Dear Readers,

It is a matter of great pride and honor for being the President of ASHRAE India Chapter, as we are marching ahead with energetic team of BOG members, in building a sustainable Nation. Sustainability is the need of today to conserve the natural resources for our future generation. The theme of the current year is, “Sustainability through Innovations”. Keeping sustainability in mind, our annual event AICTECH (flagship event of ASHRAE India Chapter) is on, “Sustainability in Practice-Building Sustainable Hotels”. This will have a positive impact on designers, Contractors and operators of Hotels (a step forward towards building net zero Energy Hotels).

Another focus will be on Building information modelling (BIM) education, by conducting workshop for ASHRAE India Student Chapter in association with Building Services design and energy Institute – MEPa2Z and Capricot technologies (Autodesk platinum partners).

From past few years, ASHRAE India Chapter has engaged itself in many sustainable activities in villages such as; installed a 5.0 KW solar plant in a village in Uttara Khand, solar cold storage developed and handed over, in a village in U.P., solar lantern distributed in village in Rajasthan etc. This year also many more such sustainable activities are planned in villages by joining hands with NGO’s, to take a step forward in making villages sustainable.

Other than above, the focus will be in disseminating the knowledge from knowledge bank of ASHRAE to the members by conducting number of full day & half day workshops. There will be 3rd ASHRAE Developing Economics Conference which will be held in Delhi. It would be our pleasure to invite all the members for ASHRAE Night on 21st of December, 2019, which will help members in networking by meeting Industry Stalwarts.

We also request more members to volunteer themselves and take part in ASHRAE India activities. Let us all work towards a goal of more sustainable development, so we leave a healthy and habitable planet for our future generation.

Dr. Varun Jain  
ASHRAE INDIA PRESIDENT  
(2019 – 20)
Annual General Meeting

The Annual General Meeting and installation ceremony of the new ASHRAE India Chapter BOG (2019-2020) elected to serve ASHRAE India Chapter for the year 1st July, 2019 to 30th June, 2020 was held on Friday, 5th July, 2019 at Magnolia, India Habitat Centre, Lodhi Road, New Delhi – 110003. The new BOG was administered the oath by Mr. Ashok Virmani. The event was followed by Networking Dinner. The event was supported by Ensavior Technologies Private Limited as Principal Partner. The event was attended by more than 150 members including the spouse of the members.
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First ASHRAE India Chapter BOG Meeting

for the Society year 2019-2020 was held on 12th July, 2019 at Teak Room, Paharpur Business Centre, Nehru Place, New Delhi – 1100019. The first meeting was attended by Dr. Varun Jain, Mr. Indrajit Bhattacharya, Mr. Dharmendra Rathore, Mr. Abid Husain, Mr Kanagaraj Ganesan, Mr. Rajesh Kumar Jain, Mr. Praveen K Jha, Mr. Sandeep Goel, Mr. Abhishek Jain, Mr. Paresh Mishra, Dr. Om Taneja, Mr. K K Mitra, Mr. Sunil Bajaj, Mr. Priyank S. Garg, Mr. Dinesh Gupta, Mr. Money Khanna.

Technical talk on Indoor Air Quality in Hospitals was held on Saturday, i.e., July 13, 2019 at MNIT Incubation Center, Jaipur. It was supported by ASHRAE Jaipur Section. The lecture was delivered by Mr Satendra Pal Singh, Chief Engineer, Narayana Hospital, Jaipur. The event was very well attended.

The RAL SR2 Coordination meeting was held on 19-20th July, 2019 at Double Tree by Hilton, Ahmedabad, Gujarat. Dr. Varun Jain, Mr. Dharmendra Rathore, Mr. Priyank S Garg, Mr. Kanagaraj Ganesan and Mr. Ashu Gupta will attend the meeting.

Technical talk on ‘Lighting Protection Systems & Earthing’ by Mr. Satyam Srivastava was held on 20th July, 2019 at Hotel Leisure Inn, Jaipur supported by ASHRAE Jaipur Section. The event was well attended.

Retailer training program under BEE standard & labelling programme successfully held at Hotel Park Inn, Chandigarh on 26th July, 2019 supported by ASHRAE India Chapter.

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Department of Mechanical Engineering, Poornima College of Engineering, Jaipur and ASHRAE Jaipur Section organized a Technical Talk by Mr. K D Singh on Waste to Energy- Running Chillers with Organic Waste on July 27, 2019. The event was appreciated by the participants and well attended.
Selection interview of student for participation in RAL CRC 2019 student competition was held on 29th July, 2019 at Building Services Design and Energy Institute. Mr. Bhaskar Sharma from Poornima College of Engineering (PCE) has been selected. The training on Domestic Air Conditioners was also held on 29th July, 2019 for the students in association with Building Services Design and Energy Institute.

GAC workshop was held by Mr. G. C. Modgil, RVC GAC RAL on 2nd Aug., 2019 at room 105, Paharpur Business Center, Nehru Place, New Delhi. The workshop was supported by Mr. Kanagaraj Ganesan, ARVC GAC SR2. GAC Chair and Co-Chair from AIC, GAC Chair from Mumbai and GAC Chair from Deccan Chapter attended the workshop. Discussion on GAC activity and action plan for the year was discussed.

AIC weekend sustainability walk to Kiruri village, Sohna was held on 4th Aug., 2019 with support from Zeco team. AIC team lead by Dr. Varun Jain, President AIC interacted with the villagers to understand issues and challenges. The visit concluded with visit to Zeco CSR skill center where training is imparted on stitching, computer learning and English speaking.

Retailer training program under BEE standard & labelling programme held at AP Residency, Ambala on 8th Aug., 2019 supported by AIC.

Technical Lecture on ‘Waste to Energy’ by Mr. K D Singh was held at Maharaja Agrasen Institute of Technology, Delhi was held on 9th August, 2019. The event was attended by 60 student and 7 faculty members. The event was appreciated by the participants.

Technical Talk by Dr. S C Bhaduri on ‘Psychrometric Analysis for Thermal Comfort’ held at MNIT, Jaipur on 24th Aug., 2019.

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Technical talk on ‘Recent advancements in Anaerobic Digestion’ by Dr. Vanita Prasad, Founder & Director, (REVY environment Solutions Pvt. Ltd.), was held on 10th Aug., 2019 at Poornima College of Engineering Jaipur. The event was attended by 100 participants. The event was appreciated by the participants.

Retailer training program under BEE standard & labelling programme held at Hotel Clarion Inn, Green Park Colony, Patiala on 12th Sept., 2019.

Technical Talk by Dr. K K Khatri on ‘Development of Biogas Plant Based on Kitchen Food Waste’ at Poornima College of Engineering, Jaipur on 31th Aug., 2019. The event was well attended.

Site visit of PEDA Building for Chandigarh Group of colleges Jhanjeri held on 29th Aug., 2019. The visit was appreciated by the students.

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Engineers Day celebrate at student branches at Pusa Institute Of Technology on 13th Sept., 2019 and Poornima College of Engineering, Jaipur and Maharaja Agrasen Institute of Technology, Delhi on 14th Sept., 2019.

Two day Training Programme on Energy & daylight Simulation for Compliance of ECBC 2017 held on 19th & 20th Sept., 2019 at Architecture, Chandigarh University, Mohali.

Retailer Training Programme under Standards & Labeling Programme held on 19th Sept., 2019 at Bathinda, Punjab

Installation Ceremony of ASHRAE Student Chapters conducted at DAV University and NIIT Jalandhar Punjab on 19th Sept., 2019. The technical presentation was given by Mr. Abid Husain which was very well appreciated by the student members and faculty members present.

BIM Workshop was held at AMITY University student branch at Noida on 26th Sept, 2019. Student. The workshop was very well attended and appreciated by the participants. Participation certificate was distributed to the students.
RAL CRC 2019

RAL CRC 2019 was held in Grand Hyatt hotel, Amman, Jordan from 26th to 29th September.

The Chapter was represented by Dr. Varun Jain, Mr. Dharmendra Rathore, Mr. Abid Husain, Mr Kanagaraj Ganesan, Mr. K K Mitra, Mr. Priyank S. Garg, Dr. Rajinder Singh, Mr. Money Khanna, Mr. Ashish Rakheja, Mr. Richie Mittal, Mr. Ashu Gupta. Spouses of some members also attended.

Mr. Suhaas Mathur, YEA Co-Chair gave a expert talk on the Topic “Building Energy Efficiency and Climate Change” at conference organized by the student chapter at Maharaja Agrasen Institute of Technology held on 1st October-2019. The vent was very well attended.
Maharaja Agrasen Institute of Technology Delhi Student Branch organized an industrial visit to Hitachi Engineering Excellence Centre on 4th Oct., 2019. The visit was appreciated by the student and faculty members who visited the facility.

BIM Workshop was held at Poornima College of Engineering, Jaipur on 09th Oct, 2019. The event was very well attended and appreciated by the students and faculty members present.

SGT University organised a three day event Synergy 2019 from 10th to 12th Oct., 2019 providing a platform for grassroot innovation and technology drive project.

ASHRAE India Chapter Inter Student Branch Quiz Programme organized by ASHRAE India Chapter on 11th Oct., 2019 at BSDEI, Okhla, New Delhi. 1st prize went to student from Pusa Institute Of Technology student branch, 2nd prize went to student from Delhi Technological University & Maharaja Agrasen Institute of Technology, student branch and the 3rd prize to students from Sharda University, G. Noida student branch.

Site Visit Conducted on 12.10.2019 at Central Air Conditioning plant, PGIMER, Chandigarh for students of Chandigarh Group of Colleges, Jhanjheri (Mohali).

BIM workshop was held at Maharaja Agrasen Institute of Technology, Delhi on 16th Oct, 2019. The event was very well attended and appreciated by the students.

Installation of Chandigarh Group of Colleges, Jhanjheri (Mohali) Student chapter and technical talk by Mr. K D Singh was held on 18th Oct., 2019.

Learn-n-Meet session was held at Hotel KLG Starlite, Chandigarh. There were more than 45 professionals attended the event from Chandigarh, Ludhiana and Jalandhar. Architects, engineers, consultants, contractors and manufacturers/distributers participated in the event.

Amity University Noida Student Branch organized an industrial visit to Hitachi Engineering Excellence Centre on 21st Oct., 2019. The visit was appreciated by the student and faculty members who visited the facility.
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How Internet of Things (IoT) can support Demand Side Management (DSM) in Residential Buildings?

What is IoT and DSM?

For the starters, we think it is pertinent to give brief introduction of what is Internet of things (IoT) and Demand Side Management (DSM).

Draft policy on Internet of things by Department of Electronics & Information Technology (DeitY), Ministry of Communication and Information Technology, Government of India defines IoT as a "seamless connected network system of embedded objects/devices, with identifiers, in which communication without any human intervention by using standard and interoperable communication protocols". In simple words, IoT, is an environment under which daily-use objects, machines, physical devices, when given the ability to transfer data with or without human interaction over the internet, can interact and communicate amongst each other. These devices can be remotely monitored and controlled over the internet.

Whereas the Demand Side Management (DSM) is a method of influencing end consumer behavior and willingness to reduce electricity consumption. DSM initiatives not only help the end customers to reduce their electricity bills but also help utilities in cutting the peak loads, thereby, saving high investment ventures to expand generation, transmission and distribution networks.

How IoT Supports DSM?

The rise of e-commerce platforms like Amazon, Flipkart etc. and Reliance Jio ventures are successful business models and looked upon by entrepreneurs. If we look at the micro picture of what turned them into successful models, it is the comfort and affordability. Users now can get their desired product delivered at their home and that too at cheaper costs. Similarly, cheaper data packs have revolutionized the Indian market, people are more connected now than ever before.

IoT based solutions can provide the cushion of comfort with affordability. By using IoT enabled products in households, the occupants can make informed choices of optimally operating the energy consuming appliances and equipment. With the help of integrated advanced control and automation systems, energy consumption of devices can be limited. Utilities can take advantage of information exchange from these IoT based solutions to offset the peak load and conduct demand response programs through grid connected devices over smart integrated networks.

We believe that IoT based systems through demand side management in residential buildings will contribute in achieving India’s Nationally Determined Contributions (NDC) goals of limiting carbon emission intensity of the economy.

Future of IoT in residential buildings

In India, residential buildings account for almost one-fourth of the total electricity consumption. This demand is increasing due to rapid growth in economy, improved living standards and high pace of urbanization. It is expected that by 2030, residential sector will become the highest energy consuming sector.

The projected electricity demand in residential sector is also driven by aspirations of occupants to have improved comfort (thermal, visual and air quality) and user-behavior. With the technological development in IoT, the cost of integrating IoT enabled systems has become affordable and it is expected that the cost of such systems may further go down if they are pursued by large group of users.

Deity envisions IoT industry in India to word USD 15 billion by 2020. With smart city mission in place, increasing netizens and mushroom growth of home automation-based startups, this vision seems quite achievable.

-Kanagaraj Ganesan & Rohit Jindal, Integrative Design Solutions Pvt. Ltd.
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Effect of Pressure Drop in the Condensing Unit On the Cooling Rate of a Split Air Conditioner

Rimi Sinha and Basant Singh Sikarwar
Department of Mechanical Engineering,
Amity University Uttar Pradesh NOIDA, India
*corresponding author: rimisinha08@gmail.com

Cooling is produced by using condenser and evaporation with compression and expansion device. Split air conditioner is very popular for room air conditioning (T= 25°C and RH= 55%). In this cooling unit, evaporation chamber with fan is indoor unit. However, others are outdoor unit. This arrangement makes the cooling noise free and more effective and efficient in Indian climatic conditions. In this unit, the condenser is a heat exchanger, which is used to cool down and condense high-pressure refrigerant into liquid by transferring heat to the surrounding air through forced convection. The tube arrangement in which refrigerant of condensing unit flows Figure 1. However, the air flows over tubes by external fans. It is the coiled copper tubes with one or more rows, connected with the help of various bends and joints such as U-bends, rectangular bends and T-joints. Recently, Al finned tubes are used in condensing unit.

Although the above-mentioned tube arrangement with bends and joint increase heat transfer rate, Nu/Cf decrease due to large pressure drop. Figure 2 shows the COP of cooling unit decreases when Nu/Cf decreases.

To know the effect of shape, size, bends and arrangements on the pressure drop of tubes in condenser, a CFD simulation of each components of condensing unit are required. Against this background, CFD simulation carried out for each bend and joint at different Reynold numbers. The boundary conditions were taken as velocity inlet, pressure outlet and no-slip wall condition with convection having a coefficient of convection of 100 W/m2-K. The FVM method is used to discretize the Navier-Stokes coupled with energy equation with appropriate Boundary conditions. Iterative method are used to solve system of algebraic equation.

Figure 1: Front view of a 3-D model of a two-row, multi pass compressor used in commercial split air conditioners

Figure 2: (a) p-h diagram of a VCRS cycle and (b) T-S diagram of a VCRS cycle

Figure 3: (a) pressure drop in a single turn simple tube (b) Streamline in the simpler tube, (c) Pressure drop in a U-tube connecting two rows (d) Streamline in the U-bend Pressure drop in a short rectangular bend (b) Streamline in the bend

Figure 4: Pressure drop in T-Joint (a) x-z plane (y=0), (b) x-y plane (z= 0) and (c) Streamline in x-y plane (z= 0)
Figure 3 shows pressure drop and the streamlines for different bends and joints in various planes. Among the bends, the pressure drop is maximum in the T-joint in turbulent flow of refrigerant. The streamlines show flow separation in all the bends because of adverse pressure gradient near the walls. In the de-superheating zone, the pressure drop decreases due to a decrease in the specific volume and velocity. The pressure drop is higher than predicted by Colburn (1933), because single phase does not consider shear stresses at the liquid-vapour interface. However, as soon as the condensation begins to take place, the pressure drop starts to rise because the condensed liquid starts forming a wall around the tube. The liquid film is thickened as the condensation proceeds, increasing the shear stress at the liquid-vapour interface. This results in a further increase in the pressure drop. At the same time, the density of the refrigerant increases, resulting in a decrease in velocity for a constant mass flow rate, due to which the frictional and momentum losses decrease. Therefore, the pressure drop once again starts to decrease. As the pressure drop increases, the evaporating temperature and evaporating pressure also increase. This results in a decrease in refrigeration density. Hence the mass flow rate and refrigeration effect also decrease. However, the enthalpy difference across the condenser and the compressor increases. This results in a decrease in condenser capacity considerably. The coefficient of performance (COP) is also reduced as compared to the case when the condensation takes place at constant pressure and temperature. However, the pressure drop can be decreased by lower mass flow and level of superheating. It is concluded that the joint and bend in condensing unit reduce the cooling effect.

References

[1] Prof. M Ramgopal, lesson on Vapour compression refrigeration systems, version 1 ME, IIT Kharagpur (http://nptel.ac.in/courses/112105129/10).


Assessing indoor air quality inside underground metro stations. A Case study of Delhi Metro

A. K. Garg, Director Operation
Delhi Metro Rail Corporation Limited, India

Rajesh Kr. Jain, Dy. Chief Electrical Engineer

1. INTRODUCTION

According to World Health Organization (WHO) survey of 1600 world cities in 2014, the air quality in Delhi is the worst of any major city in the world. The level of pollutants goes beyond the hazardous level in the winter season during December and January months in National Capital Region. These elevated levels of pollutants thereby affect the Indoor Air Quality (IAQ) inside the underground metro stations where indoor air pollutants cannot be easily discharged by natural ventilation. Furthermore, due to abrasive force acting on rails and wheel braking, various types of air pollutants such as particulate matters (PMs) are generated internally.

Air pollutant inside the railway stations and metro stations are extensively studied. The studies done so far for assessing the IAQ level inside enclosed underground metro stations in general concludes that the levels of pollutants remain higher than the requirements specified by the various national and international standards and guidelines. The comparison between level of different pollutants in the different type of UG metro stations which has PSD, half height PSD and no PSD along with different type of operation of the ventilation and air-conditioning system are not being undertaken till date to the best knowledge of the authors.

This paper presents a study undertaken at Delhi Metro to assess the level of major pollutants like PM2.5, PM10, CO, O3, CO2 inside underground stations and to find out some measures, which can be adopted to lower the level of pollutants inside the underground stations. The underground metro stations having different arrangements like full height Platform Screen Doors (PSD), half height PSD and no PSD are chosen for this study.

2. STATION SELECTED AND METHODOLOGY

<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of UG Station</th>
<th>Concerned Line</th>
<th>Peak Headway</th>
<th>Platform Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Mandi House (MDHS) interchange station</td>
<td>Line-3 and line-6</td>
<td>2 minute 43 Seconds</td>
<td>Without Platform Screen Door</td>
</tr>
<tr>
<td>(ii)</td>
<td>Bhikaji Cama Place (BKCP)</td>
<td>Line-7</td>
<td>5 minute 12 Seconds</td>
<td>With half height Platform Screen Doors</td>
</tr>
<tr>
<td>(iii)</td>
<td>Shivaji Stadium (SVJI)</td>
<td>Airport Express Line</td>
<td>10 minutes</td>
<td>With Full height Platform Screen Doors</td>
</tr>
</tbody>
</table>

The measurements were taken in December’ 2018, January’ 2019 and February’ 2019 as the level of pollutants were maximum during this period in Delhi-NCR. The measurements were recorded for Open Mode, Close Mode and only AHU Mode operations at all the three stations chosen for the study. The data was recorded during morning, afternoon and evening time on different days in different modes of operations during the measurement period of three months.

3. MODES OF OPERATION OF ENVIRONMENT CONTROL SYSTEM

In Open mode, 100% outside air is circulated in the stations. It is the more economical mode of operation when the outside air temperatures are relatively low. AHU shall take the air directly from outside via fresh air shaft and deliver the air at platform and concourse level. Trackway Exhaust Fan (TEF) shall extract the air from Over Trackway Exhaust (OTE) and Under Platform Exhaust (UPE) and discharge it outside directly via exhaust shaft. The water-cooled chillers units shall remain shutdown in this mode. This mode is generally used during winter season.

In Close mode, air is extracted from the public areas through the TEF and returned to the air handling units to be cooled and delivered back to the platform and concourse. This mode is generally used during summer and monsoon season. During close mode fresh air is added to the system through the Fresh Air Fans. The fresh air fan is further integrated with the CO2 sensors based on which the speed of fan is regulated as per the CO2 level inside the station.

For study purpose another mode of operation i.e. Only AHUs mode was also run to observe the effect of TES on the indoor air quality parameters of the station. In this mode only the AHUs were run during the open mode operation.

4. RESULTS AND DISCUSSIONS

It was observed that the readings of TVOCs, CO and O2 are almost zero in all modes of operation and the sensors chosen for study were not able to detect these pollutants outside and inside at the stations. The concentration of CO2, PM10, and PM2.5 are discussed hereunder at these stations in Open, Close and only AHUs mode of operation.

4.1 CO2 concentration

The Carbon dioxide were found to be maximum at platform than concourse and lowest at outside ambient. This happens to be due to the fact that numbers of passengers waiting at the platform area for boarding the trains are more than the number of passengers at the concourse level.
MDHS being the interchange station of Line-3 and Line-6 has more passengers and lesser headway of the trains, therefore, it has the maximum CO₂ level in the range of 600-800 ppm at platform level than the BKCP and SVJI station which are having 450-480 ppm and 590-690 ppm respectively. The CO₂ level at SVJI are more than the BKCP because at BKCP station half height PSD are available, therefore, the air exchange from atmosphere is possible due to the piston effect of the train. The SVJI has full height PSD and therefore, the outside air ingress is minimum at the station. Therefore, the CO₂ levels are higher at SVJI station.

It can be concluded that CO₂ level inside a station are affected by presence of PSD, train headway, number of passengers inside the station and outside ambient conditions. In general, the CO₂ level inside the stations meets the guidelines set by Indian and International standards.

4.2 PM₁₀ and PM₅₀ Concentration

At the outset, it is seen that at all the stations, during different mode of operation of ECS system the level of PM₁₀ and PM₅₀ were mostly higher than the acceptable limit set by Indian and International guidelines.

The concentration of PM₁₀ is more than PM₅₀ in both platform and concourse areas during different mode of ECS operation. The high level of PM₁₀ than the PM₅₀, might be due to abrasion and wear of rail tracks, wheel and braking pads caused during the motion of the trains. The outside pollutant level of PM₁₀ and PM₅₀ was mostly higher as compared to the inside levels.

The PMs were generally higher at platform than concourse at BKCP and MDHS station. This is due to half height PSD and no PSD respectively at BKCP and MDHS station, which allows the mixing of tunnel air having more PMs with platform air. At SVJI station the PMs were generally lower at platform and higher at concourse level. This variation is due to presence of PSD at SVJI station, which restrict the mixing of tunnel air with the station platform air. The litter higher level at concourse are due to return air exhaust which may induct the PMs from the outside atmosphere and mix in concourse environment.

The station wise concentration of PM₁₀ and PM₅₀ during different mode of operations are discussed in following paras.

4.2.1 Bhikaji Cama Place Station

In open mode, both PM₁₀ and PM₅₀ concentrations are more at platform than the concourse level. The higher level of PMs at platform are more due to direct entry of PMs at platform from the tunnel sections. In open mode the trackway exhaust system directly captures the PMs and exhaust them to the atmosphere. The AHUs taking air from outside ambient is filtered to restrict the entry of the PMs in the station environment directly from the atmosphere. In close mode operation, the level of PMs are more than the open mode operation as the TES is not directly exhausting the air to the atmosphere, the air is recirculated in close mode and hence the PMs are increased marginally at the platform and concourse level.

Further, in only AHUs operation it is seen that PMs level further increased at platform and concourse due to non-availability of TES at the platform level.

4.2.2 Mandi House Station

The pattern of PMs in Open mode, Close mode and only AHUs mode is similar to what is observed at the BKCP station.

4.2.3 Shivaji Stadium Station

As expected the concentration of PM₂.₅ and PM₁₀ both are less at Platform and Concourse level than at the BKCP and MDHS station. The PM₂.₅ and PM₁₀ concentration at platform and concourse during open and close mode operation are similar as there is no mixing of tunnel air with the station platform due to absence of piston effect and hence no ingress of PMs due to train movement. It may be noted from the measurements that close mode is having more concentration of PMs than open and only AHU mode operations at platform and concourse area both. This has happened due to higher concentration of outside PMs on the date of measurement and return air from concourse and platform has caused ingress of atmospheric air in the station environment.

5. CONCLUSION

The level of PM₂.₅ and PM₁₀ are higher than the acceptable limit set by Indian and International guidelines. The reason for the high concentration of PMs inside metro station is also due to the fact that the outside level of PMs during winter months are quite high and the ventilation system operates in open mode. The Platform screen door has significant effect in controlling the particulate matter, which result in quite less concentration of PM₂.₅ and PM₁₀ at Platform and Concourse level than at the station with half height PSD or no PSD. The TES is effective in reducing the level of particulate matters at the platform area in case of station with half height PSD or no PSD. Therefore, the lowest levels of particulate matters were achieved during open mode operation as compared to close mode operation.

The IAQ levels inside the station can be improved by having regular cleaning and washing of the station trackway and platform. The IAQ levels can also be improved by using high efficiency filters of MERV-12 category in the Air Handling Units.

The study for assessing the different pollutants in different seasons of the year to be further investigated. The measurements of various pollutants for assessing the IAQ inside the train shall also be conducted where passenger stays for most of the time.

These excerpts are taken from the paper presented by authors at ISAVFT-2019 Conference at Athens, Greece.
INTRODUCTION

• The building of a new Jang-e-Azadi memorial poses a remarkable challenge and offers opportunity to restate the values of Indian freedom fighters who laid down their lives and regional concerns in built form. One of the most important factors, which have influenced the design, is making it a sustainable building.

• In India a huge impact can be made by adopting sustainable construction and operation strategies. According to recent sustainable research it makes sense to adopt sustainable features during design and planning stage itself which we are adapted during initial stages in its design. As sustainability cannot be added on in a project but has to be built into it. As some of the fundamental requirements such as optimum orientation cannot be changed once the construction has started.

ADAPTED STRATEGIES

• To maximize the use of natural resources (Daylight), the layout opted was circular which can reduce the energy demands during energy peak loads and help towards attaining a sustainable goal on a regional level aswell.

• To achieve water sustainable build-ups, the design and construction industry can work towards a two-pronged approach, i.e. minimising the demand by use of water efficient fixtures (low flow faucets, dual flush WCs, efficient irrigation systems like drip irrigation) and storing the rainwater.

• Adapted good construction management practices such as preservation of existing vegetation, preserving natural features. Further, efficient lights and equipment, the more long-term impact can be made on the operational cost.

• Appropriate air pollution control measures such as minimum 3 meter high barricading all around the construction site, wheel washing facility and sprinkling of water on loose soil, must be adopted. In addition, the more green features were incorporated in the project such as insulated walls, sealed windows, and systems use.

Huge openings getting the maximum daylight in the building

Future building which will be using far less than the energy benchmarks by Green building rating system.

Dynamic energy model can be done to know the study model in more detail if required

UNIQUE ASPECTS OF THE MEMORIAL

• Natural ventilation provides a highly
energy efficient method of reducing costs and environmental impact. The innovative and holistic approach towards sustainability.

- Manual opening of the windows is also incorporated into every floor, so that individual units can be opened or closed by the buildings services professionals when external weather conditions permit, to provide good indoor air quality and thermal comfort.

- Specialized lighting systems with sensors, which will go off in case of enough daylight required for a public building (avr 300lux).

- Sustainable Site Planning, as existing trees were preserved and transplanted along the periphery of the site.

- For achieving thermal comfort, double glazing has been used which helps reduce cooling loads in AC spaces and meets thermal comfort levels in non AC spaces.

- Centralized air conditioning through variable refrigerant flow technology is installed. Daikin’s VRV system integrated advanced technology to be used, which can provide comfort control with maximum energy efficiency and reliability. (Inspirational case study- CRISIL India which achieved platinum rating from Indian green building council).

- Heat reclaim ventilation for reducing the energy demands and Outdoor air processing (OAP) used for fresh air treatment and air conditioning simultaneously.

- VRV system is proposed for this building as it is energy efficient and uses environmental friendly refrigerant with zero Ozone depletion potential (ODP). It is also complaint with Restriction of Hazardous Substances in electrical and electronic equipment (2002/95/EC)

**SUSTAINABLE HIGHLIGHTS**

**Site**

Access to public transportation employee only parking

**Water**

Grey Water used for irrigation porous pavement use indigenous vegetation low flow toilets and fixtures

**Energy**

Efficient building envelope Day lighting, High performance lights (LED Lights) + Photovoltaics installations, Advanced Control System Efficient HVAC (VRV)

**Materials**

Durable low maintenance materials invest in recycling infrastructure renewable materials

Indoor Environment

Visual Comfort low VOC materials

Air quality / acoustic quality

Green New buildings can have tremendous benefits, both tangible and intangible. The most tangible benefits are the reduction in water and energy consumption right from day one of occupancy. The energy savings could range from 20-30 % and watersavings around 30 - 50%. The intangible benefits of green new buildings include enhanced air quality, excellent daylighting, health & well-being of the occupants, safety benefits and conservation of scarce national resources-Indian Green Building Council.

**SUSTAINABLE HIGHLIGHTS (DETAILS)**

**ENERGY**

- Efficient building envelope – use of dry wall cladding with air gap acting as insulation. Building orientation for less solar gain. Courtyard design used as a passive method of ventilation.

- Day lighting – all offices and public corridors have large openings with Double glazed window unites which creates thermal insulation. This reduces the flow the heat transmittance through the building envelope through large openings. It also provides sound insulation with glazed doublepanes.

- Solar film with good g-values can be proposed for reducing the solar gains through the openings.

- High performance lig h ts - LED Lig h ts which are extremely energy efficient and consume up to 90% less power than incandescent bulbs. Since LEDs use only a fraction of the energy of an incandescent light bulb there is a dramatic decrease in power costs. It will be a moneysaver.

- Photovoltaics – Solar street lights have been proposed which will makeuse of the solar energy during day time and provide lighting solution during late evening and night. Also solar water heaters have been provided in the food court area where there is demand of hotwater.

- Advanced Control System – BMS and occupancy sensors to control lights and systems use.
MATERIALS

- Durable low maintenance materials – permanent external finish of stone which requires very less maintenance.

- Investment in recycling infrastructure – STP for treating sewerage and water. Recharge pits for ground water recharge. Making swales along the front boundary wall for natural surfaced drainage.

- Renewable materials – Terrace water proofing, glass (recycling material)

INDOOR ENVIRONMENT

- VisualComfort

- Low VOC materials – paints and other finishing materials

- Air quality / acoustic quality – ventilation system and panelling on walls

CONCLUDING WITH SITES SUSTAINABLE FEATURES

Site

- Access to public transportation employee only parking

- The site is accessed form National Highway 1 (NH – 1) connecting Jalandhar and Amritsar at two points. One is the main entrance and the other one ceremonial entrances to the site. Two separate gates have been provided for servicing the campus and to monitor parking.

- Porous pavements – sandstone with grass strip joints, Turf paver (TurfpaveXD)

- Use of indigenous vegetation which require less water (Technical names- Bauhinia purpurea (Kachnar) | Cassia javanica | Cassia fistula (Amaltas) | Ficus Infectoria (Pilkhan) | Grevillea robusta (Silver oak) | Cassia grandis | Cassia roxburgii | Chukrasia tabularis)

Green New buildings can have tremendous benefits, both tangible and intangible. The most tangible benefits are the reduction in water and energy consumption right from day one of occupancy. The energy savings could range from 20 - 30 % and water savings around 30 - 50%. The intangible benefits of green new buildings include enhanced air quality, excellent daylighting, health & well-being of the occupants, safety benefits and conservation of scarce national resources- Indian Green Building Council.

CHAPTER POSITIONS

1. Mr. Ashish Rakheja has taken over as Director At Large
5. Mr. K.K. Mitra has been selected as RAL Regional Lecturer

FROM THE EDITOR DESK

We have completed the extended first quarter of the Society Year. The schedule was busting with large number of programs and workshops. There was extensive participation from the society members. We have lots of upcoming events including DL visits. ASHRAE objective of knowledge dissimilation has been the theme of the programs & events and will continue to do so. We look forward to support from our senior members and all esteemed members to carry AIC to new heights.

K.K. Mitra
ASHRAE INDIA CHAPTER POSITIONS

<table>
<thead>
<tr>
<th>Name</th>
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<td>Mr. K K Mitra</td>
<td>News Letter &amp; Home Page Editor &amp; ECC</td>
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<tr>
<td>Mr. Abid Husain</td>
<td>Historian</td>
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UPCOMING PROGRAMS

1. AIC Tech. on 15th November
2. ASHRAE Night on 21st December
3. DL Visits
   a. ASHRAE DL Mr. Frank Mills lecture is scheduled on 15th Nov. 2019 at AIC Tech. Mr. Frank will also give lecture at Jaipur.
   b. ASHRAE DL Mr. Daniel H Nall lecture on 18th Nov., 2019 at Jamia Millia Islamia University
   c. ASHRAE DL Mr. Kishore Khankari lecture is scheduled on 11th Dec., 2019 at Delhi.
   d. ASHRAE DL Mr. Christopher O. Muller lecture is scheduled on 20 Jan., 2020 at Jaipur.
   e. ASHRAE DL Mr. Bjarne Olesen lecture is scheduled during ACREX 2020
4. All Chapters President meeting with ASHRAE President during ACREX in Feb.2020.
5. Reftec in March 2020
6. ASHRAE EGDE in April 2020
7. 3rd Developing Economy Conference in May-June 2020
8. Meeting with ASHRAE members in Chandigarh, Jaipur & Kolkata