e-Journal Articles: RRCAT Scientists and Engineers publish their papers in national/international journals. All journal articles are made available as full-text within RRCAT Infonet through the web based Online Public Access Catalogue (OPAC), a feature available in LibSys.

All the above listed digital documents can be accessed from user's own desktop through RRCAT Infonet. All bibliographical details of these digital documents can be easily searched and full text of the files can be viewed.

Library also plans to archive conference papers and invited talks, submitted by scientist and engineers of RRCAT to different national and international conferences.

Reported by:
Rashmi Dighe (rashmid@rrcat.gov.in),
Arati Deshpande, Indu Bhushan, Dilip Tamrakar,
J. K. Pattnaik and Anil Rawat

I.5: Construction & Services

A) Making of Super Conducting Radio Frequency (SCRF) building

Introduction:

The article highlights constructional features of the facility, created for the SCRF cavity development programme at RRCAT. Owing to the diversified and multidisciplinary requirement of the facility, a number of challenges in terms of integrated planning, designing and construction of the building were faced. The building has been designed with an aim to have a complete facility for the fabrication and testing of the cavity, which includes design and validation of the components required for the cavity. Salient features of the building are; comprehensive building plan, for making optimum use of space, to satisfy functional layout and ensuring required electrical power and stringent environmental conditions, which are essential for different processes of the facility.

The Layout:

The building layout for such facilities though dictated by the functional requirement and the process flow, yet needs to be in conformity with a set of conditions put forth by services, location, ambience, ground topography etc. Selection of the type of structure for a particular requirement is an important decision and should be taken after considering above mentioned parameters. The building has been constructed as two blocks connected by a corridor. The Air Handling Unit (AHU) & Electrical rooms have been housed in a service block which has been constructed adjacent to the Pre Engineered Building (PEB).

The PEB hall has been provided with Reinforced Cement concrete (RCC) floor in M25 grade, cast using vacuum dewatering process, which is followed by 2 mm thick, self levelling epoxy flooring, to ensure clean space. The Alternating Current (A/C) supply ducts have been shielded, using aluminum composite panels following profile of duct with provision for mounting of diffusers. The planning of building also includes provision for an emergency escape door. Coordinate Measuring Machine (CMM) room has been provided with insulated composite panel false ceiling, along with epoxy coatings on walls and floors to ensure dust controlled environment. This has the added benefit of achieving the room temperature conditions in close tolerance. Figure I.5.1 depicts the final building plan of the SCRF building. Figure I.5.2 depicts the elevation of the completed SCRF building.

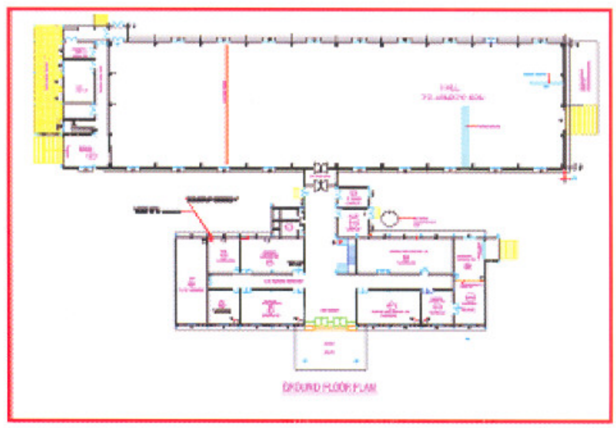

Fig. I.5.1: SCRF building plan

Fig. I.5.2: Elevation of the completed SCRF building

Special features of the building:

- Pre-engineered building with modified design to suit the requirement.
- Designed for optimized space with integrated planning of services.
- Clean room finishes with epoxy flooring, painting and wall cladding using aluminum composite.
- Efficient layout for man and material movement.
- Provision of fire safety and emergency escape.
- Emphasis on entrance lobby for aesthetics.
- Rigid, concrete floor using vacuum dewatering.
- The floor coating and colour demarcations for process area and hidden passage, with bright yellow strip in between.

Figure I.5.3 depicts the details of portal frame used for Pre engineered building.

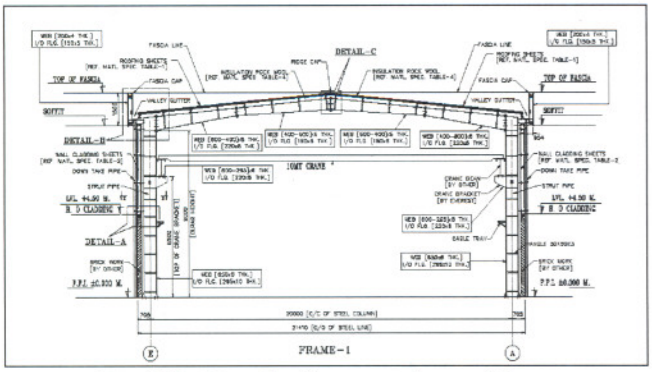

Fig.15.3: Details of structural portal frame

B) Illumination & Electrical power distribution in SCRF building:

The total electrical load of building is around 1600 KVA including lighting load of 50 KW. A dedicated main panel has been installed in electrical room. The main panel has been provided with air circuit breaker in incomer side, while a molded case circuit breaker with microprocessor based over load, short circuit and earth fault protection has been provided in outgoing side. Power to the wall mounted Power Distribution Board (PDB)/ Equipment is being fed through suitably sized Cross Linked Poly Ethylene (XLPE) insulated Fire retarded Low Smoke (FRLS) PVC power cables. Galvanized Iron (GI) cable tray of 300mm size has been installed on both sides of the PEB shed for power cabling, while in the lab area it is above the false ceiling. Earthing is provided by normal conventional earthing station. SCRF PEB shed is a huge metallic structure on higher elevation. For lightening protection a network of 25X3 GI strips has been installed on the roof of the PEB shed. This network is connected with earthing station at various locations through GI strips. The main SCRF building consists of a) SCRF processing building and b) SCRF laboratory building. The illumination and electrical power distribution details of these buildings are as given below:

a) SCRF Processing Building (Pre-Engineered)

To illuminate the PEB shed of 70 x 12 x 10m, 250 W metal halide high bay luminaires are installed on the MS Girder. For the control of lighting in the PEB shed, dedicated lighting distribution is provide in the connecting wall of PEB shed. In scrubber room, 2X36 W corrosion resistant luminaire has been installed. Total lighting load of the SCRF processing building is of the order of 20 KW. Figure I.5.4 depicts an illuminated view of the SCRF building's Clean Room Bay area.

Fig. I.5.4: An illuminated view of SCRF Processing building Clean Room Bay area

The details of the power distribution system of the SCRF Processing building are as follows:

- General purpose load: A well distributed network of single phase (2X5A+1X15A), single phase 20A metal clad and Three phase power points 32A TPN metal clad power point is provided on both the wall of PEB shed. Two wall mounted power distribution boards are installed on each side wall of the shed to feed these points.
- Equipment load.- Power to the equipment loads mainly EB welding unit, Chemical lab, High pressure rinsing unit, Ultrasonic cleaner, Oven (annealing/brazing) etc. shall be directly fed from main panel
- EOT crane- Power to the EOT crane is being fed by the three phase distribution board.
- HVAC: Total electrical load of air-conditioning of SCRF processing Building is around 200 KW. To cater these load HVAC wall mounted DB is installed.

b) SCRF Laboratory building

For illuminating the SCRF laboratory building, the ground floor lab area has been equipped with surface mounted mirror optics type luminaires with 2X36W fluorescent lamps, while the first floor sitting area has been equipped with mirror optics type luminaires with 2X36W compact fluorescent lamps. For laboratory area, wall mounted concealed lighting distribution boards have been provided in the corridor wall. Total lighting load of the SCRF laboratory building is of the order of 30 KW.

Electrical loads of the laboratory building have been catered by laboratory area panel of 630A capacity. This panel feeds to the wall mounted power distribution board, located in the corridors of each floor. A well distributed network of single phase (2X5A+1X15A) general purpose points, single phase industrial type 20A metal clad and three phase industrial type 32A TPN metal clad power point is provided on the wall of rooms. These power points are being fed by respective wall mounted power distribution boards located in the corridors.

C) Air Conditioning of Clean Room High Bay and CMM hall of SCRF Building

The bay area of SCRF facility has been constructed as PEB shed and shall accommodate proposed chain of clean rooms up to ISO class 4 with all supporting infrastructure and services. The comfort air conditioning of the long bay and the CMM hall in SCRF building has been completed.

The 70m(L)x 20m (W) long high bay has maximum height of 11m with multiple services running overhead, like Electrically Operated Over Head crane, electrical cable trays and PEB trusses. The floor area shall accommodate clean room hutches of varying heights. The tall building stratified air conditioning concept has been implemented for comfort air conditioning of this bay. Volume of only up to 4.5m shall be air conditioned instead of the full 11m height. Considering that the air flow pattern may also require substantial changes after installation of clean rooms in the 20m wide hall, the supply air system has been designed with 1200 high blow spot jet diffusers (38 Nos) to spot (focus) the flow as per balancing and load requirements. The commissioned system has been designed as ducted supply & flooded return circuits, fed through air cooled Direct Expansion system with two dedicated double skin AHUs of 70 tonnes of refrigiration, 38000 cfm x 75mm WC Double inlet double wise blowers. All the Galvanized steel sheets ducting (~4000sqft) used were factory made & pre fabricated on automated machines designed as per Sheet metal and air conditioning contractors association (SMACNA) standards. The system has been commissioned and is working state.

Fig. I.5.5: View of CMM Hall showing cassette air conditioning units and insulated wall cladding

Figure I.5.5 depicts the ceiling view of the CMM Hall. The air conditionings of CMM hall with 3 x 3TR cassette air conditioning units have been completed. It has achieved a temperature stability of 25±10 C. The excess tonnage capacity has been added for achieving conditions faster & better temperature stability as the bulk granite surface block of CMM machine acts as thermal sink. The system has been fully commissioned and is working state.

Reported by:
G.Parchani, parchani@rrcat.gov.in,
Ashok Sharma, R.P.Agarwal, V.Jharware, Deepak Arzare,
N.Suresh, B.Rawlani, A.Pundlik, S.S.Kulkarni.

D) Air Conditioning of Video Conference Room with features like in-situ capacity adjustment and winter heating

Air conditioning of video conference room at central complex building has been completed with new kind of standalone system meeting fresh air ventilation norms along with energy savings compressor capacity adjustment as per occupancy and loads.

Video conference rooms are normally made as sound proof isolated spaces for noise free audio video communication. Various treatments are done on walls floor and roof. Multiple wall claddings with air gaps, long curtains, thick carpets, and sound absorbing false ceiling material along with cushioned furniture are used. This results in continuous release of Volatile Organic Contaminants (VOC) like aldehydes, ketones, benzene products and accumulated dust & fumes. All these have been reported as prime reasons of Sick Building Syndrome (SBS) and Building Related Illness (BRI). Drowsiness, headache, mild asthmatic attacks and nausea are normal symptoms which are normally noticed when it yields as disease in long runs.

Video conferencing sessions are also normally held for prolonged durations with intense involved discussions of occupants, releasing higher CO2 levels and body odors. American Society of Heating and Refrigeration Engineering (ASHRAE) standard 62-89 recommends 10-15 cfm fresh air per person to dilute odors and limit the concentration of all such contaminant below Threshhold Limit Value (TLV). Thus necessary ventilation of fresh air shall be made to have healthy sessions.

The inverter based Variable Frequency Drive (VFD) controlled air conditioning system with filtered fresh air supplies has been commissioned for newly constructed video conference room at central complex building. Traditional air conditioners/ refrigerators use a refrigerant compressor that is either working at full capacity or switched off periodically, to regulate the temperature of the room. A thermostat is used to measure the return air temperature and switch the compressor on/off when the ambient air temperature is too far from the desired temperature. But the installed air conditioning system uses a VFD to control the speed of the motor and thus the compressor. The VFD uses a rectifier to convert the incoming Alternating Current (AC) current to Direct Current (DC) and then uses pulse-width modulation of the DC current within an inverter to produce AC current of a desired frequency. The AC current is used to drive the brushless motor of compressor. As the speed of the motor is proportional to the frequency of current, the compressor runs at different speeds as per actual load-measuring return air and adjust the speed of the compressor appropriately. This keeps the compressor in always running mode at both part/full loads & does not have stop-start cycles which results in higher efficiencies thus extending the life of mechanical components. This helps in the elimination of sharp fluctuations in the load. Ultimately this makes inverter air conditioners less prone to breakdowns, draw less current, cheaper to run, more silent - due to slow blower operations - which is required in any video conferencing rooms. Figure I.5.6 depicts the ceiling view of the video conferencing room.

Fig. I.5.6: Ceiling Mounted Dual Mode Air Conditioning System at Video Conference Room

The complete system is also used as heat pump during winter season by switching it to heat pump mode, thus maintaining the room at 24 degree Centigrade without any resistive heating even when the ambient temperature is much less than 10 degree Centigrade. Heat pump has very high Coefficient Of Performance (COP) and consumes approximately 250 Watt of power for an equivalent resistive heating of 1Kilo Watt. The capital cost of installed system is Indian Rupees (INR) 35000 per ton and comparable to any 5 star rated split air conditioner with substantial savings in energy bills. The installed system has been in use and being monitored for other advantages and disadvantages.

Reported by:
Deepak Arzare (arzare@rrcat.gov.in),
R P Agrawal and S.S.Kulkarni