RADIO FREQUENCY SHIELDING OF A MULTI-STORIED BUILDING AT GMRT OBSERVATORY

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Outline

Introduction

Shielded Laboratory and Auditorium at GMRT Observatory

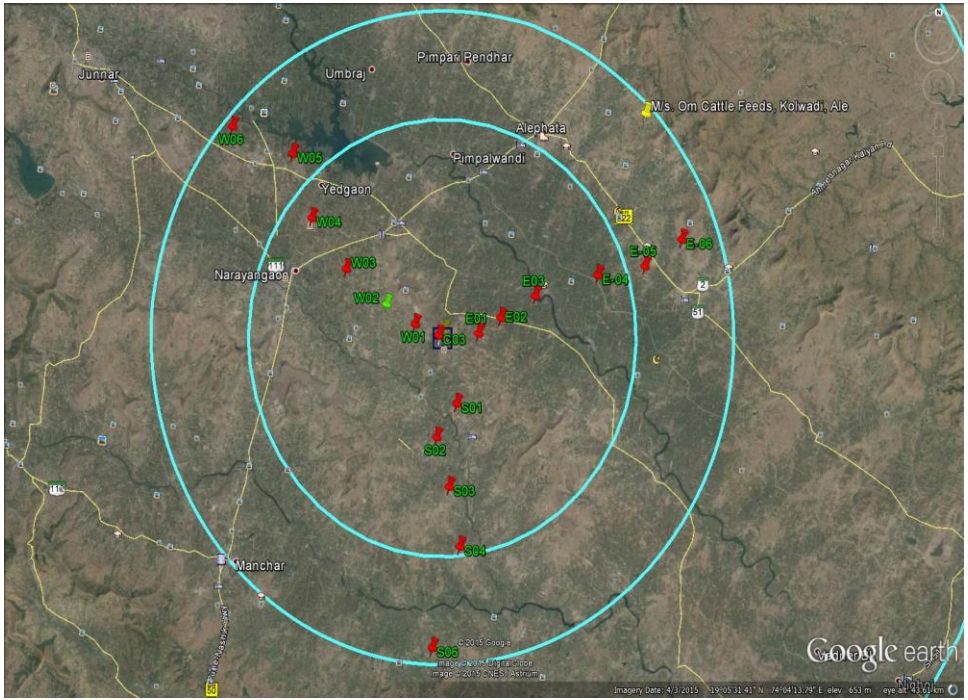
Building in a Faradays cage

Design constraints and challenges

RFI performance and evaluation

Summary

Introduction to the GMRT



- GMRT is designed and built by NCRA – TIFR Pune
- Located at 80 km N of Pune and 160 km E of Mumbai.
- 30 antennas of 45 meter diameter covering 30kms diameter in 120MHz to 1450 MHz band.

Need of the GMRT observatory

Laboratories

- R & D activity
- Use of Instruments, PC's, Servers in shielded area

Auditorium

- Auditorium for conference
- Exhibition area

Shielded building requirements

Laboratory

- Power connection
- Lighting load
- Water Facility
- Internet connection
- Rooms for R & D, test labs

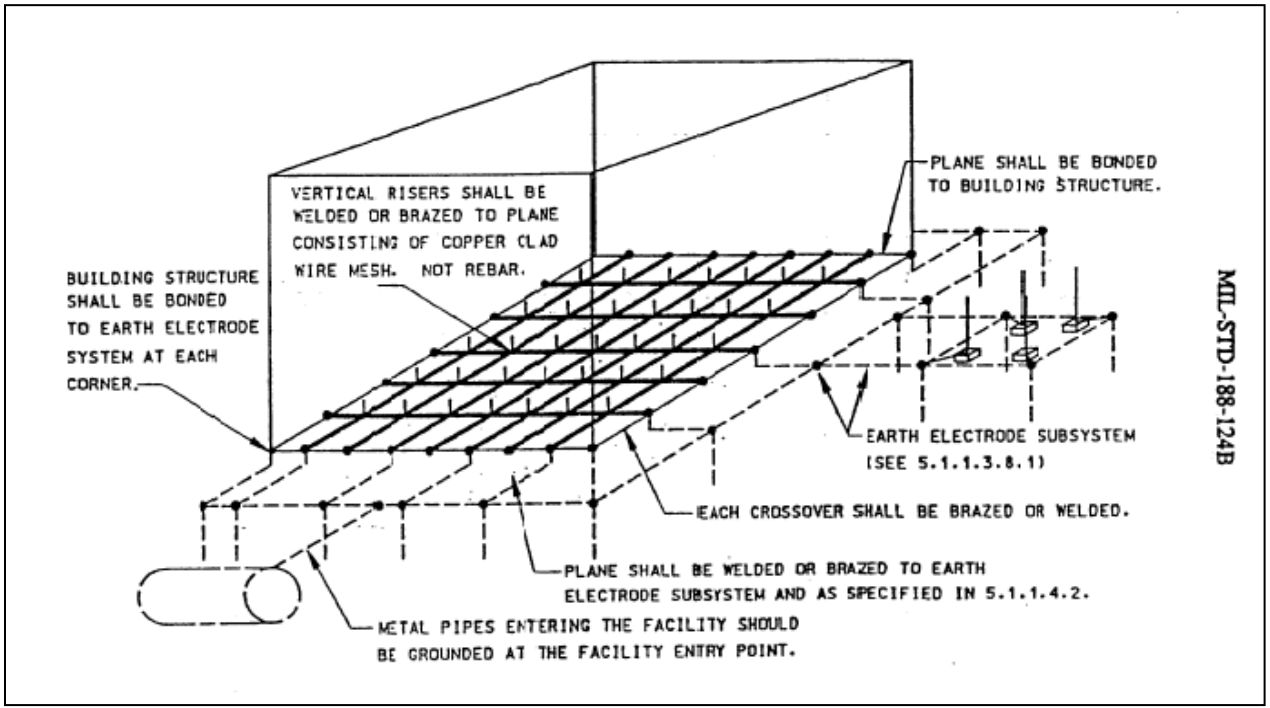
Auditorium

- AV equipment's
- Central Air Conditioning System
- Lighting load
- Internet facility
- No use of mobile and Wi-Fi communication

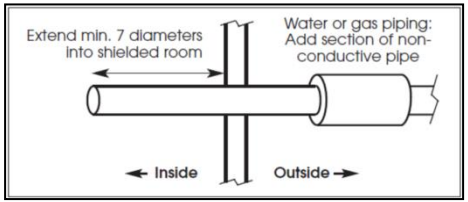
Building inside a Faraday's cage: Design considerations

- Designing a building with six sided shielded mesh
- Equipotential / multipoint grounding
- Bonding building structure to the Earth electrode system
- Lightening protection to the shielded structure around the building
- Utility pipe entry to the shielded building
- HVAC system and Central Air conditioning system
- Electrical supply through the shielded structure
- Computer networking and connectivity inside shielded area
- Shielded double door entry to the building
- RFI free lighting lamps and shielded AV system for the auditorium

Equipotential or Multipoint Grounding to Earth electrode system

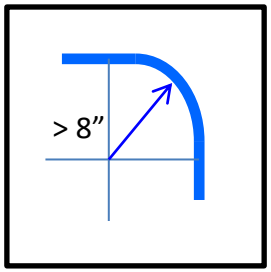


A rule of thumb is that
length / diameter ratio of the in-room section should be > 7 with dielectric breaking outside the shielded area

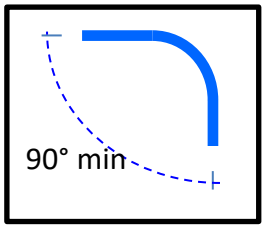


Building Structure Lightening Protection

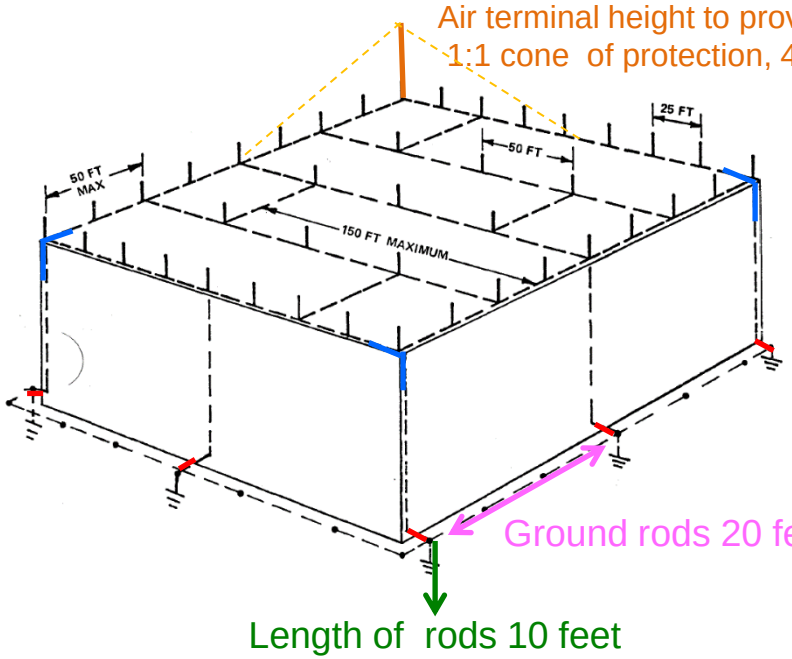
- Down conductors bonded to earth electrode system within 1.8m (6 feet) from structure
- All bonds between elements of lightning protection system made by welding/ brazing.
- Spacing between rods should be between one and two times the length of the rod.



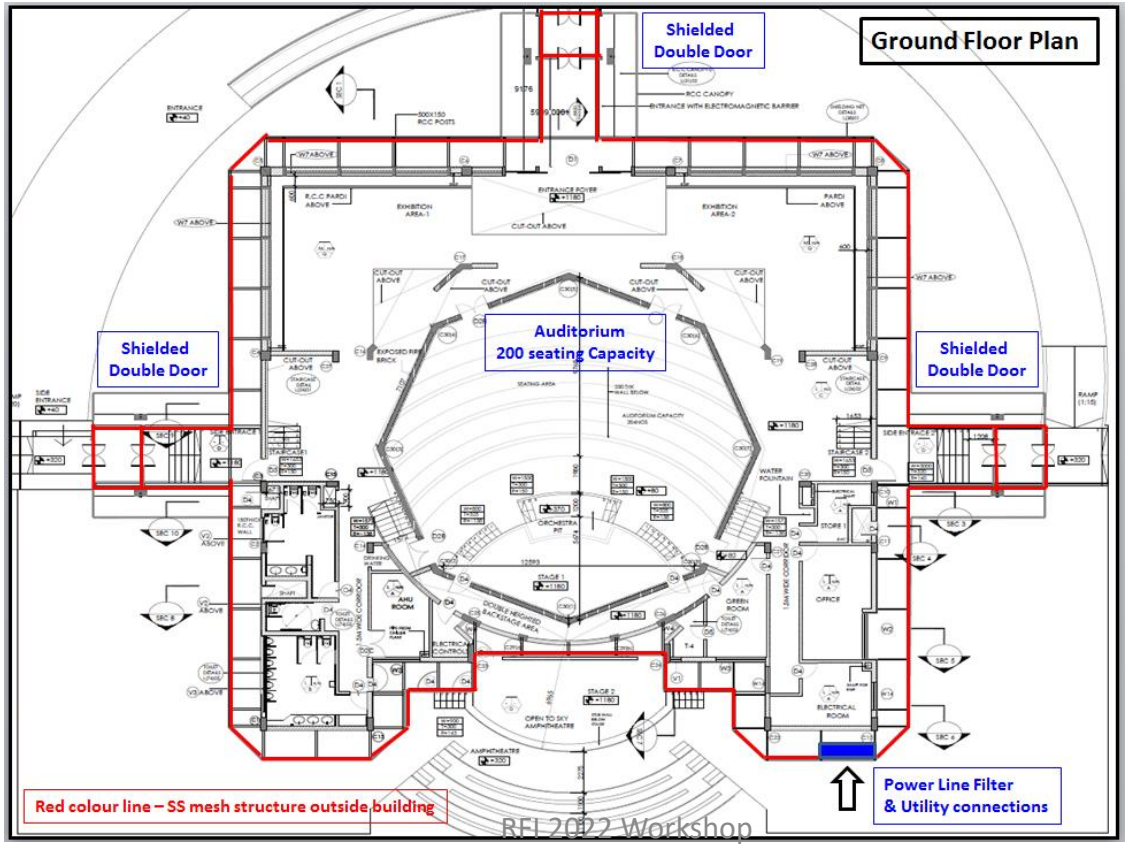
Radius of Bend not less than 8.0 inch



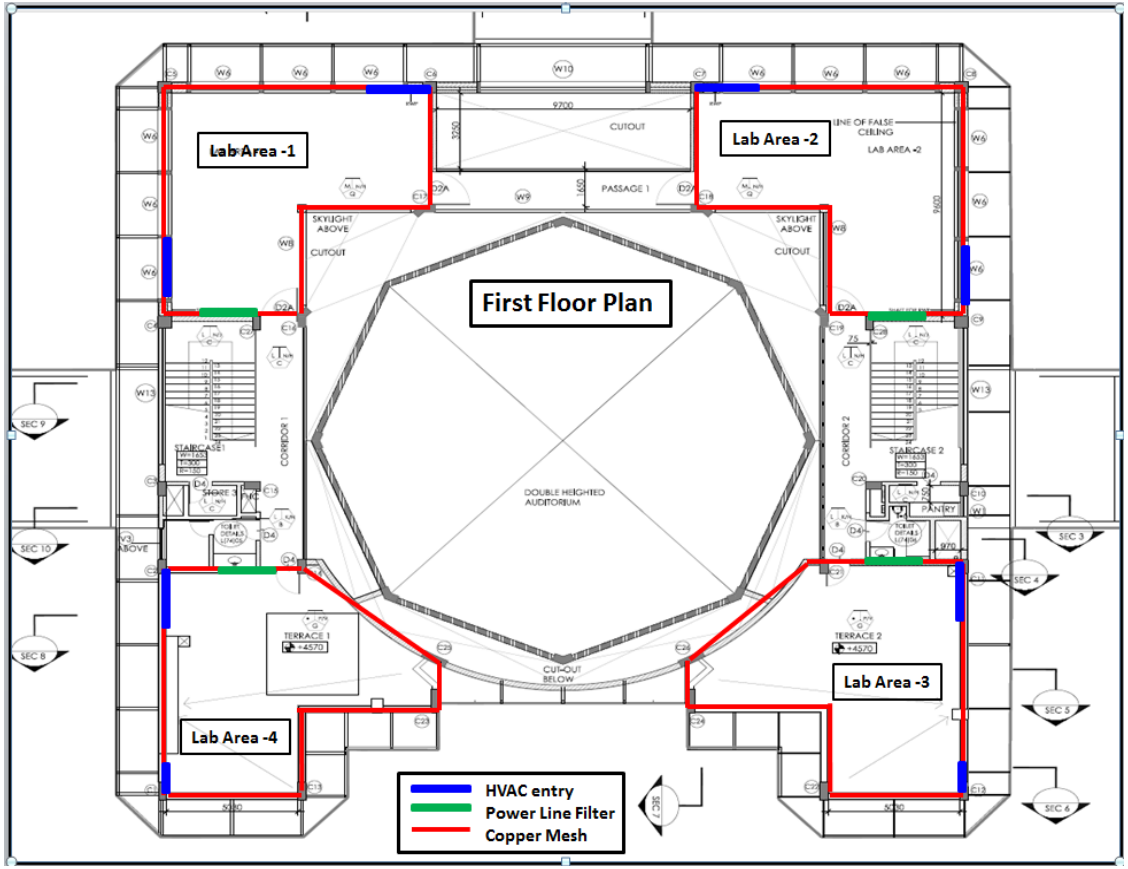
Angle of Bend not less than 90°



Top view of Ground Floor Plan of Multi Purpose Building



Top view of First Floor plan– Second level of shielding for the labs



Construction Phase -1

SS mesh inserted in the pillar

SS mesh brought down at plinth level

Establishing Electrical connectivity

Spot welding mesh joint with 1” overlap

Connecting Earth plate with SS mesh

Laying mesh on the floor

Second level shielding for Laboratories

window side

Ceiling

Floor

Piping for data & power connection

Construction of Dome structure with shielded mesh

Installation of Dome structure

Placement of GI sheets

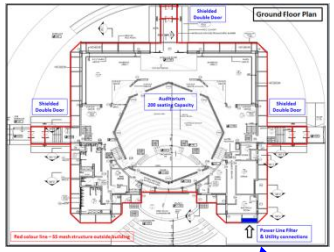
Bottom view during installation

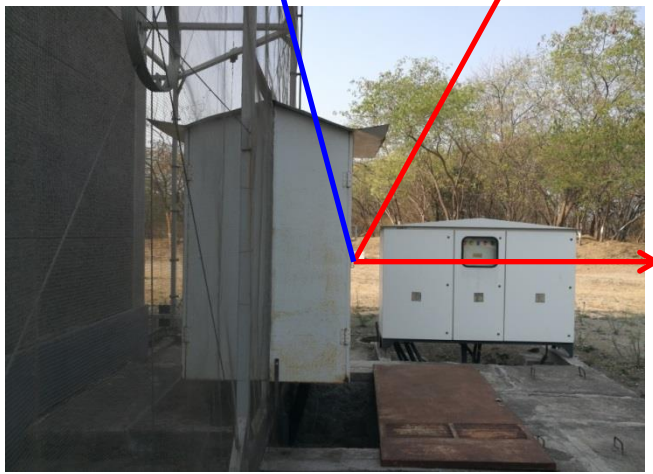
Concealed piping embedded on terrace

Terrace shielding with SS mesh

Mesh placement and RCC work

Electrical power with power line filter



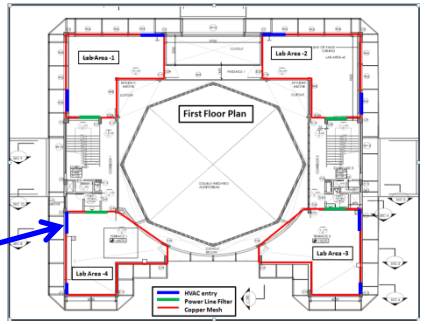


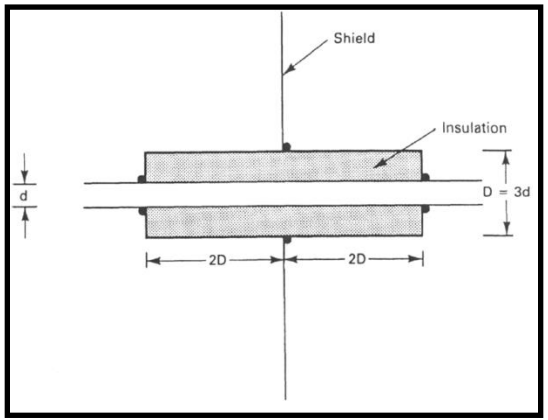
Fiber optic cable entry

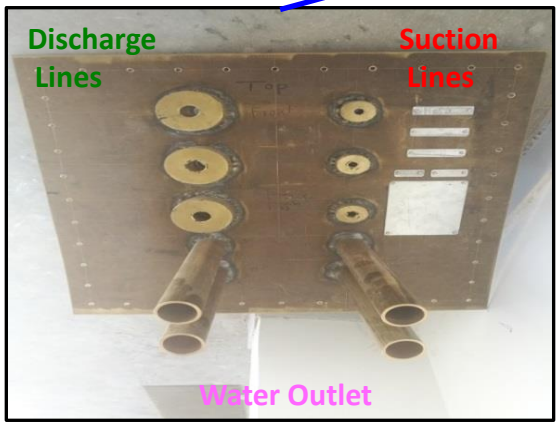
- Power Line RFI/EMI filter
- 277 Volts single phase
- 480 Volts 3 phase 4 wire
- 4 X 250A, AC 50/60Hz
- Insertion loss: 100dB, 150KHz to 10GHz
- MIL_STD-220A, MIL-PRF-15733 & UL 1283

Design of HVAC system for Laboratories

- Specially insulated (Teflon) with shielded pipes for hot and cold liquids circulation
- circumferentially welding joints for pipes
- Waveguides used for water outlet
- AC and DC filters implemented for outdoor unit
- Removable panel design arrangement for easy maintenance







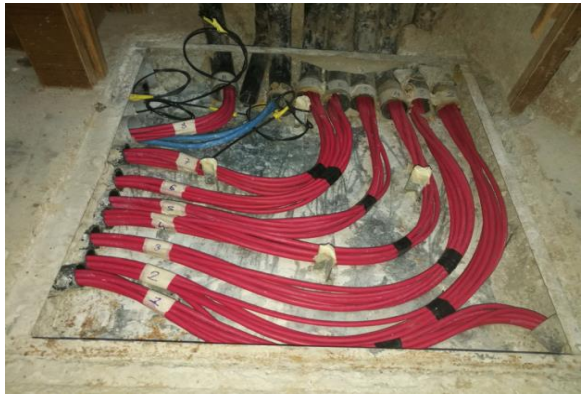
In house design of RF Shielded door

Shielded Door

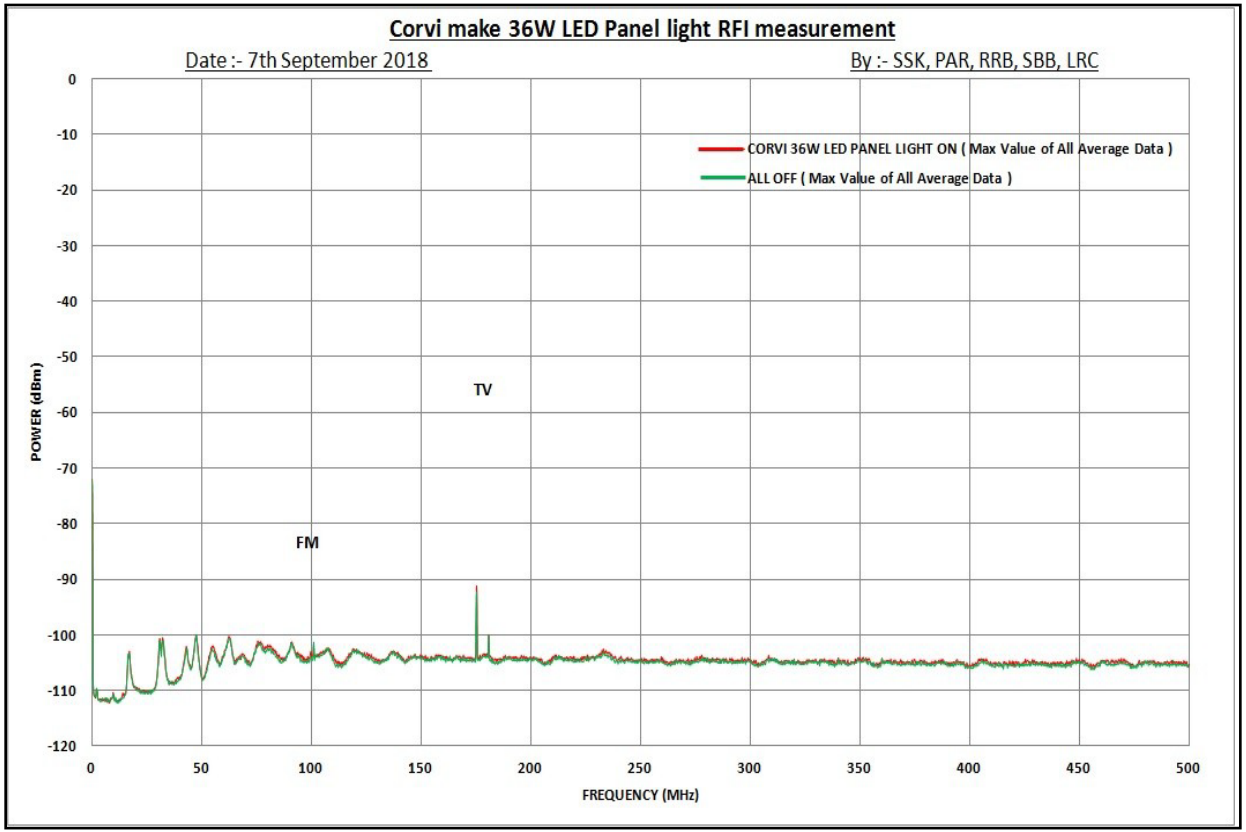
Shielded Gasket on door frames with U groove on door

Auditorium - Shielded LAN CAT5 connectivity

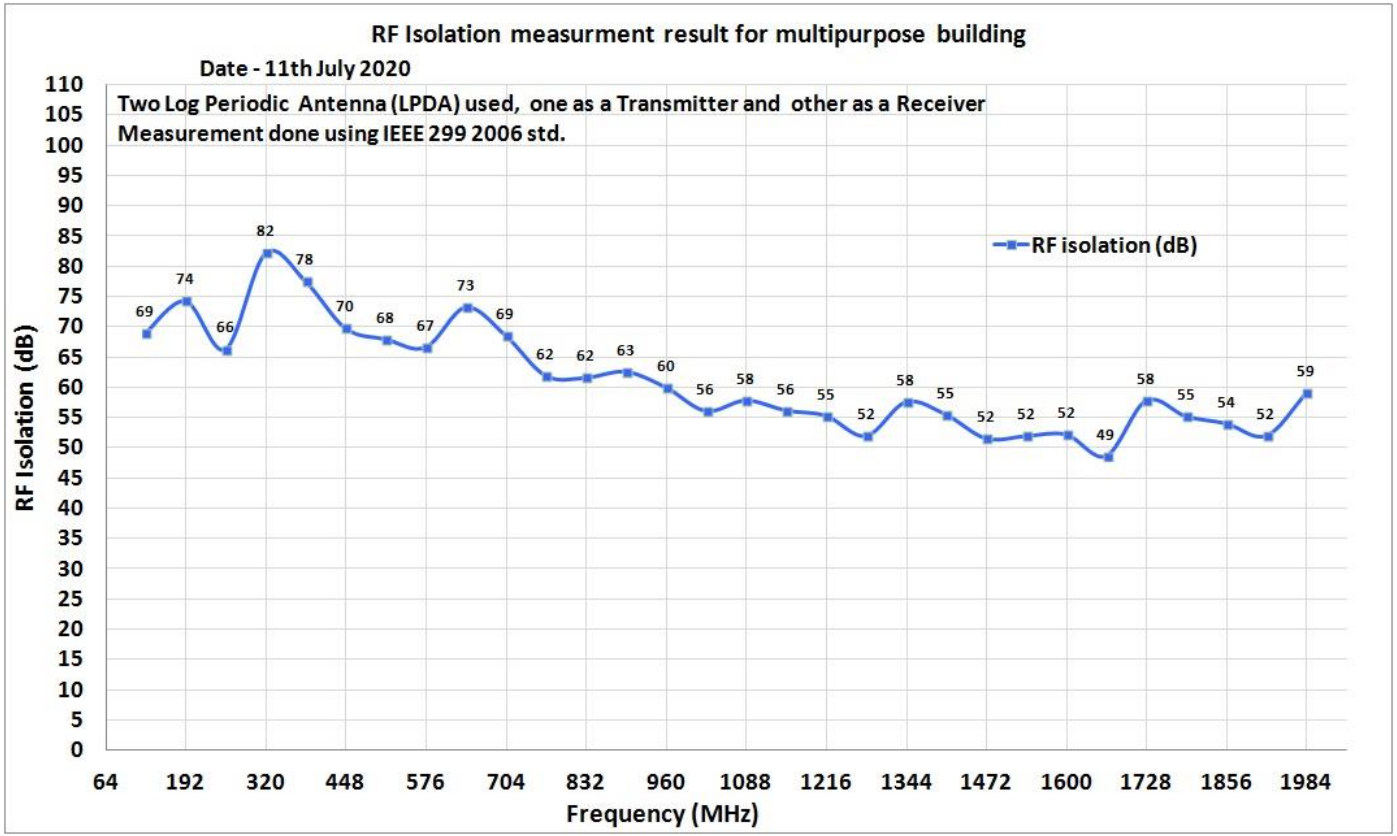
(Pop up Connector)



LED Lighting - RFI performance



RFI shielded building RF isolation performance



Summary

Area : 30.9 SQ.M X 30.9 SQ.M

Total Buildup Area: 1478.99 SQ.M

Auditorium :
200 seating capacity with Exhibition Area

RF Isolation better than 49dB up to 2GHz

Total Construction cost: 0.8 million USD ~

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