



# Enabling Smart, Sustainable Spaces

K Raghavan – Director Channel Sales, Johnson Controls India shares his experience in improving energy efficiency and offering solutions for the company’s new office, notwithstanding the limitations a multi-tenanted leased office presents.

**M**aking a leased office space ‘green’ or ‘sustainable’, that too in an existing 15-year-old building, poses a lot of challenges, compared to designing a new building. There is a continuous effort from architects, consultants and designers, who keep finding new ways to improve energy efficiency and offering excellent comfort to the occupants in an office space. This brief article shares our experience in finding some interesting solutions for our new office, notwithstanding the limitations a multi-tenanted leased office presents.

When we decided to move to a new office in Kalyani Nagar, Pune last year, which our management wanted to be a ‘platinum rated Green Interior office’, our project team entrusted with this task identified new approaches in providing a safe, comfortable and healthy working environment for our employees. We identified the following approaches with respect to thermal comfort, indoor air quality (IAQ) and energy efficiency.

- Create an awareness on thermal comfort and IAQ and draw the employees in playing an active role in determining comfort parameters
- Incorporate employee feedback in our controls strategy, while automatically controlling the comfort parameters through a Building Management System (BMS).
- Ensure the smart office environment for employees
- The actual strategies implemented are briefly described below:

## CO2 sensors

The fresh air intake was liberally designed in the Air Handling Unit (AHU) rooms with a demand-based fresh air feed concept. Though this parameter is monitored on BMS system,



Fig-1: 3-in-1 sensor

Fig-2: CO2 sensor in public utility location

for employee's awareness creation of CO2 level in occupied space, we installed 3-in-1 sensors (Fig-1), which displays temperature, (Relative Humidity %) % RH and CO2 levels on a real-time basis in the workstation area. The location of the sensors is chosen in such a way that they are mounted near public utility space like a common printer station and coffee-vending machine. (Fig-2). These 3-in-1 sensors have been used in place of a standard (Variable Air Volume) VAV box temperature sensor, for optimum use and investment.

All the meeting rooms, collaboration rooms, conference halls, library etc. also have been fitted with these 3-in-1 sensors, connected to the specific-zone VAV box controllers. The control logic of VAV boxes have been programmed to address the CO2 parameter first and then the temperature feedback.

### Thermal comfort

Different standards recommend that the perception of at least 80 per cent of the occupants on the thermal comfort shall be considered to evaluate the effectiveness of comfort in an occupied space. When it comes to thermal comfort, the ground level reality in many of the office premises today, is quite in the opposite direction.

In many offices, it is not uncommon to see VAV box temperature sensors mounted on the false ceiling. Many design engineers and contractors feel reluctant to keep the temperature sensors at an accessible level – especially if they have adjustable dials for temperature control – in the workstation area. This defeats the very purpose of ensuring employees' thermal comfort, for

whom the investments in HVAC system and BMS have been affected by the employer. Another uncomfortable observation in our HVAC system audits has been the locking of AHU VFD drive at a specific point like at 35Hz or 40Hz by facility engineers. One could imagine the kind of thermal comfort available in such offices.

One practical observation is that the offices are not always in pure rectangular or square shape. Even if they are, to create a 'lively and vibrant workspace' the interior decorators take the liberty to arrange the seating in their own unique style, which are

attractive and do make a difference. From the HVAC design point of view, even with great care, there could be 'pockets' where the conditioned air may not reach at the design value, leading to uncomfortable feeling to employees occupying seats in that region.

To be ready for that eventuality and also to verify the actual temperature gradient that exists across our 25,000 square feet office, we installed more than one temperature sensor for each VAV, at eye level, to be accessed by the employees. (One VAV box can have maximum four temperature sensors, which are connected in daisy-chain fashion. The controller in VAV Box can be field-programmed to either average out the four readings or go for a polling).

Subsequently, we implemented a mobile-based application, which among its many features, has a thermal comfort page, for cabin-users and workstation employees. (fig-3). Workstation employees give feedback on the mobile app asking the system to make it warm or make it cool. Depending on the number of requests that come in, an algorithm has been set in the

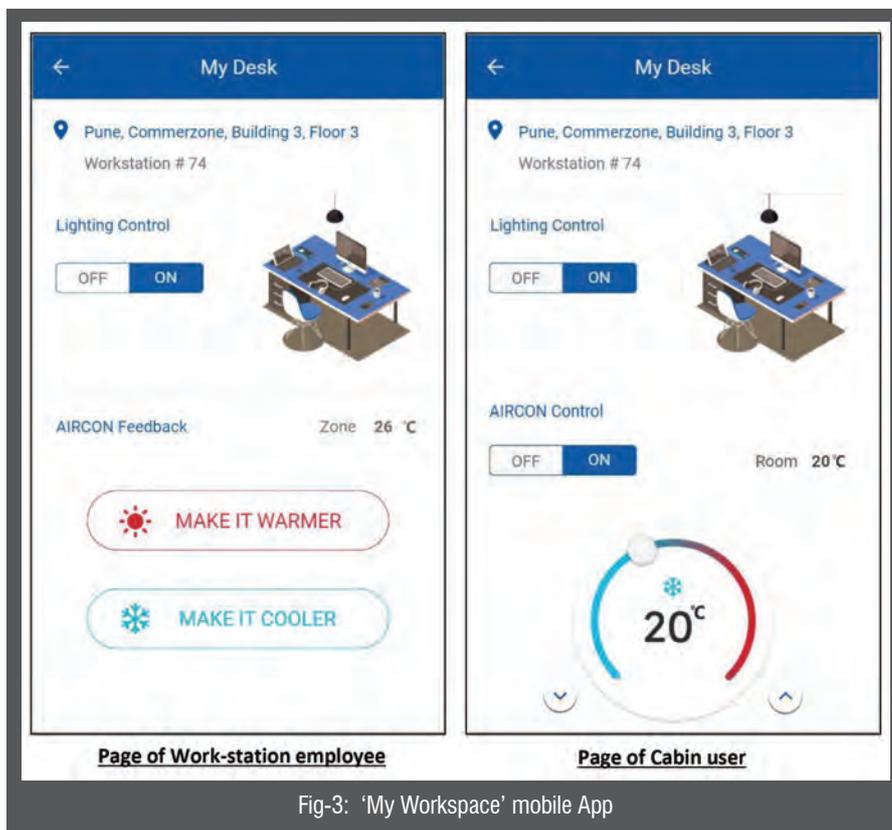


Fig-3: 'My Workspace' mobile App

BMS, which suitably increases or decreases the 'set temperature' at a specific frequency.

**Indoor Air Quality (IAQ)**

The whole office uses non-VOC (Volatile Organic Compound) carpets, adhesives for furniture and paints. How copious supply of fresh air is used and what have done differently for employee awareness creation on CO2 level in occupied zone were discussed before.

Let us deliberate on what we have done on other key parameters related to dust control, dirt accumulation and algae. Sharp corner joints and wet and dark surfaces are typical areas where we can see dirt accumulation and growth of algae and mould, respectively. Various standards like UL-181 and ASTM-C-1338 prescribe tests to evaluate material for their resistance to algae growth. All the equipment handling air-conditioned air, like the Air Handling Unit (AHU), rectangular ducts among others, are potential candidates, which could become the breeding ground for algae and mould growth and aggravate the IAQ problems.

For our new office, we decided to use our YORK AHU, which are Eurovent-certified and are fully compliant to many norms of IAQ. The flush-joint from the panel to frame has a smooth surface and curves at corners to prevent dirt and water retention. (Fig-4). Ensuring a hygienic condition in the AHU is paramount to ensuring a safe working condition for employees. We opted for installing ultraviolet (UV) lamps (Fig-5), which are



Fig-4. Smooth surface and corners of AHU (inside view)

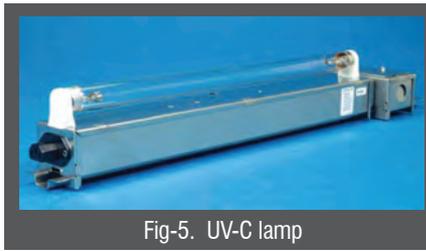


Fig-5. UV-C lamp

lab tested for performance and proven to be very effective in preventing mould growth in wet coils and drain tray.

It is well known for over 100 years that viruses, bacteria and molds are susceptible to ultra-violet germicidal irradiation (UVGI). Germicidal disinfection is delivered at 254 nanometer wavelengths in the light spectrum and is known as UV-C. The UV-C light is able to penetrate the cell wall of microorganisms, and alter the DNA structure, such that the microorganism becomes non-viable; unable to reproduce or infect. (fig – 6). The distance of the UV lamp from the cooling coil is an important parameter and has to be calculated for a given area of coil. (fig-7). This will ensure

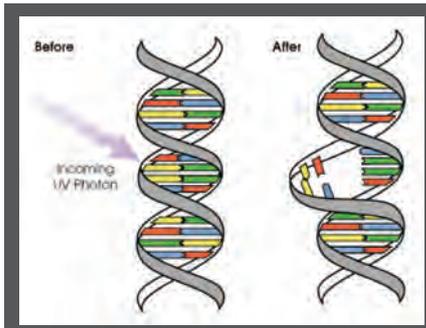


Fig-6. UV-C rays destroying the DNA of microorganism



Fig-7. UV-C lamps mounted inside AHU

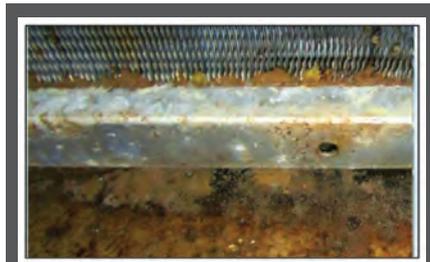


Fig-8. UV-C lamps helping to clean-up the micro organism inside the AHU

that the UV rays impinge on the coil surface with adequate intensity, helping to keep the interiors clean, without any microorganism growth. (fig-8).

The drain tray design is a crucial element in ensuring that dehumidified water does not stay stagnant inside the AHU. This may appear to be a "given" in all the AHUs in service. The drain pan of the YORK AHU uses a dual V-shaped structure with longitudinal slope, which allows for quick and easy drainage of condensed water.

**Sound levels**

We used EC fans in the AHU in place of a conventional belt-drive or plug fan. The EC fans have higher initial investments. In addition to energy conservation, the EC fans which run at part load, most of the time, operate very silently. Our office has a low ceiling height of 11 feet, which prompted us to go for an open-ceiling design and return air passage provided on the AHU room itself.

The AHU is a double-skin AHU and the AHU room is acoustically treated. This, together with the silent EC fans, provide an excellent sound performance and a very silent office to work in. This silent performance has prompted us to set-up a mini-meeting desk for employees and visitors to sit and converse, just outside the AHU room. (fig-9).



Fig-9. Meeting desk, just outside the AHU room

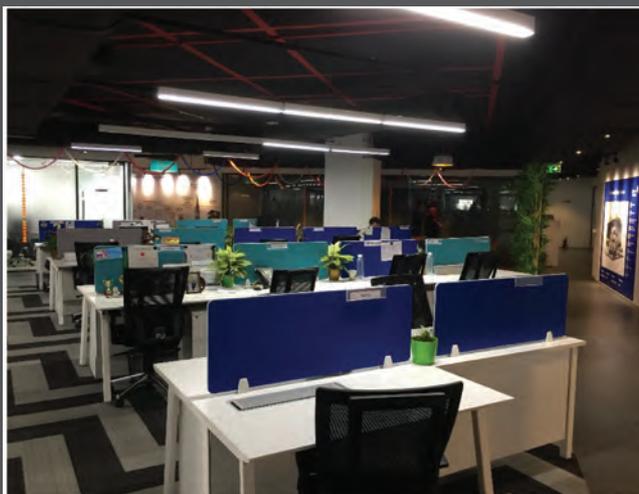


Fig-10. Work station Lighting control

### New ideas implemented for energy conservation

Ours is a multi-tenant office, where the chiller plant is owned and operated by the building owner. Though this reduces the opportunity for energy conservation

(chillers contribute approx. 45 – 50 per cent of entire energy consumed by an office) in a fit-out office space, we did detail out the scope for further energy reduction, beyond use of EC fans for AHU.

We have 17 cabins (single occupant use) and 16 conference rooms, waiting rooms, training rooms, collaboration rooms, among others. All the 33 individual zones are served by VAV boxes, offering individual zone temperature control. The

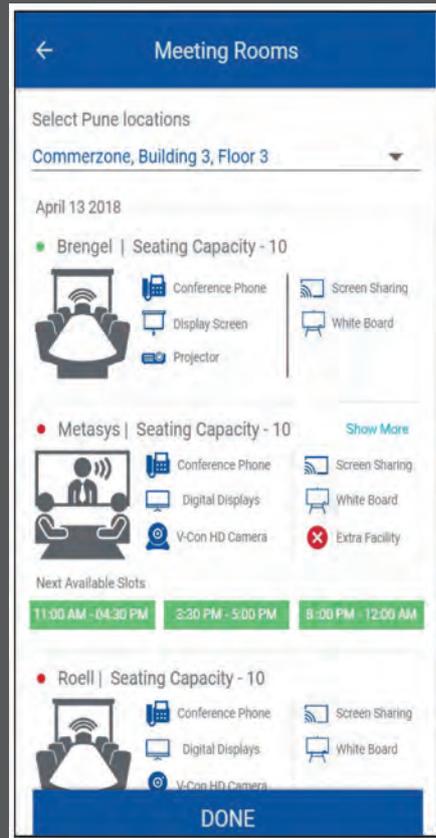


Fig-11. Conference hall booking page

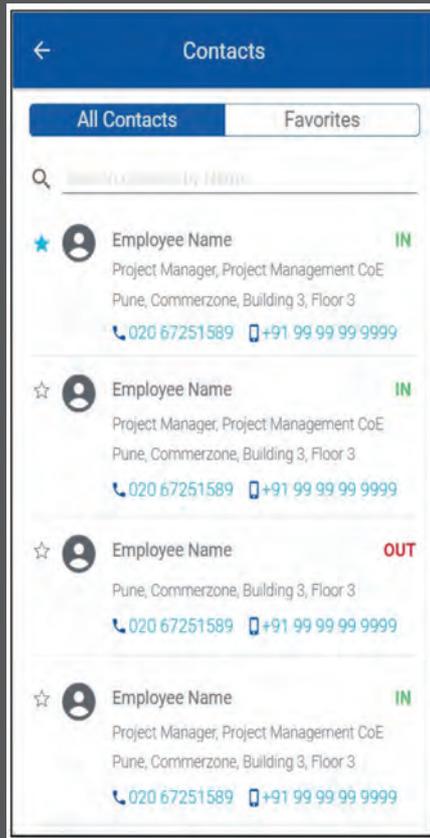


Fig-12. Tagging of employees, to check their presence in office

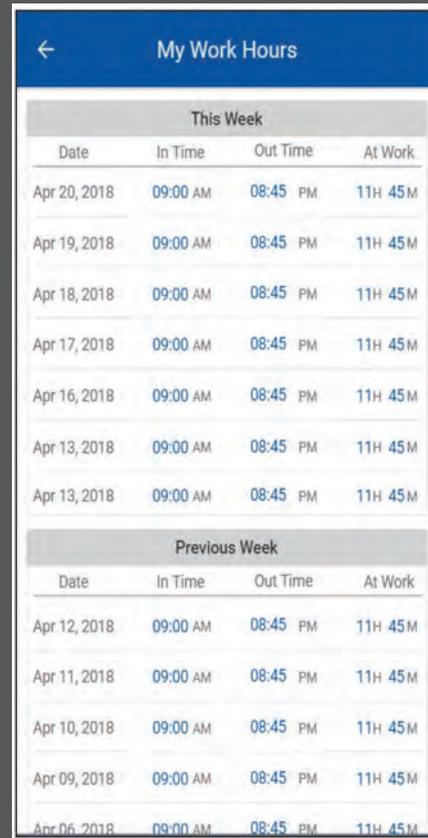


Fig-13. Individual employee working hour page

office's main entrance door access system, Microsoft Outlook for conference hall booking, HVAC, lighting and the employees, My Workspace mobile app are integrated on the BMS, which help us to save further energy in the following manner:

- In the morning, all the cabin and conference room VAV are in totally shutdown condition. Only when the cabin occupants swipe their access card, while entering the office, the BMS recognises their presence and switches on the air conditioning and lights.
- An occupancy sensor is used in the cabins, to turn the lights on and off. This device's output is connected to the VAV box controller. Whenever the occupant is out of cabin, the light is turned off and the temperature set point of VAV for the respective cabin is re-set to 27C for energy saving (overriding whatever was the previous set point as set by the user).
- Unless the conference halls are booked, the lights and HVAC won't be turned-on.

- The workstation overhead lights are placed above each desk of 4 or 6 employees. All the workstations have been tagged, along with the 4 or 6 employees' access cards, who use that desk. Each desk's overhead lights will be turned on, when 'anyone of the tagged employees of that desk enters office' and turned-off, when the 'last employee of that desk leaves office'. (fig-10).

### Employee involvement and in a Smart Office

Our general observation is that the non-technical employees (who are a majority) in an organisation, rarely comprehend the significance and benefits of a green-certified, smart office.

In our office, making the employees feel involved is facilitated through the 'My Workspace' mobile app that we have implemented. In addition to the temperature control feature, which was described above, it has many more features to provide employees with the smart office concept, such as:

- Conference hall booking from the app. This is integrated with Microsoft Outlook. (fig-11)
- Tagging their key contacts on the app. This helps to quickly check if our tagged colleague or seniors have come to office or not. (fig-12)
- Pune city weather and forecast
- Working hours (fig-13)
- Admin messages, notifications and reminders for everyone to see
- Visual layout of office, so that locating any of the booked conference hall becomes easy.
- Canteen menu and ordering portal, which we have not activated yet, as we have a limited catering offering as of now.

For the various initiatives implemented under the Indian Green Building Council's rating standard for "Interior space", our office received a Platinum rating recently. ■

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