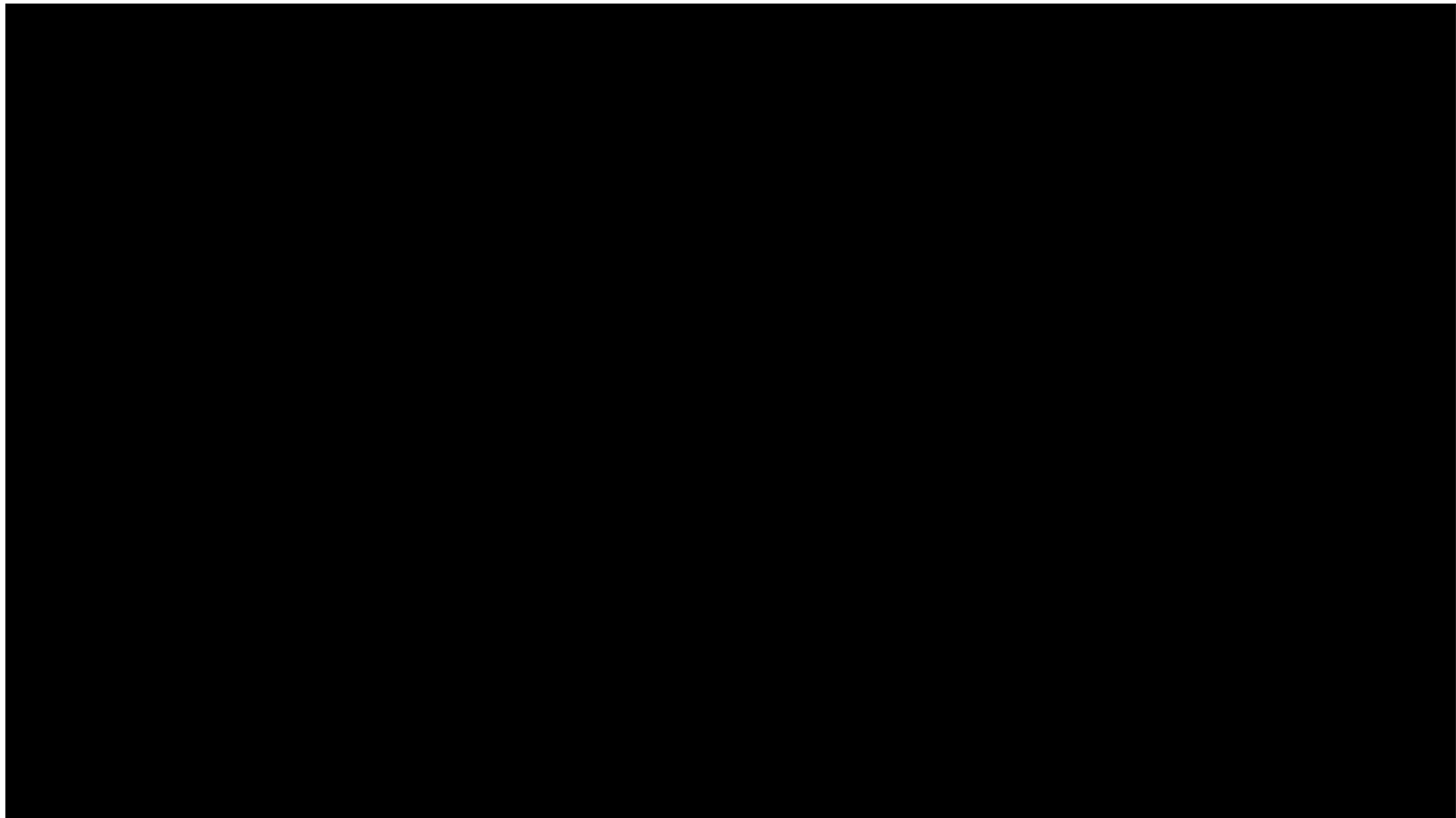
Operating Rooms

- Air Curtain Systems
 - Smaller laminar array (30-40% of total airflow)
 - Perimeter slot at 25 to 45 cfm/ft (60-70% of total airflow)
 - Displace particulates to low-level returns



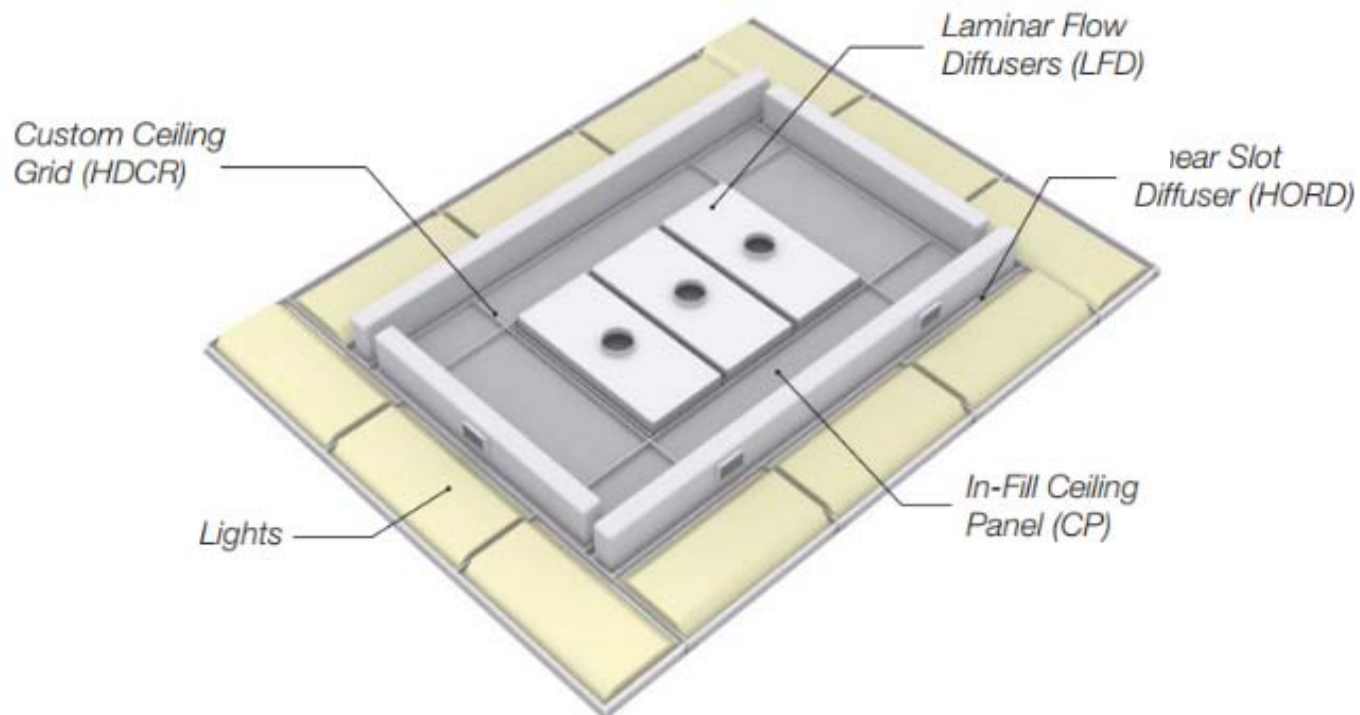
Operating Rooms

- Air Curtain System



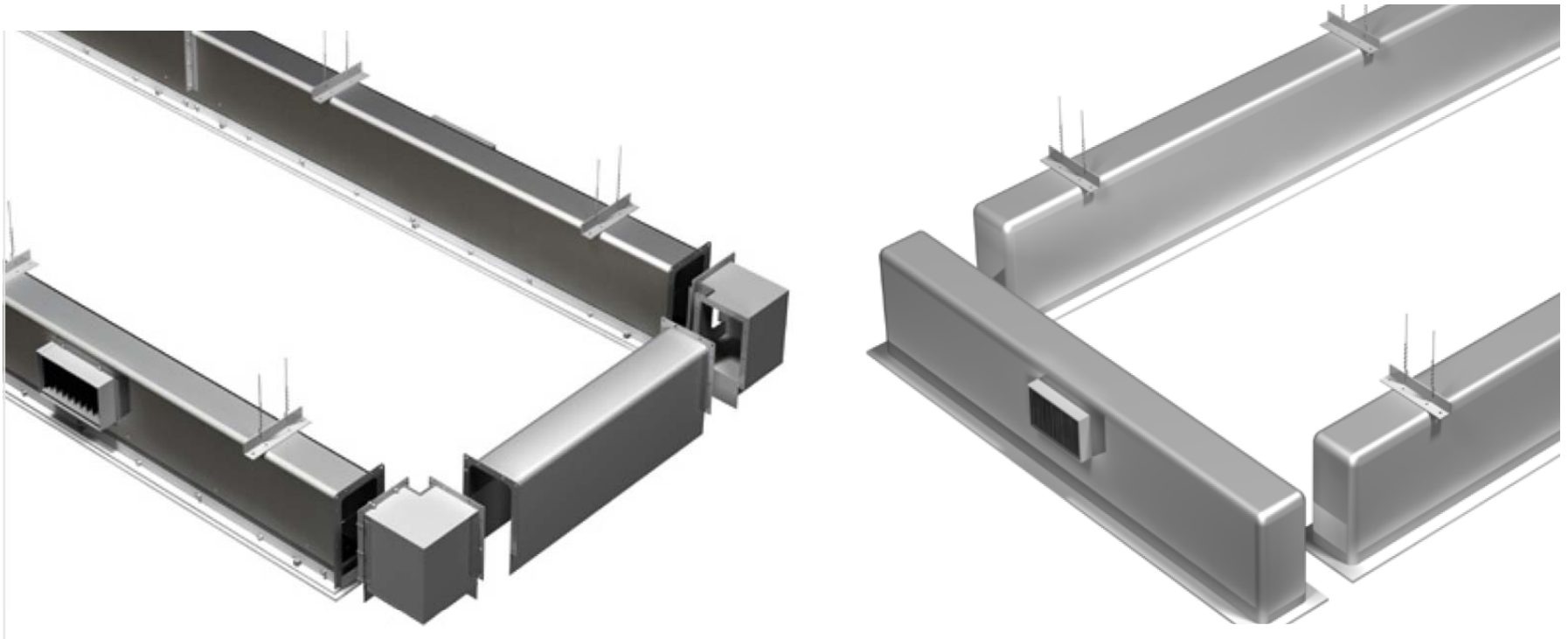
Operating Rooms

- Benefits of Air Curtain Systems
 - Smaller laminar array
 - Easier integration with other ceiling equipment



Operating Rooms

- Ductwork simplification with continuous plenum



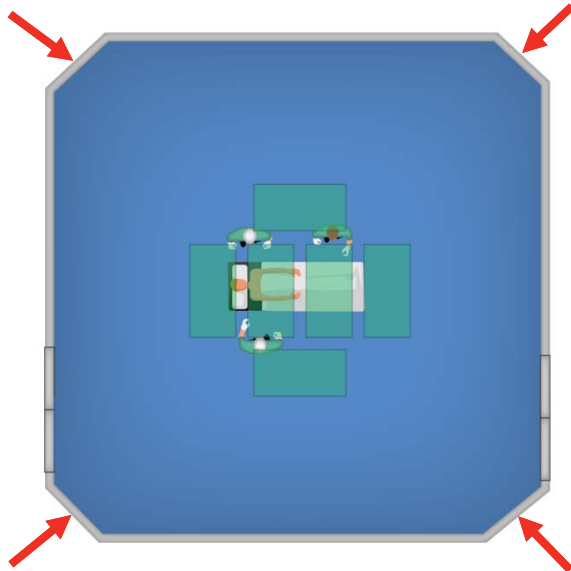
Operating Rooms

- Avoid gaps in air curtain, pathway for contaminants



Operating Rooms

- Return/Exhaust Grilles
 - Min. two low-level exhaust grilles, 4 recommended
 - Mounted symmetrically in center of walls, or in each corner
 - Optional second set at mid to high level mounting
 - Sized for 500fpm



Operating Rooms

- Laminar System
 - Ideal for smaller OR, moveable tables, and hybrid OR w/ imaging equipment
 - Allows for HEPA filter integration
 - Lower profile design, ideal for low ceiling plenum heights
- Air Curtain Systems
 - Good option for large OR, or where large airflow is required
 - Reduces overall diffuser sizes in ceiling and frees up ceiling space
 - Reduces tapering effect of center laminar array

Critical Environments

Modern Operating Room Challenges

Modern OR Challenges

Operating Room Trends

- Larger rooms
- More equipment and higher cooling loads
- Hybrid surgery/imaging rooms
- Congested ceilings layouts
- Congested ceiling plenums

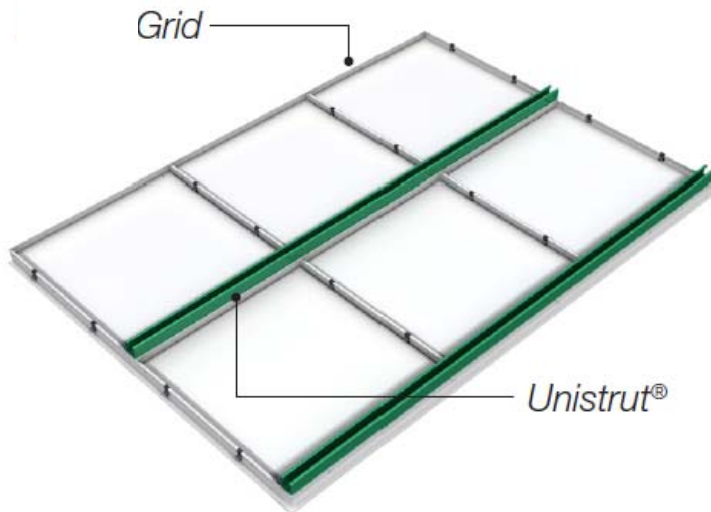
Modern OR Challenges

- Larger OR spaces, requiring more airflow/diffusers
 - 480 ft² at 20 ACH = 1600 CFM (7 diffusers)
 - 600 ft² at 20 ACH = 2000 CFM (9 diffusers)
 - 600 ft² at 25 ACH = 2500 CFM (11 diffusers)
- Hybrid/Imaging OR
 - 1000 ft² at 20 ACH = 3400 CFM (15 diffusers)

*Based on 10ft. Ceiling height and 24x48 diffusers @ 30cfm/ft²

Modern OR Challenges

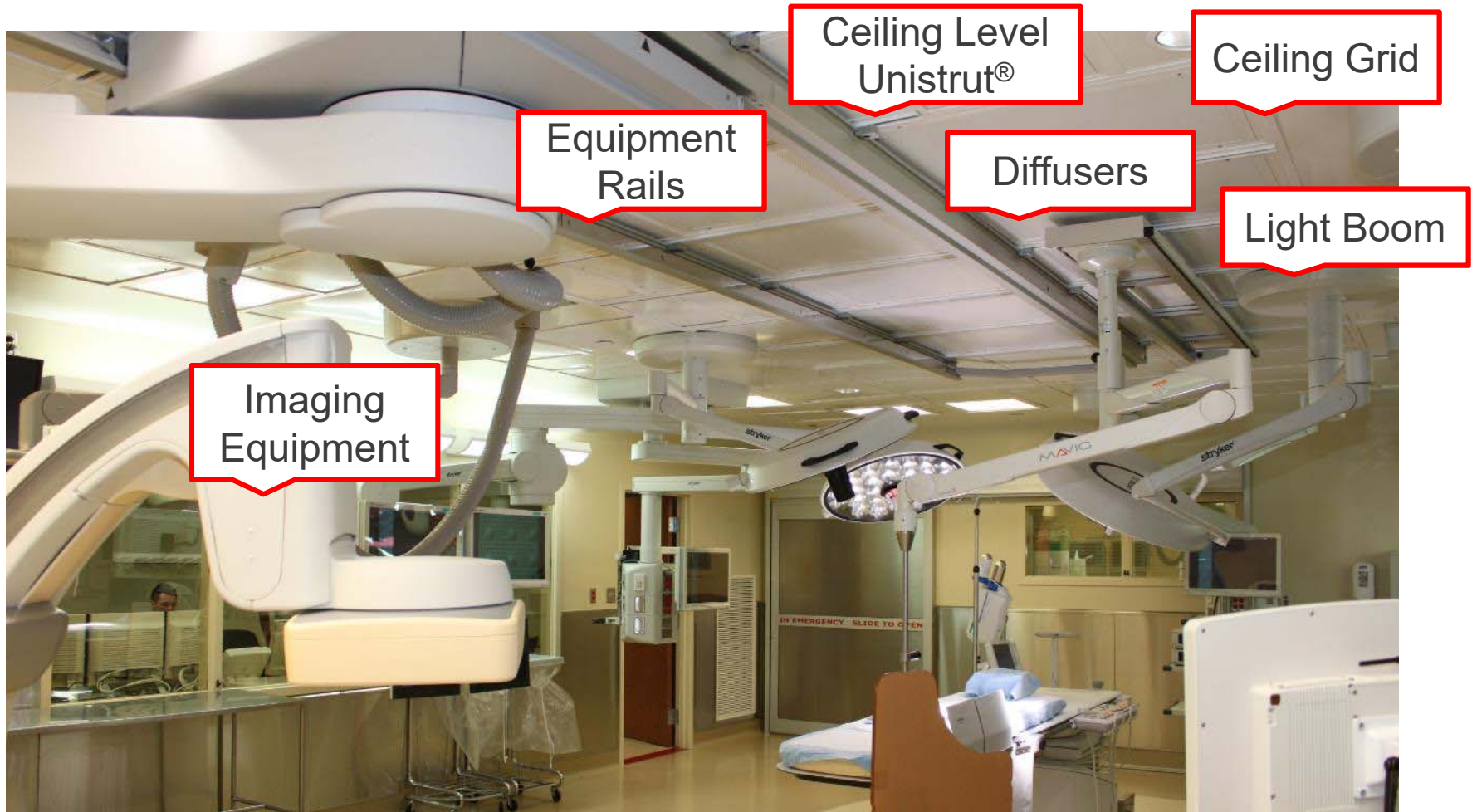
- Hybrid OR, Interventional Radiology, Catheterization
 - Ceiling level rails or Unistrut®
 - Facilitates mounting of C-Arm support tracks



Critical Environments

Modern OR Challenges

- Additional equipment and congested ceilings

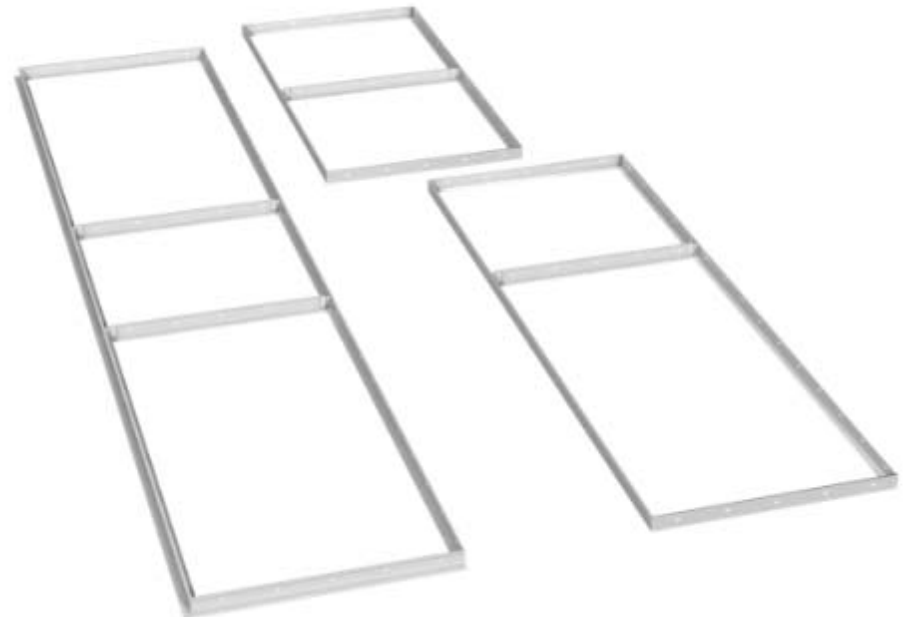
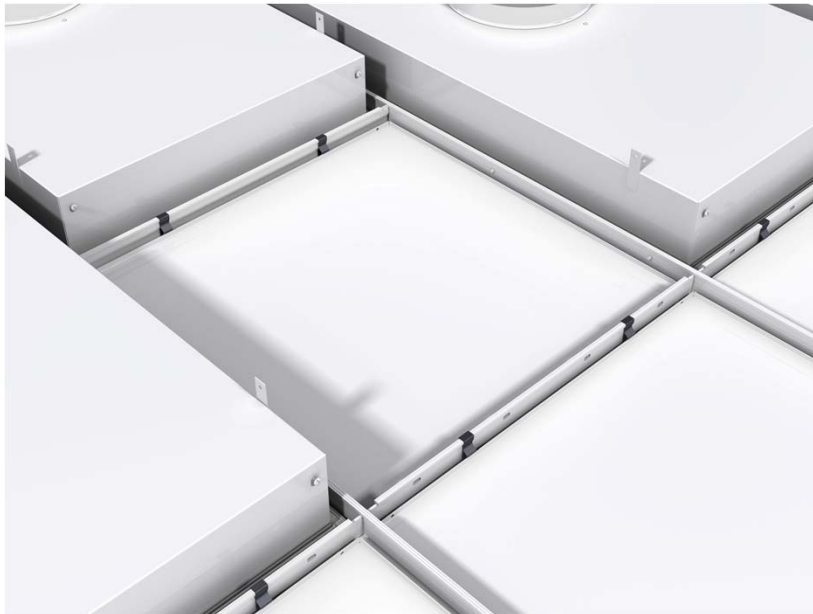


Critical Environments

Modern Operating Room Strategies

Operating Room Strategies

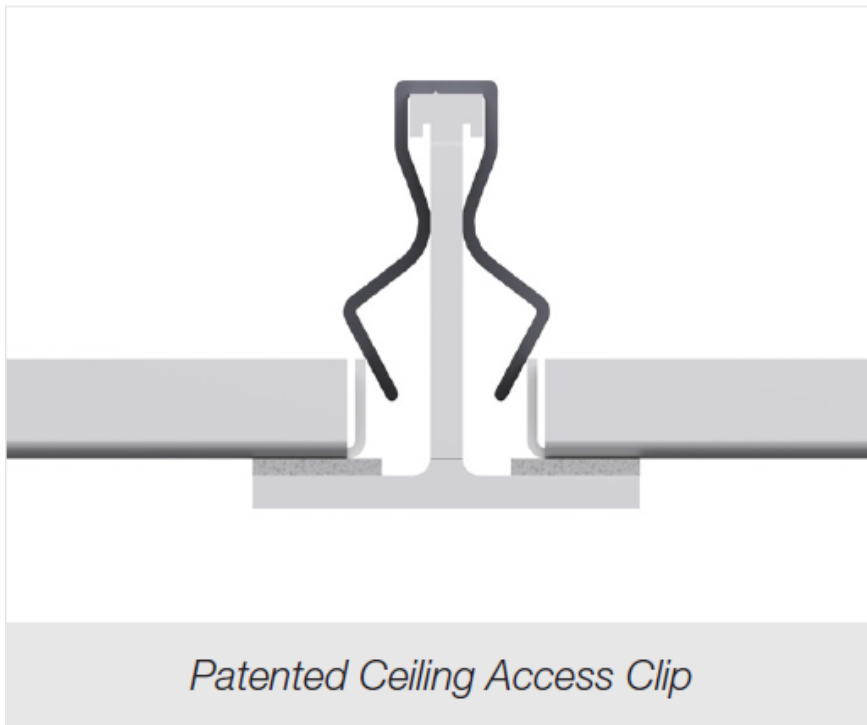
- Maintaining room pressure integrity is critical
 - Gasket T-bar grid is a great option
 - Framing for diffusers, lights, infill panels
 - Provides easy access to ceiling plenum and equipment



Ceiling Systems

Patented Ceiling Clip

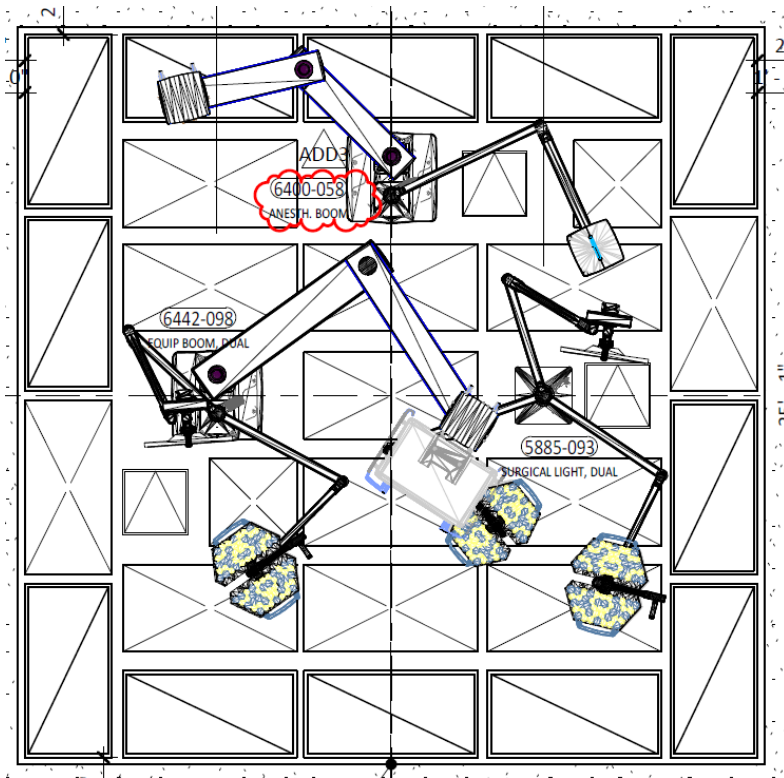
- Turn every panel into an access panel



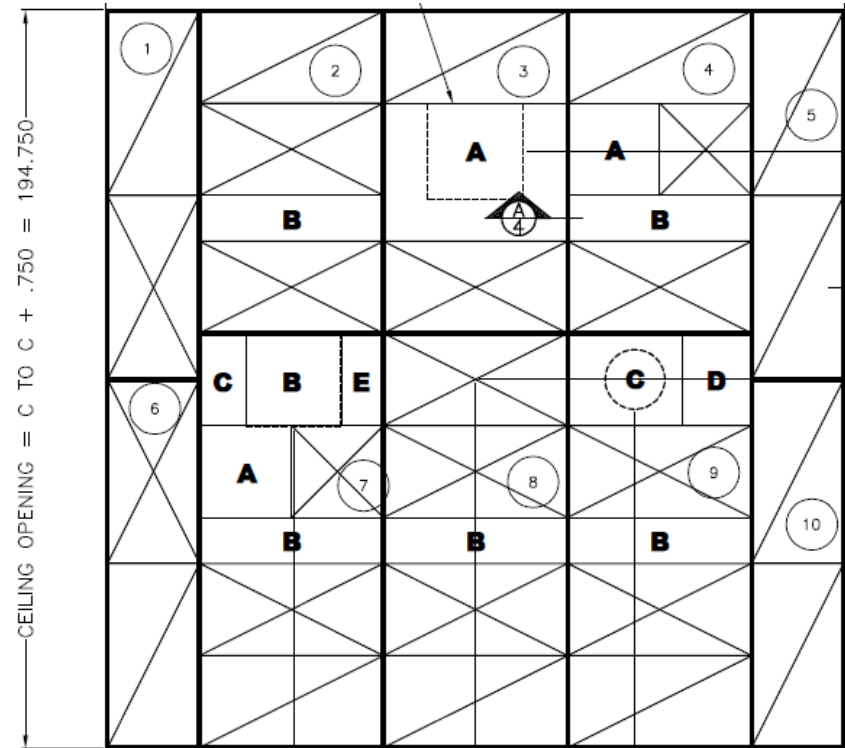
Critical Environments

Ceiling Systems

- Optimizing layouts, reduce gaps between laminar diffusers

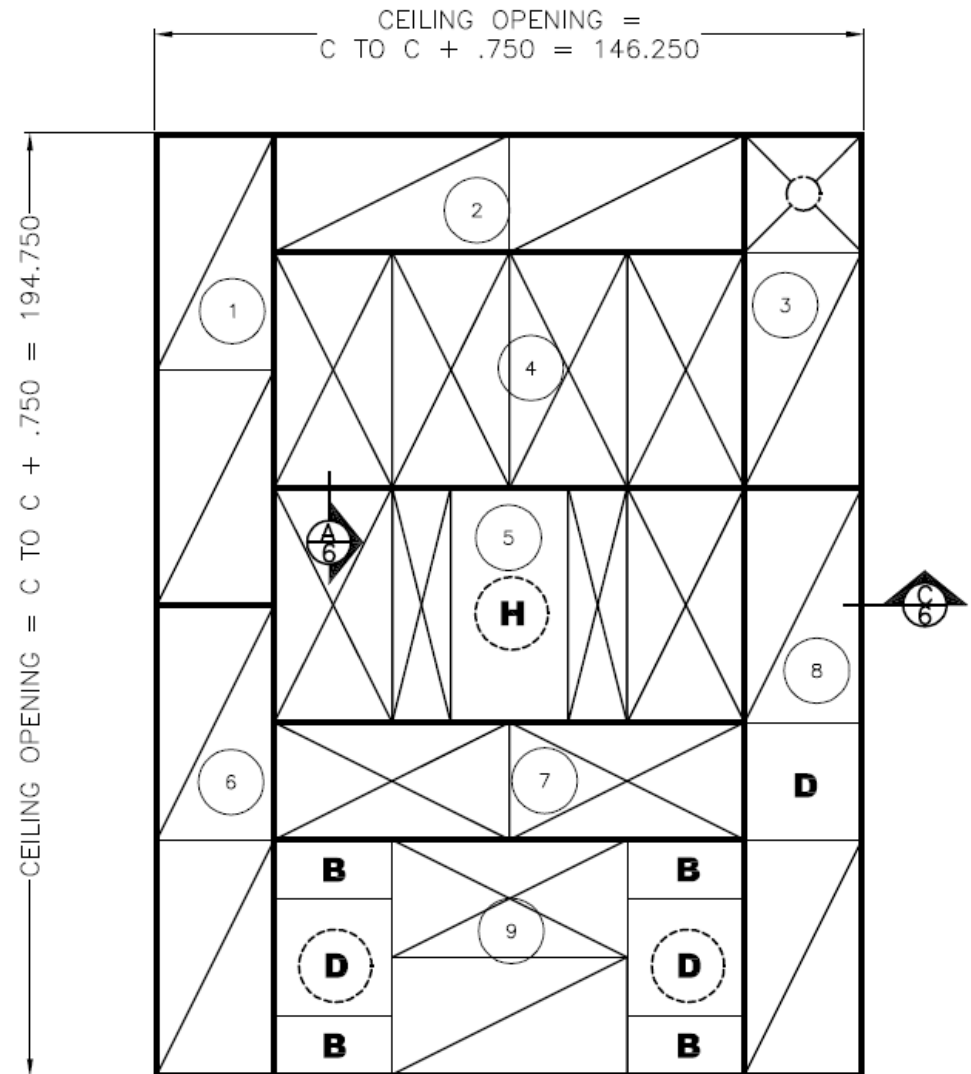
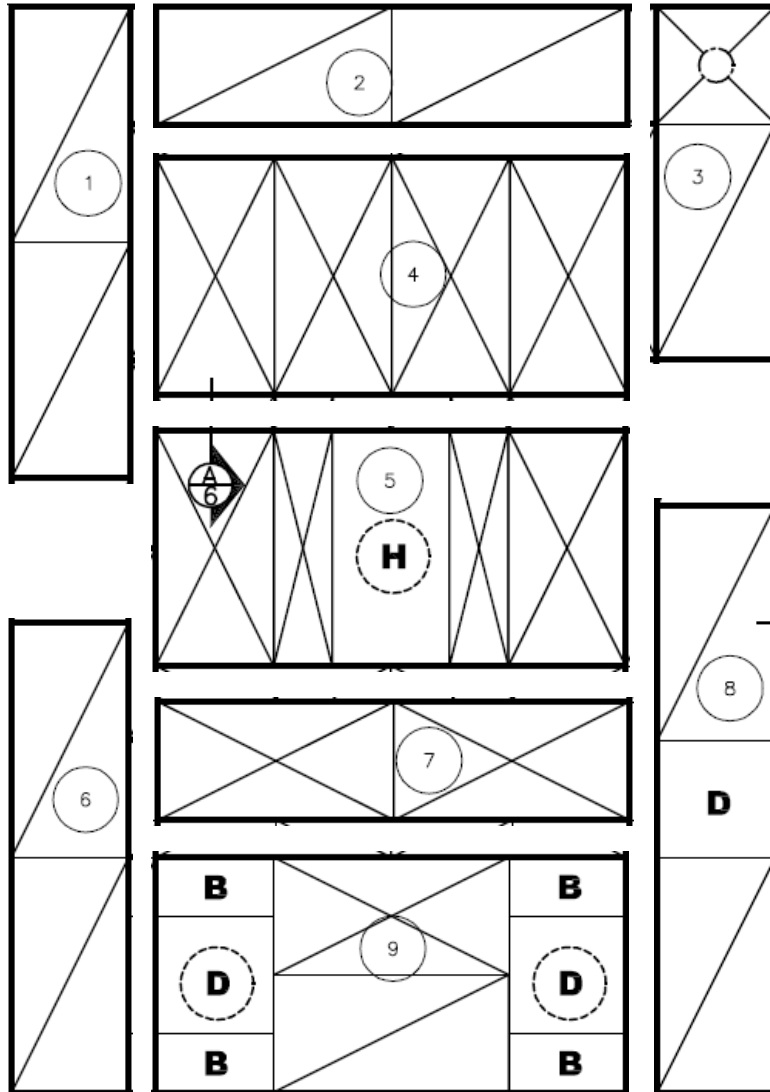


34 framed openings



1 framed opening

Ceiling Systems



Critical Environments

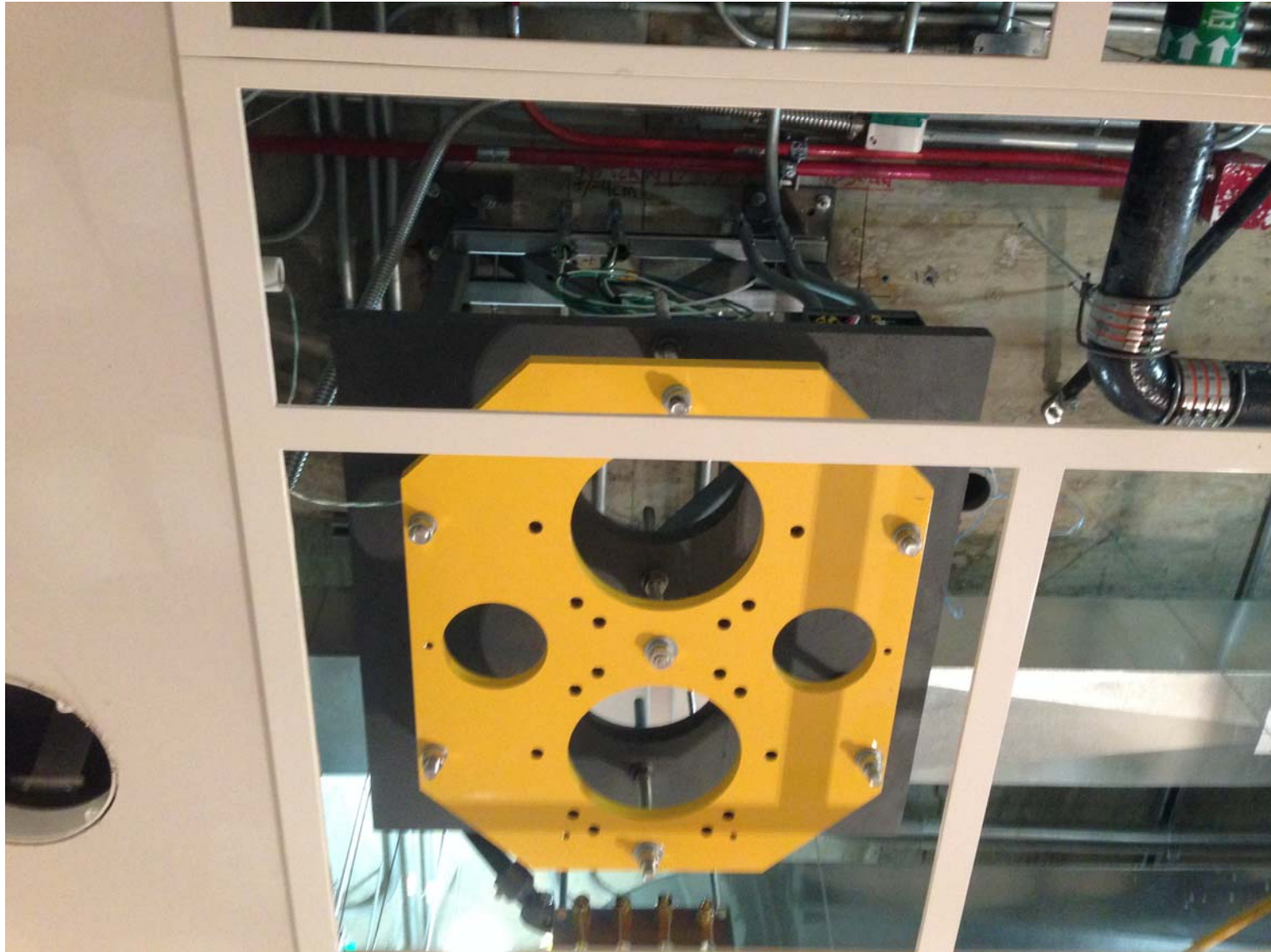
Ceiling Systems



Ceiling Systems

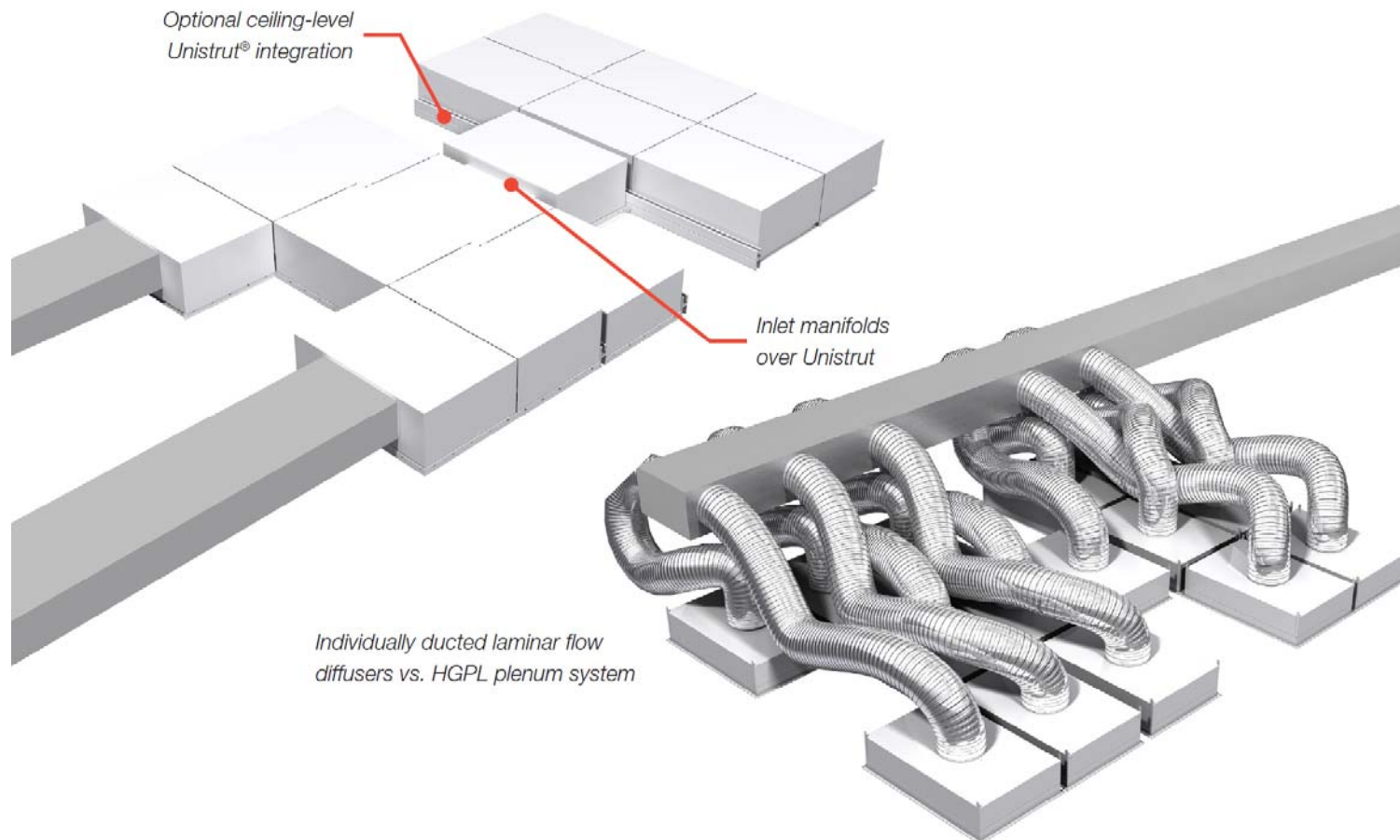


Ceiling Systems



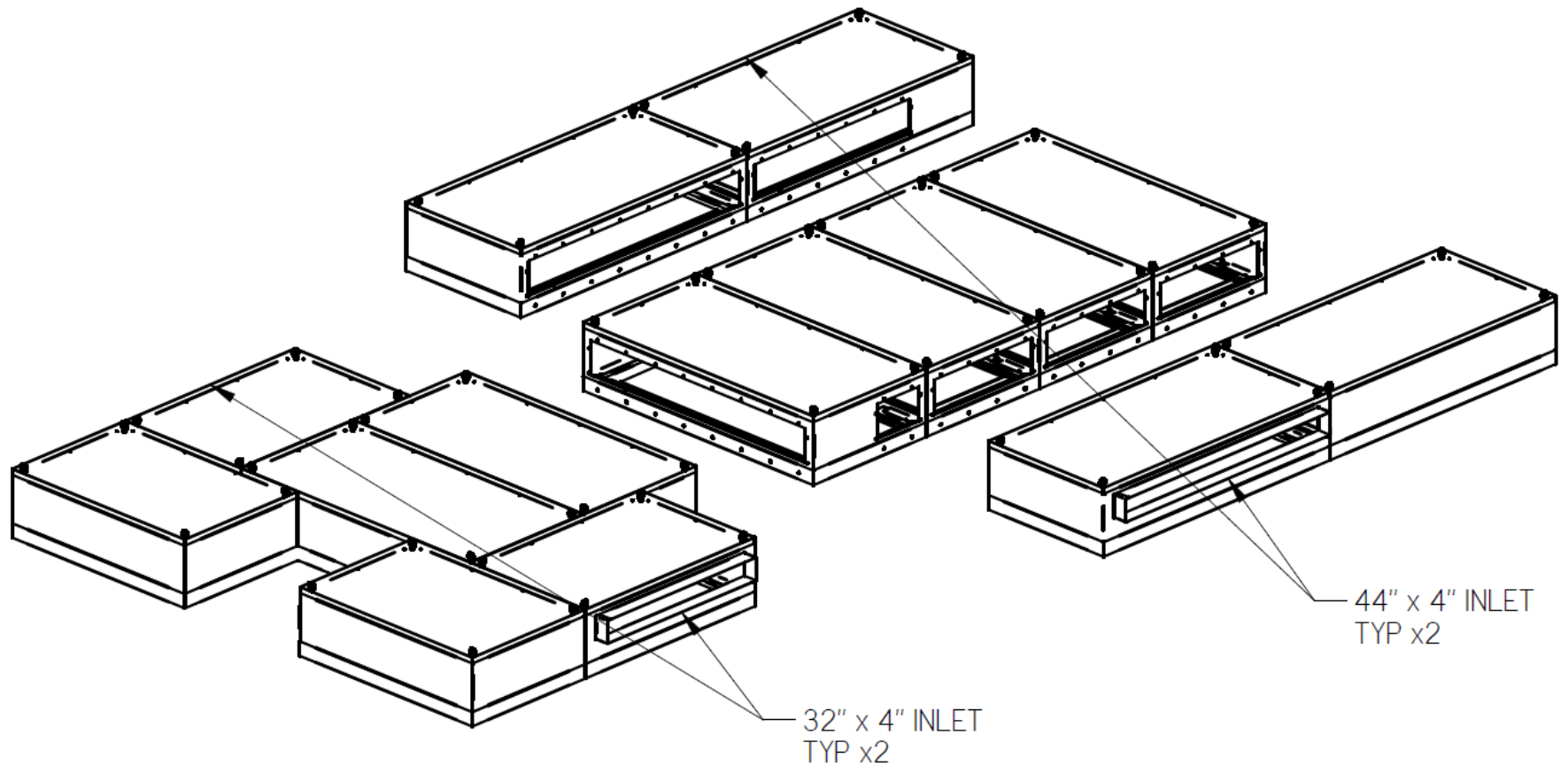
Operating Room Strategies

- Use common plenum to reduce ductwork and height

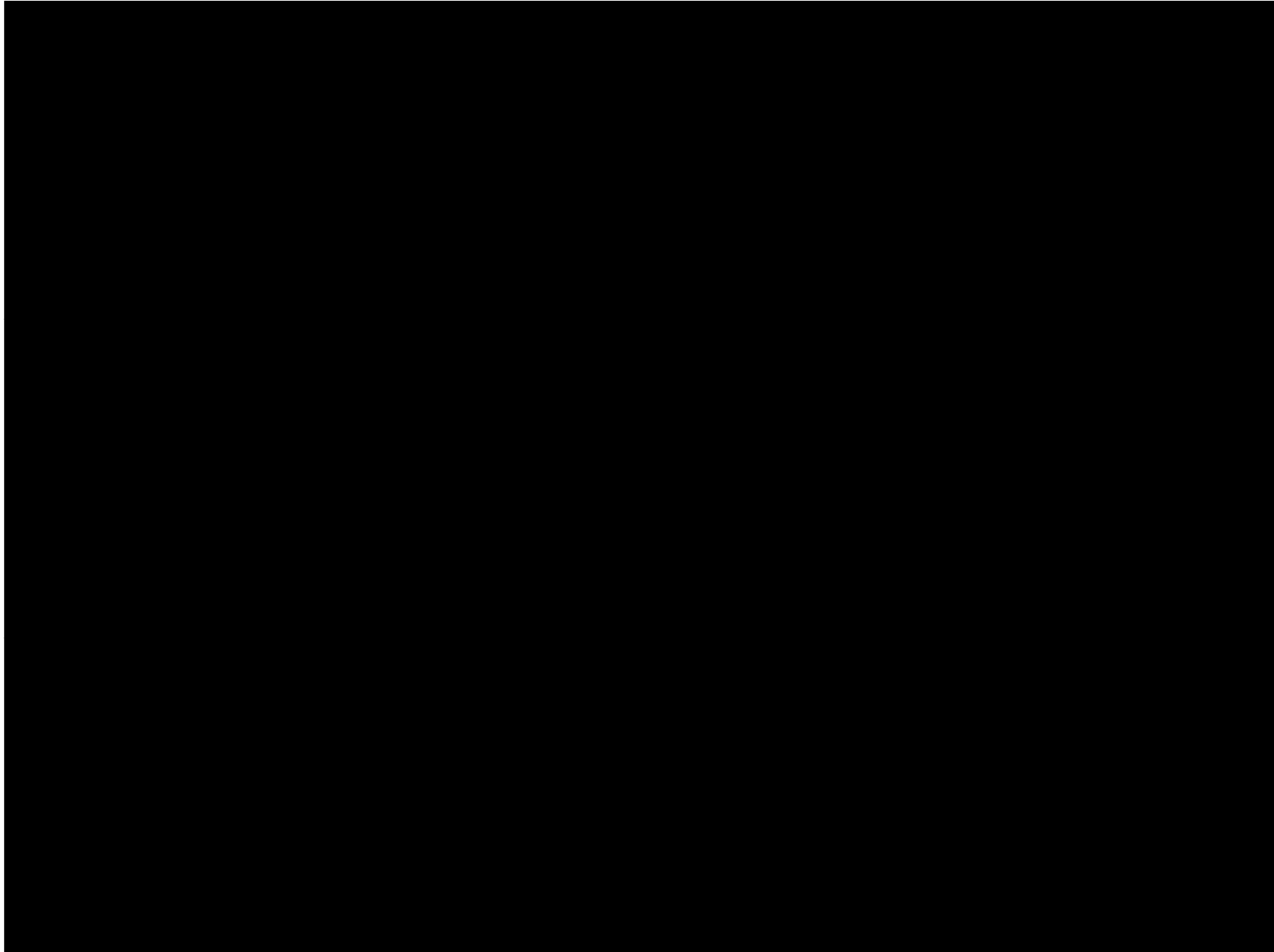


Operating Room Strategies

- Ships as modular components to site for final assembly



Operating Room Strategies



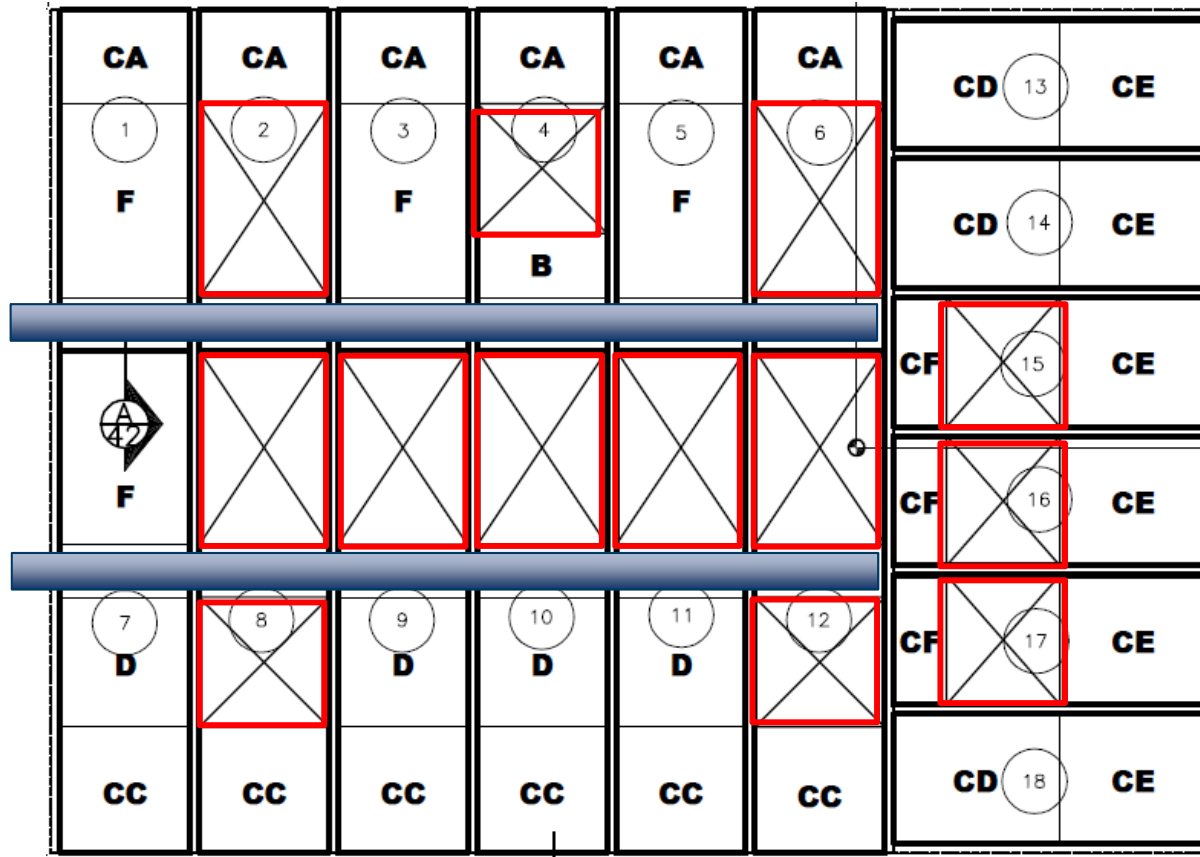
Operating Room Strategies

- Easy to clean and nice aesthetic with flush face assembly



Operating Room Strategies

- Hybrid OR: Custom diffuser sizes are common, maximize size between main horizontal equipment rails



Operating Room Strategies

- Do not cover laminar diffusers with equipment rails



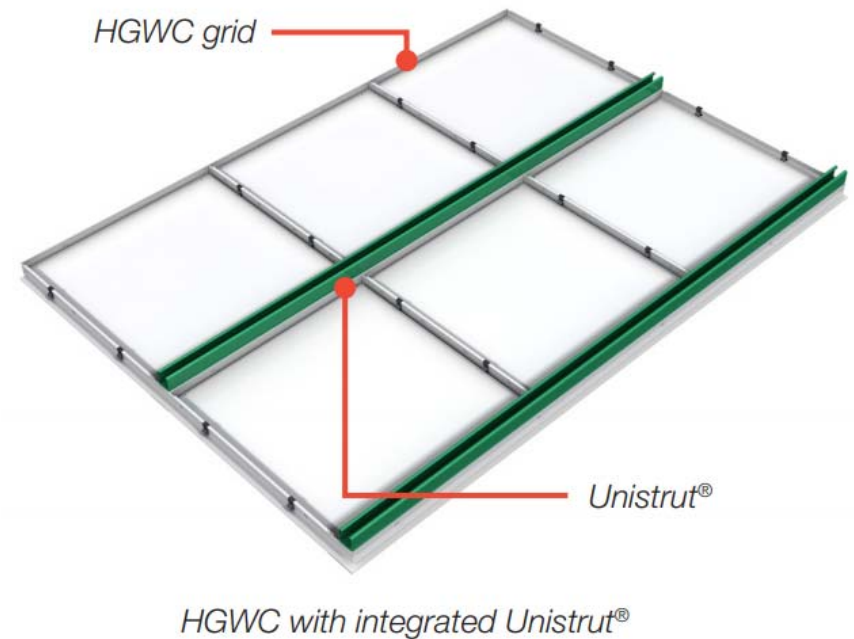
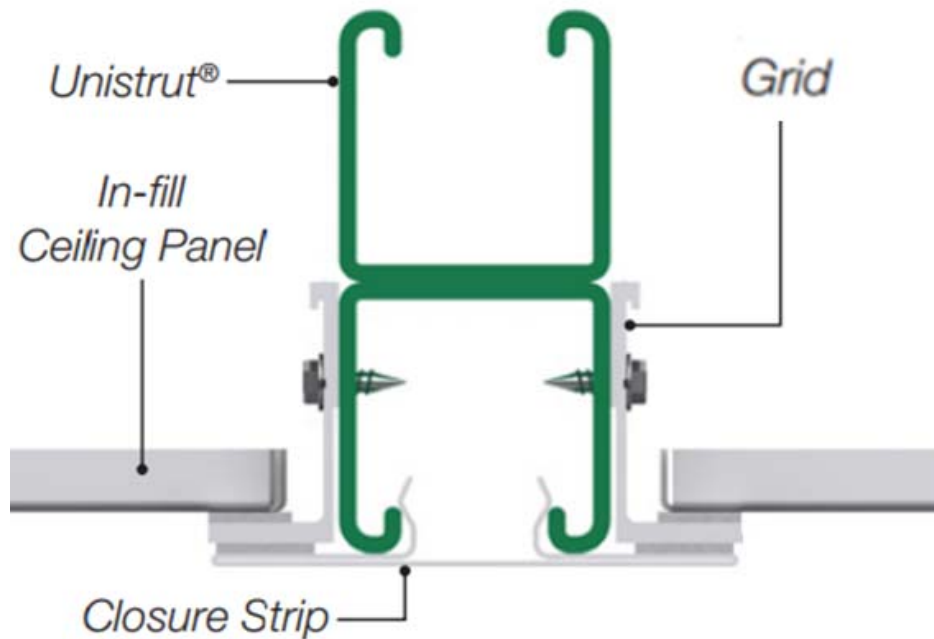
Critical Environments

Ceiling Systems



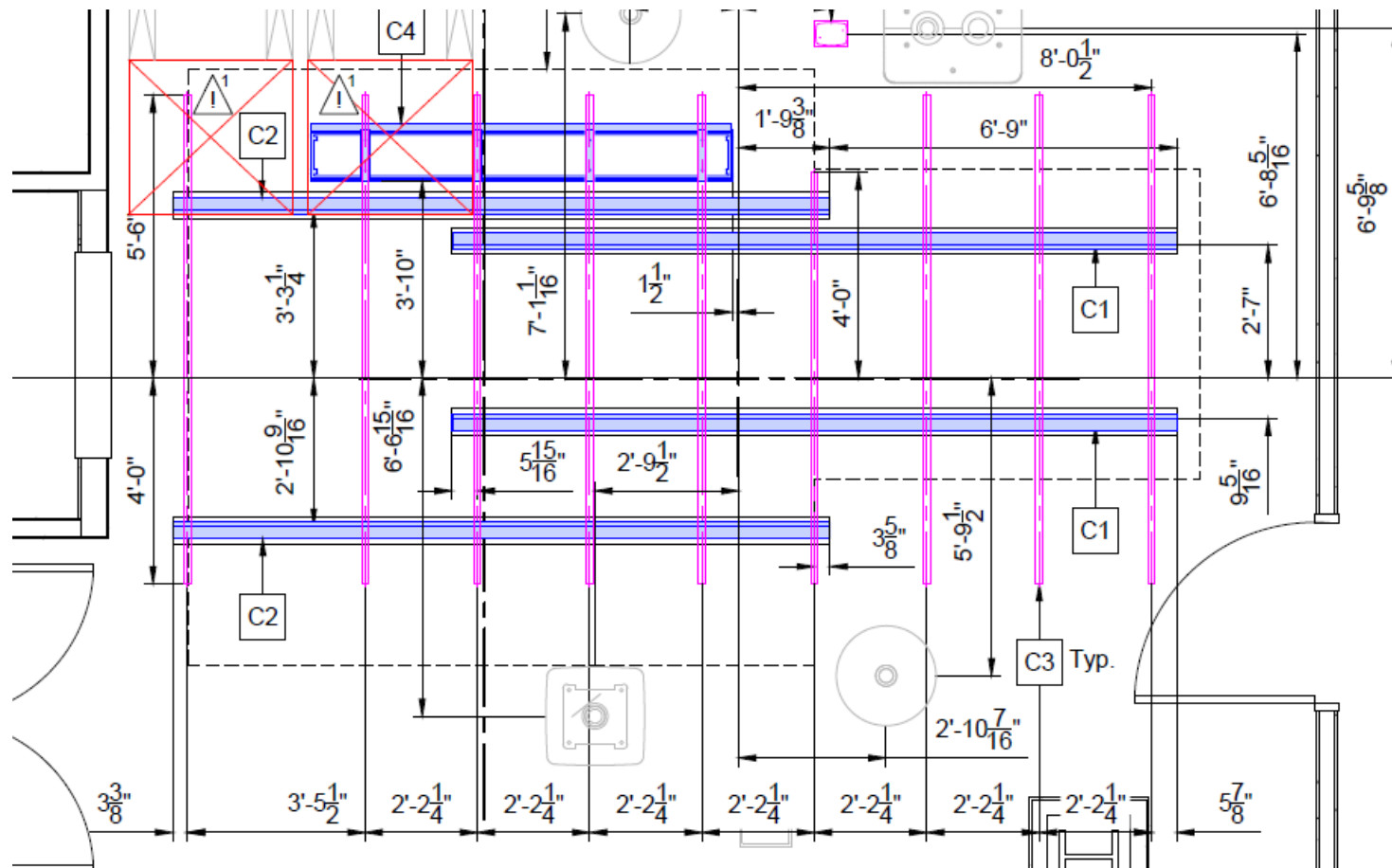
Operating Room Strategies

- Use Engineered ceiling grid between ceiling-level rail



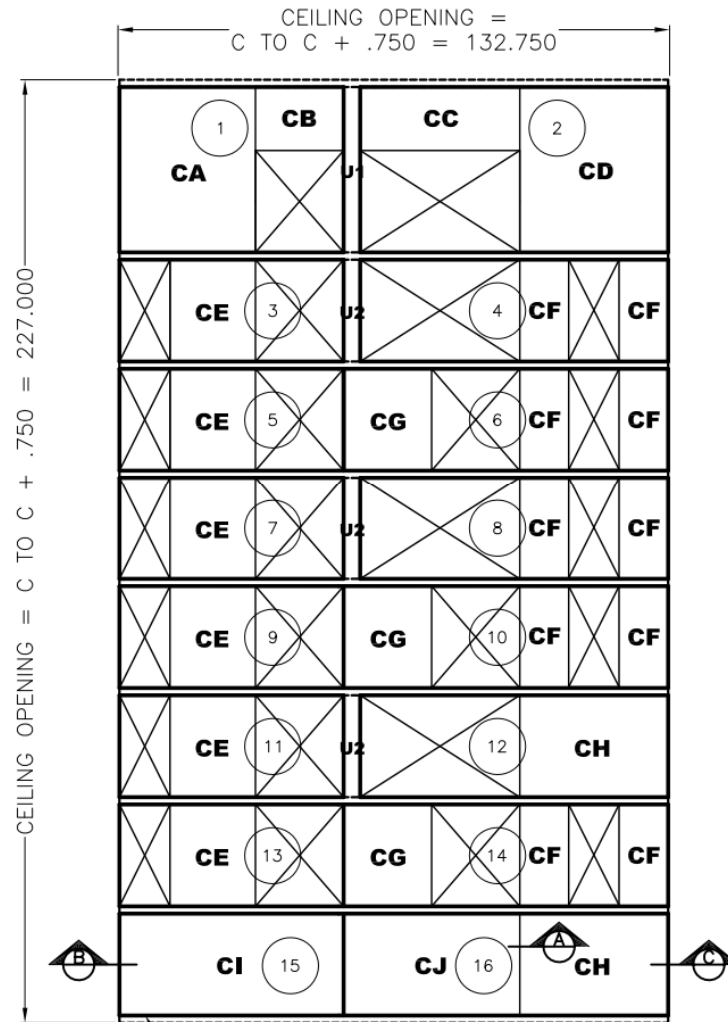
Operating Room Strategies

- Careful coordination with imaging equipment



Operating Room Strategies

UNISTRUT LAYOUT TO SUPPORT PHILIPS ALLURA INTERVENTIONAL RADIOLOGY EQUIPMENT



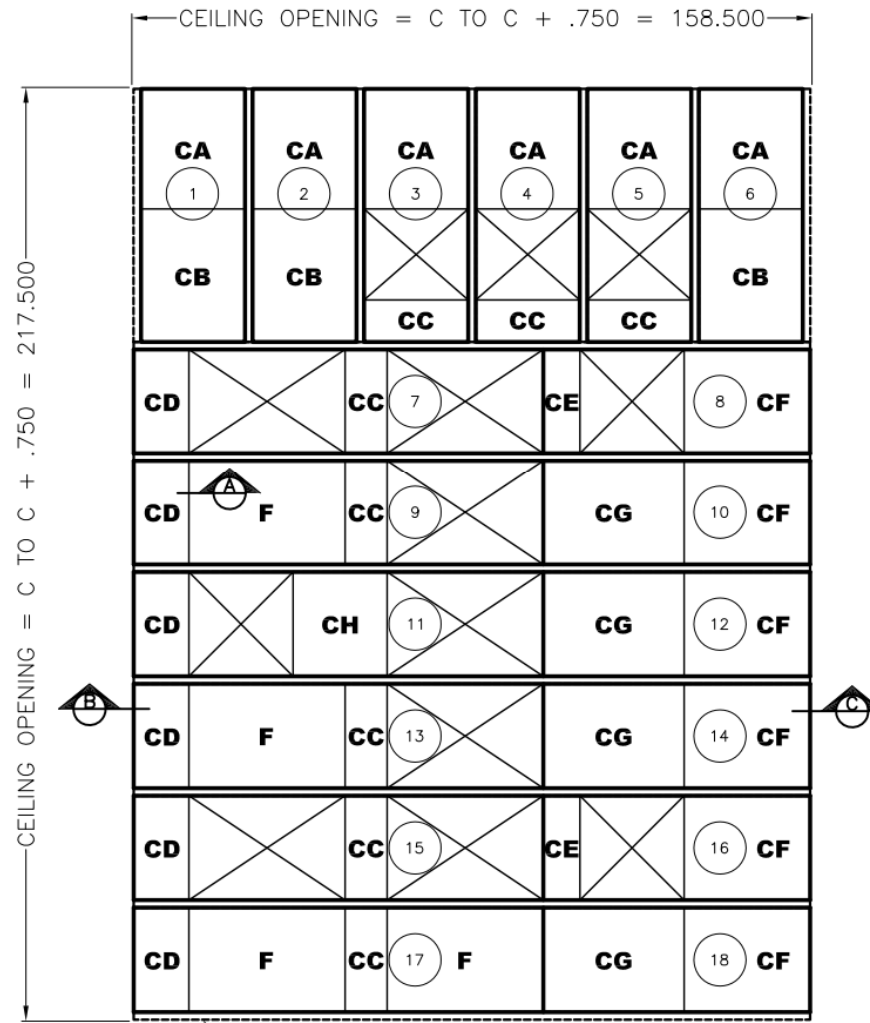
Critical Environments

Operating Room Strategies



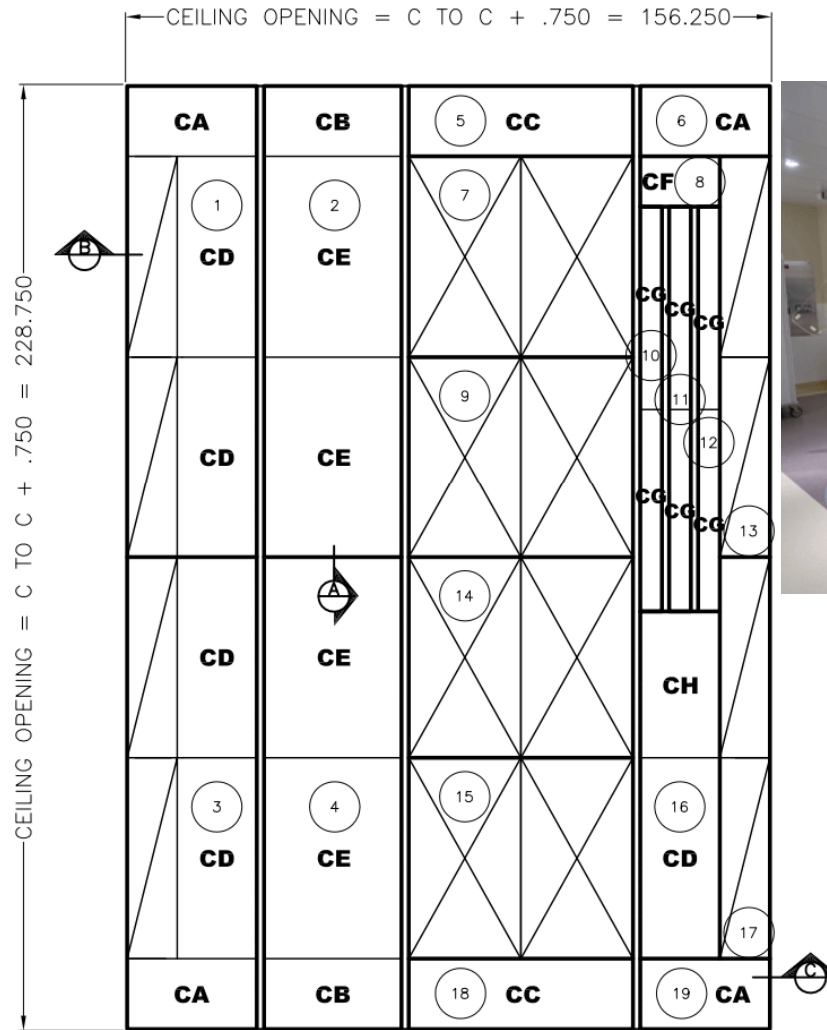
Operating Room Strategies

UNISTRUT LAYOUT TO SUPPORT SIEMENS AXIOM ARTIS RADIOLOGY EQUIPMENT



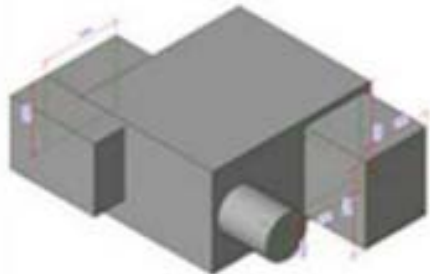
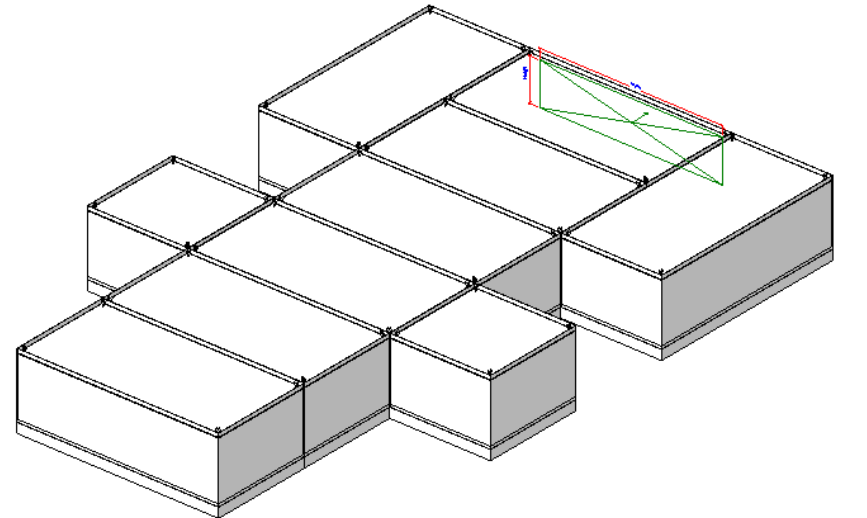
Operating Room Strategies

UNISTRUT LAYOUT TO SUPPORT GE INNOVA IGS INTERVENTIONAL CARDIOLOGY EQUIPMENT

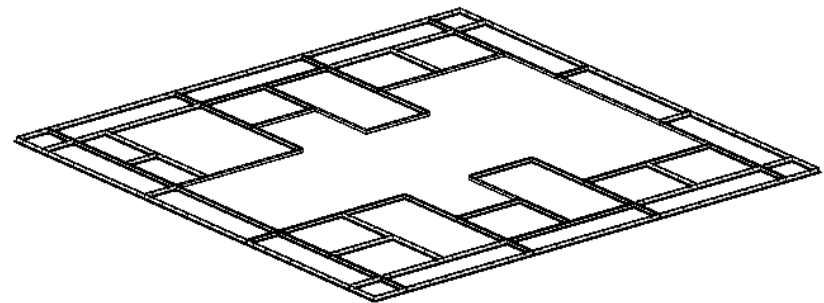


Operating Room Strategies

- Integrated Design team; design coordination between Engineers, Architect and equipment suppliers is key



Revit SMART PARTS



Critical Environments

Case Study – Common Plenum

Critical Environments

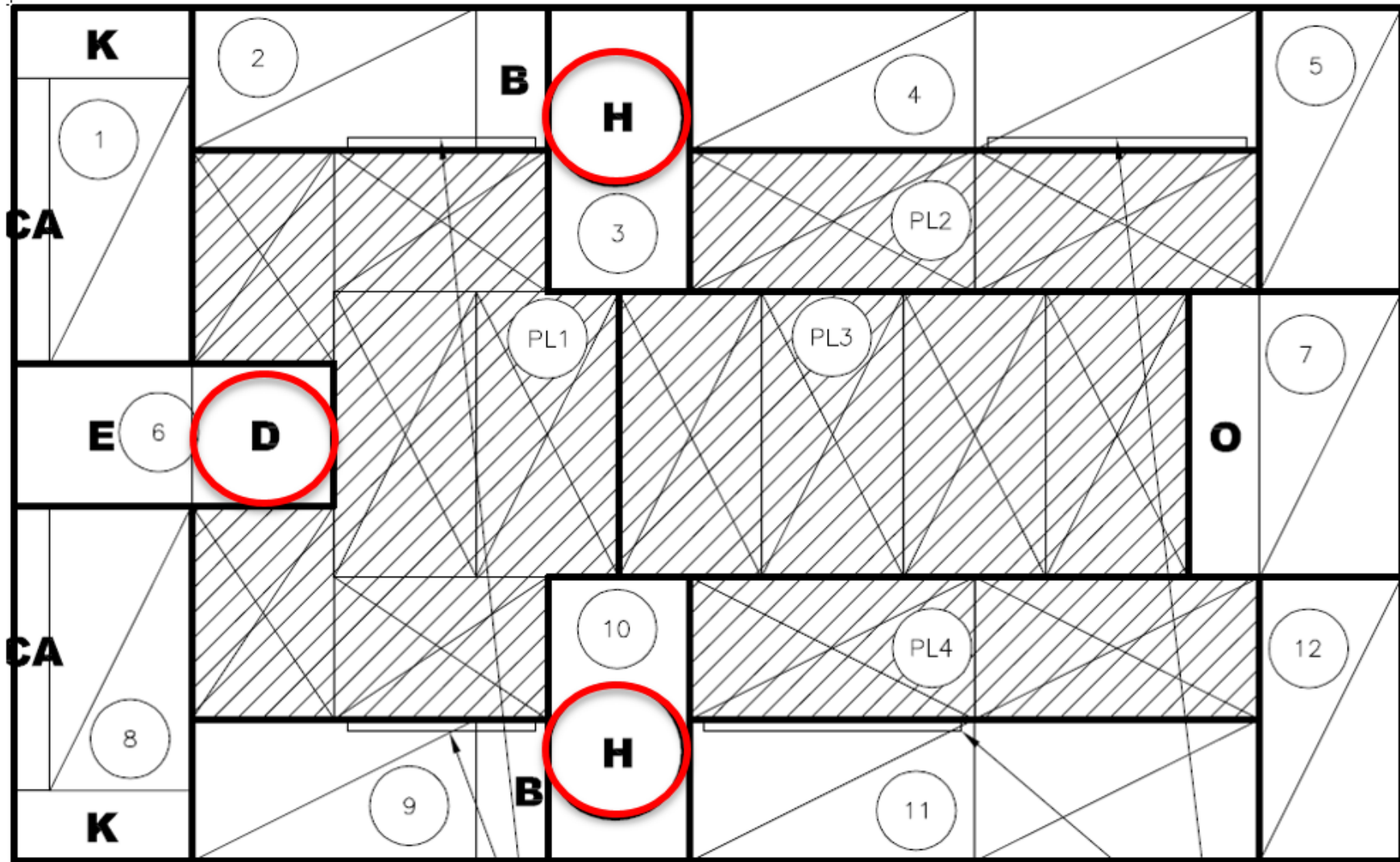
University Health Care System – Augusta, GA

- Challenge:
 - Low ceiling plenum height, 12” height limitation
 - 798 ft², 20 ACH, 2700 CFM
 - 14 laminars, no room for top inlet diffusers
 - Two light booms w/ med gas, one equipment boom
 - 11 perimeter light troffers



Critical Environments

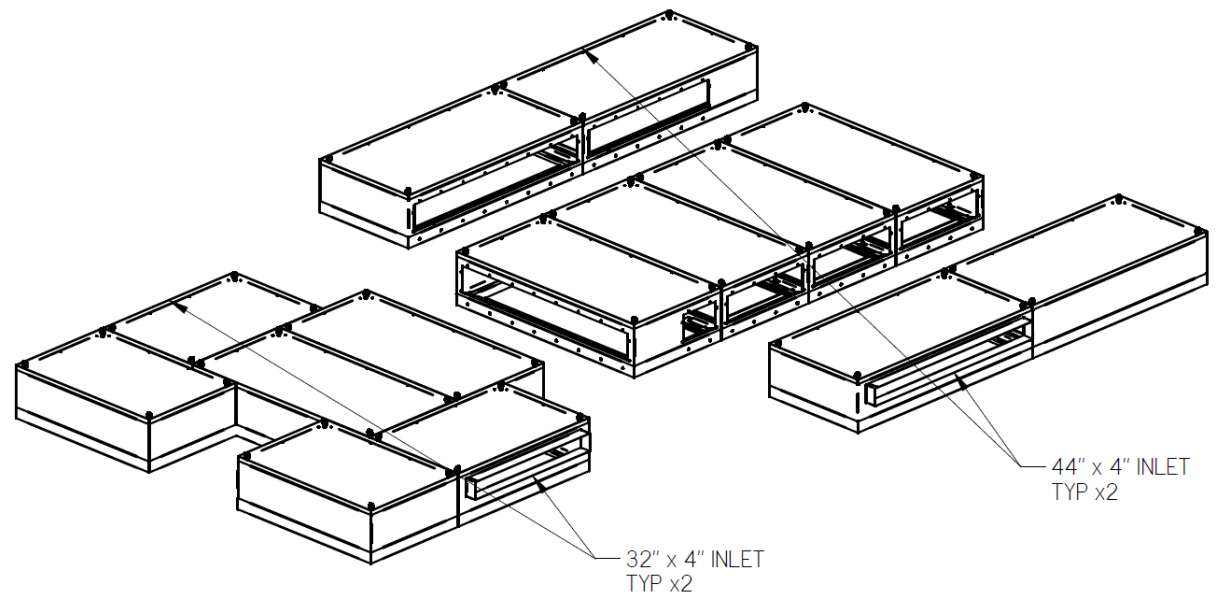
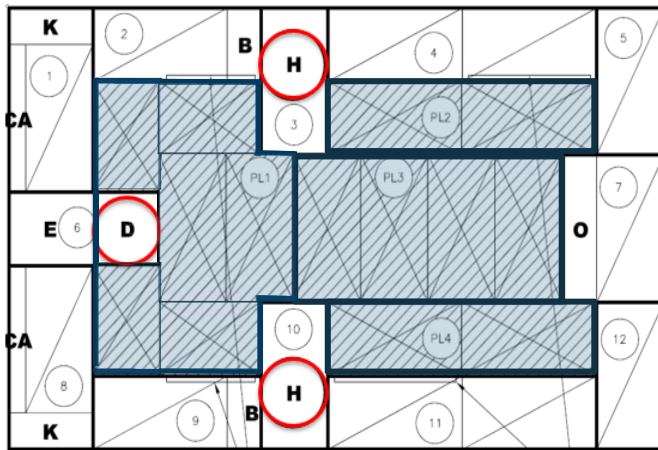
University Health Care System – Augusta, GA



Critical Environments

University Health Care System – Augusta, GA

- Solution:
 - 11" tall common plenum laminar array, 4 modules, 4 inlets
 - (x10) 24x48 and (x4) 24x36 laminar, 26 CFM/ft²
 - Welded grid for lights and boom locations



Critical Environments



University Health Care System – Augusta, GA



Critical Environments



University Health Care System – Augusta, GA



Critical Environments



University Health Care System – Augusta, GA



Critical Environment Air Distribution

New Innovations



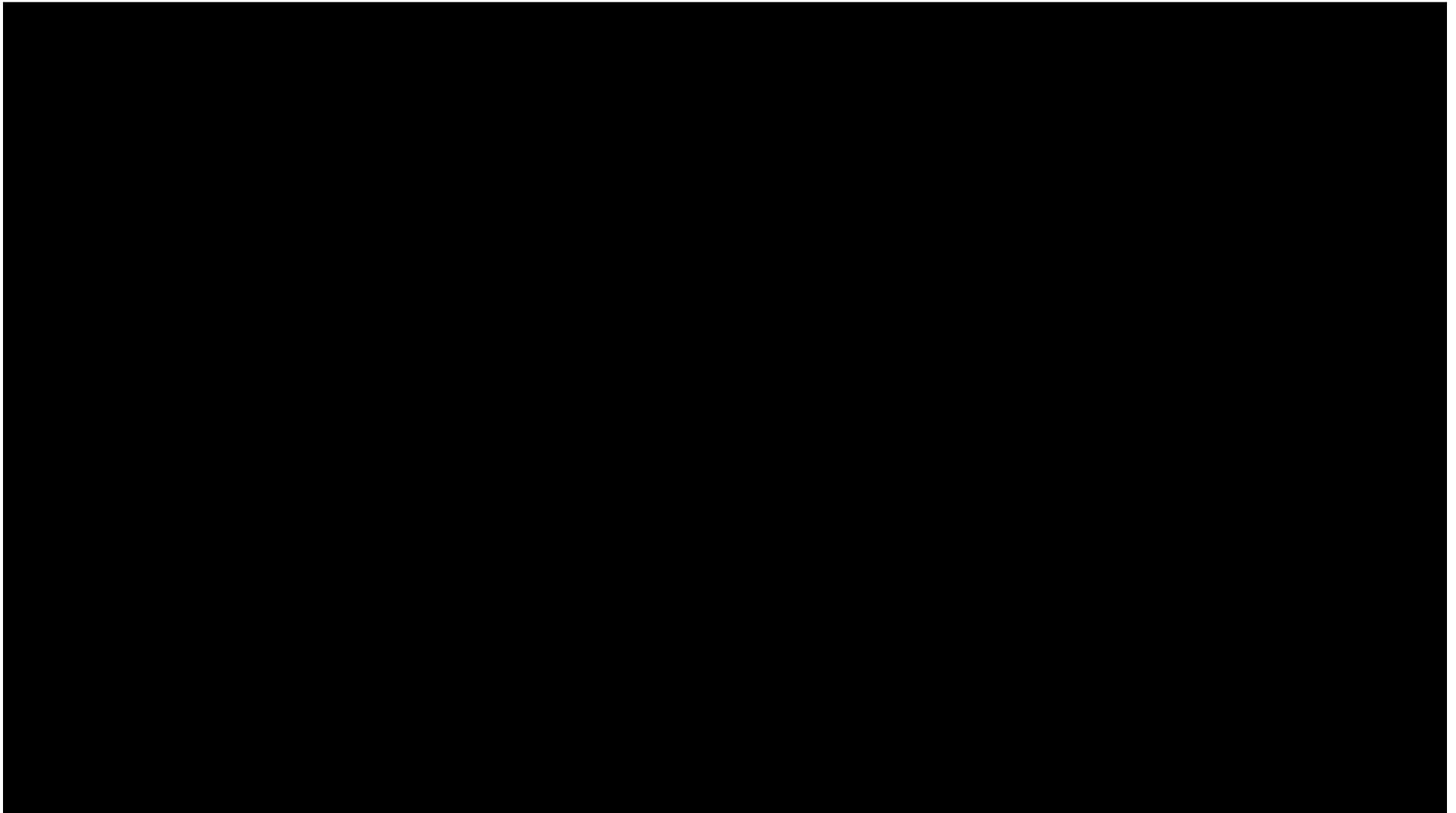
ULTRASUITE[®]

Operating Room Diffuser System with LED Lighting

Critical Environments



Ultrasuite



Critical Environments



Ultrasuite



ULTRASUITE®

- High performance LED lighting
- High performance laminar array
- Fully customizable



LED Lighting



L80 > 60,000
Lifetime



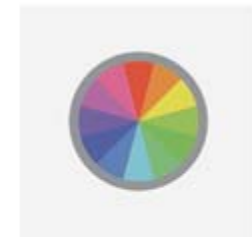
Dimmable



Ingress Protection



ETL Listed



90+ CRI

Ultrasuite

- Equalized lighting where needed – above surgical table
- Shadows eliminated



Critical Environments

Ultrasuite



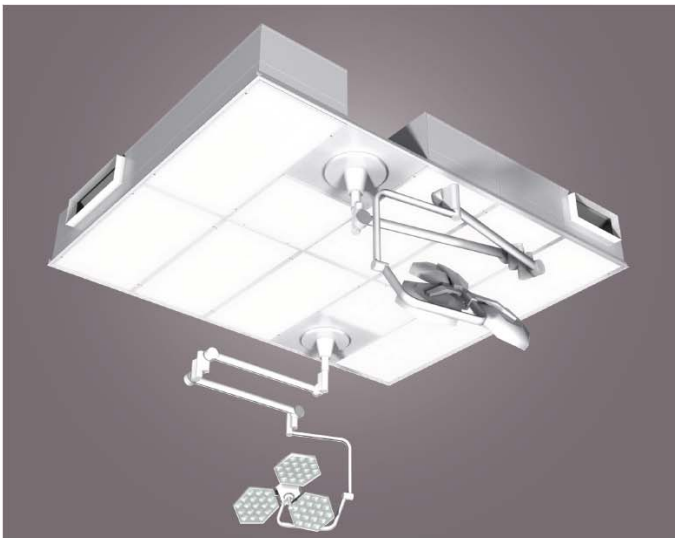
New Innovations

- Fully equalized laminar airflow for contaminant removal
- 12" low profile common plenum laminar array
- Reduced inlet connections and ductwork complexity



Critical Environments

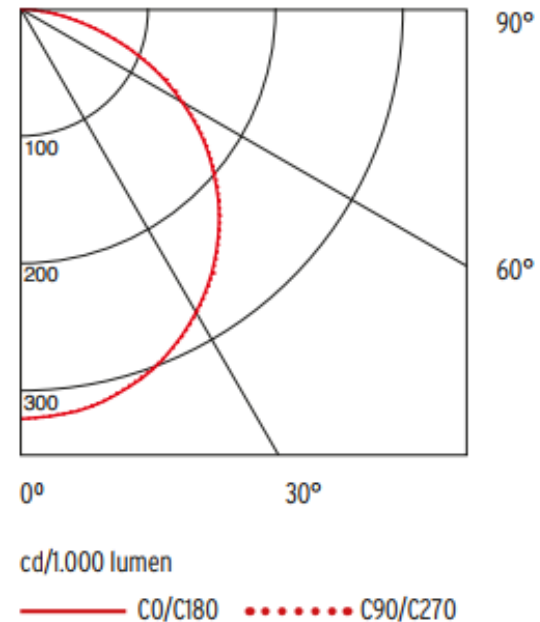
Ultrasuite



Critical Environments

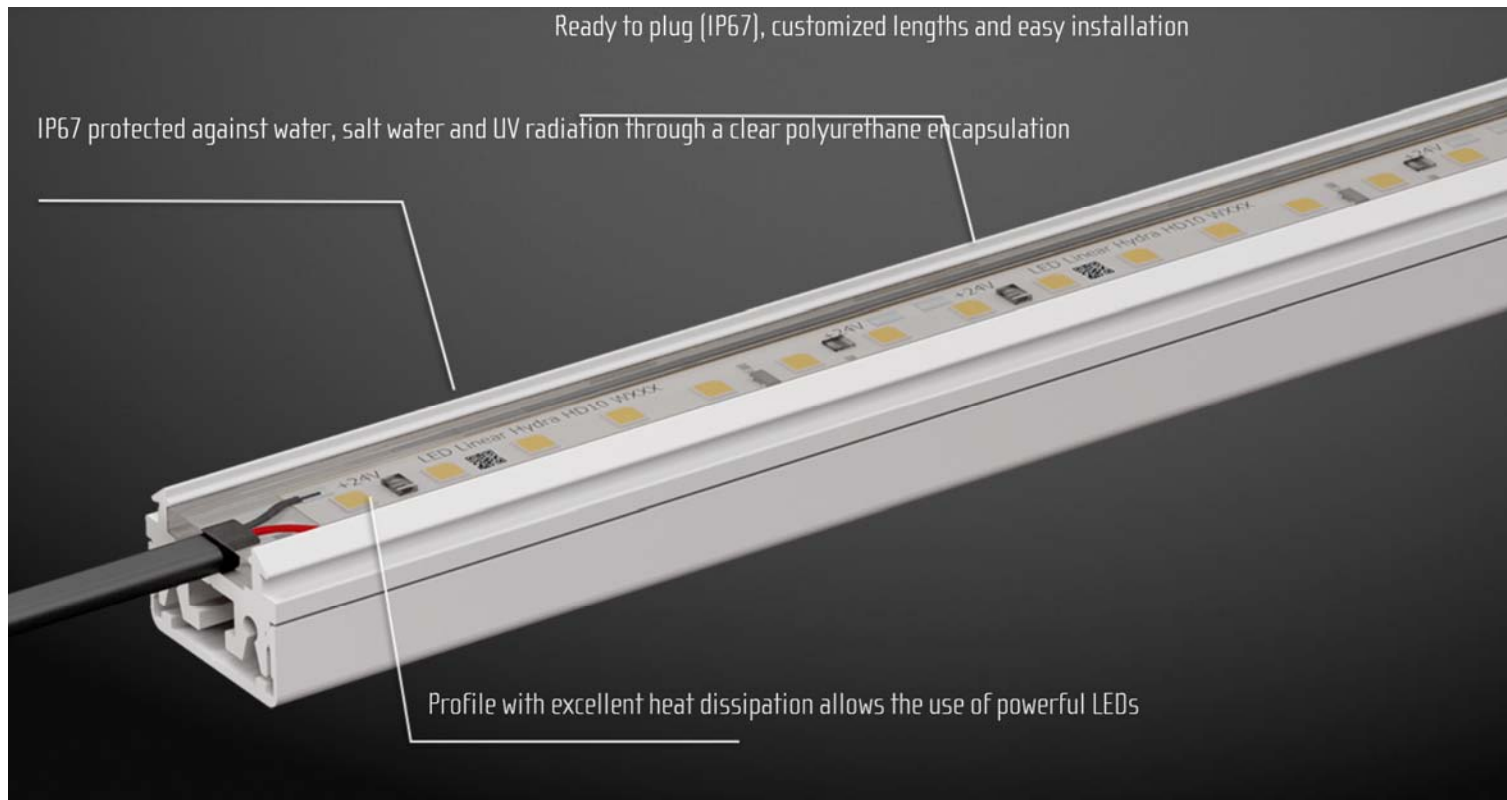
New Innovations

- Designed to meet 300+ ft-candles at table
- 24x48 Module – 17,400 Lumens
- 24x24 Module – 10,200 Lumens
- Photometric IES files available, IESNA LM-79



New Innovations

- L80 > 60,000 hours
- IP67 rated LED, impervious to dust and liquids
- 100+ Lumens per watt



New Innovations

- Emergency battery backup
- 90 min. operation on critical circuit

PHILIPS
bodine

Emergency Drivers

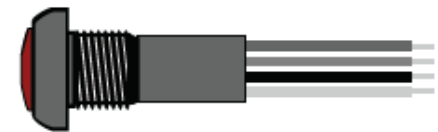
LED

BSL722



Emergency LED Driver
23.1 Watts output power

Product order number: BSL722M (metal case)



*Low Voltage Test Switch -
IP67 rated ITS*

Critical Environments

New Innovations

- Optional glare-reducing green surgical lighting

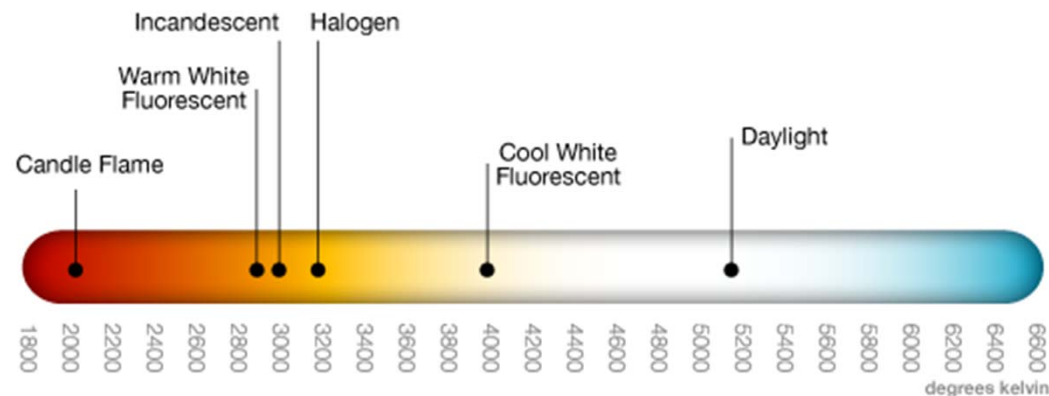


New Innovations

- Color Rendering Index (CRI) 90+



- Selectable colors; 2500k to 6100k, 5100k typical



New Innovations

- Remote LED driver cabinet
 - Normal and Critical Circuit
 - Factory wired for quick installation



Ultrasuite



CERTIFICATIONS

- + Ultrasuite is certified to UL1598 “Standard for Safety - Luminaries”
- + Engineered polymer face is fire rated to UL94 “Test for Flammability of Plastic Materials for Parts in Devices and Appliances”
- + LED lights certified to UL2108 “Standard for Safety - Low Voltage Lighting System” and UL2043 “Standard for Safety - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces”
- + LED light meets UL 8750 “Light Emitting Diode (LED) Equipment For Use in Lighting Products”
- + LED Driver meets UL1310 “Class 2 Power Units”

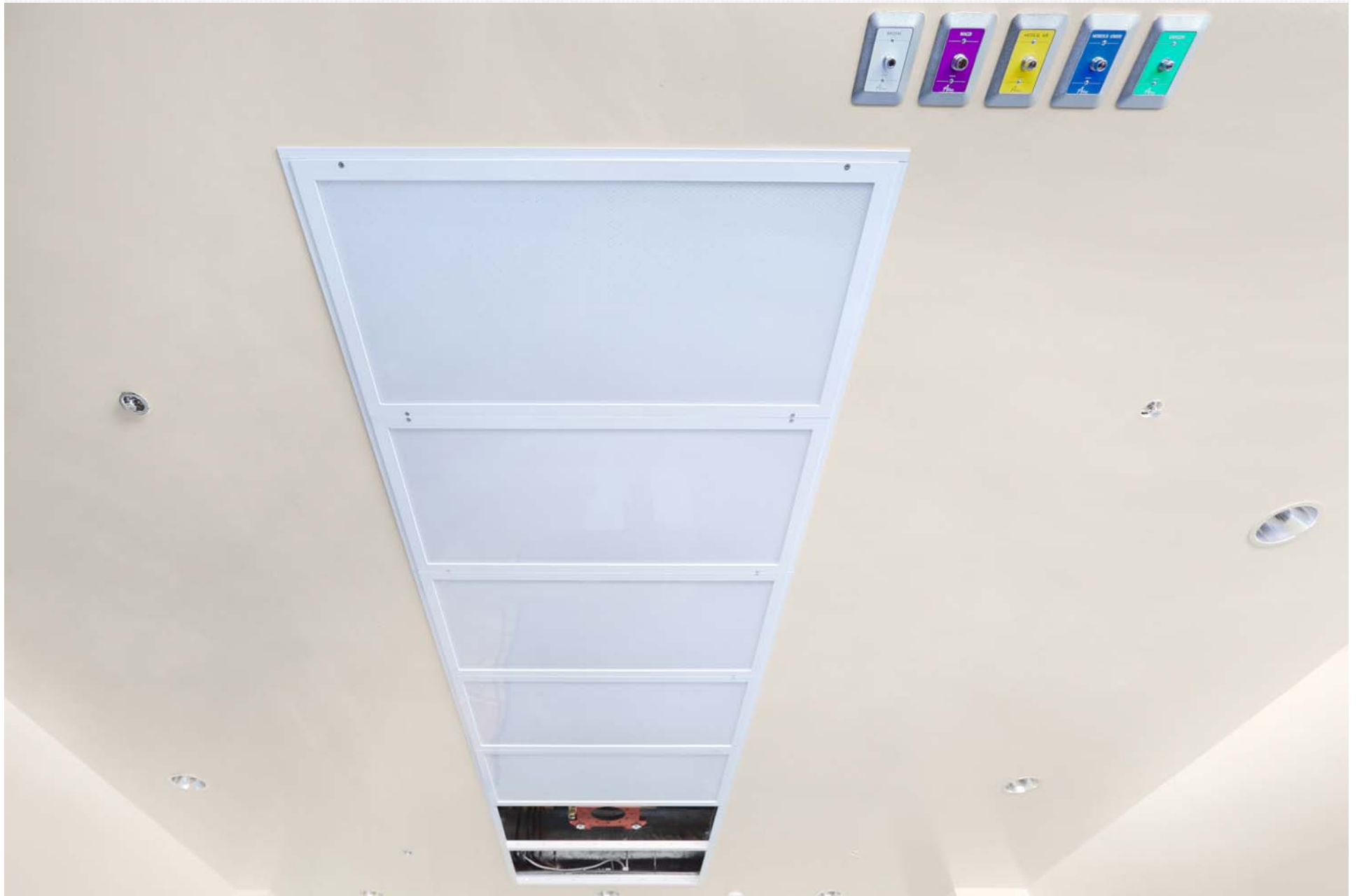


Critical Environments



Critical Environments

price | CRITICAL ENVIRONMENTS



Critical Environments

Ultrasuite

- Winnipeg and Atlanta demos



Questions?

PRICE[®]

www.pricecriticalenvironments.com
criticalenvironments@priceindustries.com