THE INDOORS

Society for Indoor Environment (SIE)

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unmask the Built Environment

“Working environments, which are inadequately designed from the building physical point of view (acoustics, indoor climate, lighting, air quality), have an impact on health, thermal comfort and performance.
The built environment has direct and indirect effects on mental health.”

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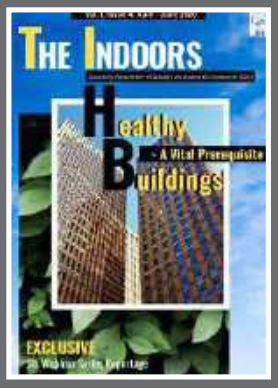
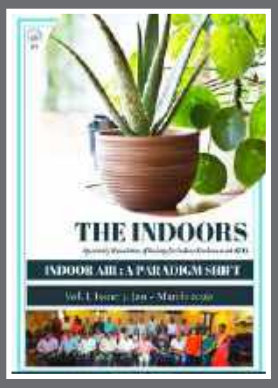
Content Table

Previous Newsletters





EDITORIAL note

by

Prof. Arun Kumar Sharma

President

At the dawn of the new year, we seem to be more relieved at having seen the year 2020 pass by. It was a difficult year and brought paradigm shift in the way we work, live and think. The COVID-19 pandemic brought the focus back on environment for two reasons. One, it is a disease that is transmitted through air and affects the respiratory system primarily and two, it drove the world indoors and made us redesign our lives with focus on remaining inside our homes unless necessary. The second part dramatically affected the ambient air and showed that it is possible to reduce polluting anthropogenic activities to a bare minimum and still continue to not only survive but progress as well. This gives us hope that energy and other consumption patterns can be altered and made environment friendly without having to compromise with growth and development.

At SIE, in the previous year, another important development was to see our young citizens offering to join hands with SIE to improve our indoor environment. Enactus groups from Saheed Sukhdev College of Business Studies and Lady Shri Ram College for Women signed MoUs with SIE to work in this field. This enthusiasm of college students inspire us at SIE to work with more intensity, vigour and passion to tackle the menace of air pollution.

In the year 2021,we look forward to launching projects at community level to improve our understanding of indoor environments, impact of indoor environments on our health and creating awareness among citizens to participate at individual and society level to contribute their bit to improving the indoors.

On this positive note, I wish you all a very happy , healthy, safe and prosperous 2021!

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Improving
INDOOR AIR QUALITY Using DOAS

By

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ISHRAE-CP, GRIHA-CP, GEM-CP, Member-ISHRAE, ASHRAE

The Indoor Air Quality that refers to Nature of conditioned or Unconditioned Air that circulates throughout the space where we work or Live i.e **THE AIR ONE BREATHES WHEN INDOORS.**

HVAC has come a long way. Designers have been constantly working to improve the system design on various fronts. Efficiency, Energy management, Indoor air quality, Controls, Noise Reduction, Compactness, Economics, and Environmental Impact, have been the key drivers pushing the designer to deliver better and more. All the innovations and design improvements have been built around the "traditional approach" with the cooling coil as our main tool in controlling both temperature and moisture (for cooling and dehumidification) in the conditioned space.

System designs need to be looked into to provide better indoor air quality by increasing and having the right mix of re-circulated and outside air, but some questions remain unanswered. "Are we really successful in controlling both temperature and moisture in the conditioned space in all weather conditions with our Traditional Approach, which has relied on using a single Air handling Unit (AHU), or Fan Coil Unit (FCU) to control the zone Humidity, temperature, IAQ and pressure.

The article advocates the need to have better and individual control over the key elements of air conditioning i.e. temperature and moisture. With the help of DOAS approach (Dedicated Outside Air Systems), one can clearly manage both elements efficiently, as it aids in taking care of Humidity and Pressurization requirements only. (1)

This Segregation of Systems enables to have an accurate control of all parameters in the most Energy Efficient Manner. A paradigm

shift in Systems Design is the need of the hour.

Are We Solving the Problem

In the current work culture, most of us spend almost 80- 90 % of our lives in conditioned spaces. Research indicates that conditioned spaces can be 10- 100 times more polluted than outside air. Hence it is important that dilution of the conditioned air is done with adequate amount of Fresh air. Minimum Fresh air Industry Standards are governed either by CO2 levels in the zone or a positive pressure in critical areas. ASHRAE Standard 62.1 is the most widely used standard for minimum ventilation requirements in non-residential facilities. The Standard specifies Fresh air and ventilation requirements for various facilities. Table 6.1 from Standard 62.1 gives the minimum ventilation requirements for different environments. (Table-1) This table provides the minimum Fresh air that is needed to improve Air quality of the conditioned space to an acceptable quality. This amount of ventilation (Refer Table 1) has definitely solved some IAQ problems, but the inability to maintain the right humidity (Fig-1) with our HVAC system design has lead us to other problems.

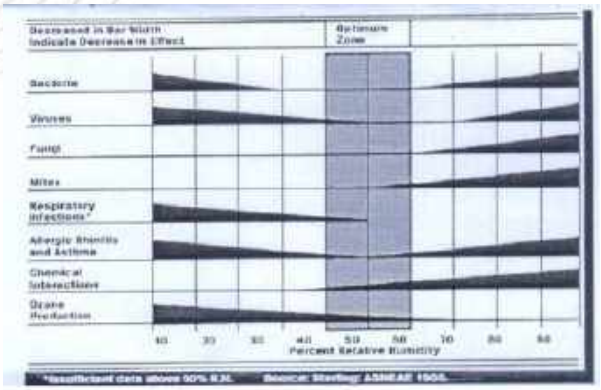
The formation of mold and mildew (2) is a serious dilemma in itself, which is caused by High Humidity leading to degradation of building materials as well as affects the Occupants Health. Low Humidity is also undesirable as this can lead to drying out of the mucus membrane and generation of Static charge. The question is “Have we Solved the problem?”

This Minimum amount of Fresh Air or Outside Air (OA) cannot be reduced due to various IAQ concerns. The benefits of increased ventilation have been clearly

Occupancy Category	People Outdoor Air Rate	Area Outdoor rate	Default Values	
			Occupant Density	Combined Outdoor Air rate
	cfm/person	cfm/sq.ft	per 1000 sq.ft	cfm/person
Office Space	5	0.06	5	17
Reception	5	0.06	30	7
Main Lobby	5	0.06	10	11
Warehouse	..	0.06	..	..
Restaurant/Cafe	7.5	0.18	100	9
Hotel Room	5	0.06	10	11
Pharmacy (Prep)	5	0.18	10	23

Table 1: Minimum Fresh Air Requirement for various Spaces as per (ASHRAE 62.1-2007)

established and absorbed by the HVAC industry. The health of occupants is of great concern and therefore the focus is on having right amount of Ventilation. Bringing in the OA however poses a great challenge for the HVAC system. The saviour of IAQ brings along with it the quandary of high latent load, imposing a heavy load on the HVAC equipment and resulting in high RH inside. (3) An Air Handling Unit with only a cooling coil can control a single variable at a time. This coil is controlled to maintain either the return air temperature or a fixed supply air temperature with variable airflow rate to match the load. Controlling additional parameters such as Air changes per Hour (ACH) and humidity will introduce additional components such as constant volume Dampers, electrical heaters, which will cause the system to operate inefficiently.



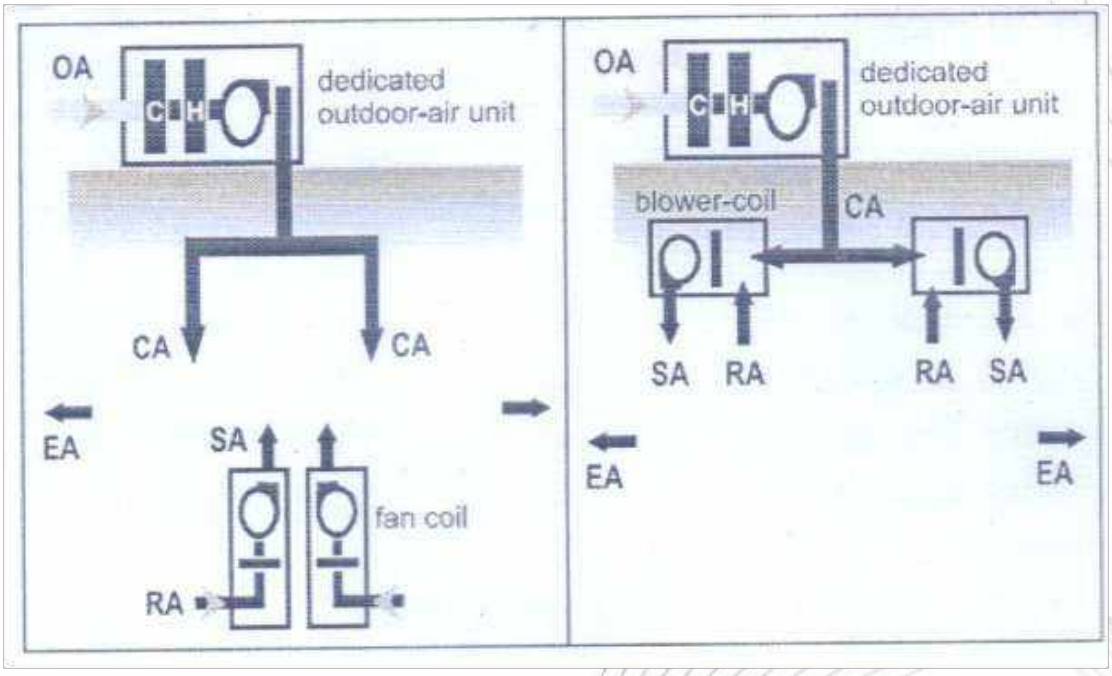
(Figure-01)

DOAS Approach

Constant volume, mixed air, HVAC units are generally selected with sufficient cooling capacity to handle dry bulb design and are controlled by a thermostat, which matches the sensible cooling capacity of the coil with the sensible cooling need of the space. But during the high Humidity conditions during rainy season outside, the latent cooling load can approach or even exceed sensible cooling load. To overcome this problem one needs to divide the load into two components i.e. 'Sensible' and 'Latent' and handle them separately. This approach deals with both components separately. Hence, it is important that the latent load of this air be handled separately. (4)

The DOAS approach works on this principle only. It removes all the latent load being brought by the outside air at the source and processes the same to a very low dew point thereby enabling it to take care of the rest of the internal latent load too. The internal cooling devices are then limited to sensible cooling only. This approach now opens up a whole new world of innovative designing and helps the designer to maintain the right RH throughout the year irrespective of the weather pattern outside. The IAQ and RH management both get resolved and one is able to overcome all obstacles being experienced by conventional systems. The designer can now increase the operating temperature feeding the internal air handling units, reduce the row depths (as ADPs can be increased) and can optimize between the air volume and ADP as one is now not

limited by the Sensible Heat Factor (SHF) any longer, to get the maximum energy and space efficiency.(5) A DOAS system typically has a Fan Blower, an Air filtration unit, and a cooling coil (Dx or Chilled Water). The DOAS controls the supply dew point temperature of the air to ensure accurate humidity control. This can be fed directly to the space or to the Re-circulation AHU (Figure- 02 & 03) The conditioned fresh air provided by DOAS to the space has much lower water content than the room air. When this dry air is mixed with the room air, the resulting air mixture will have a humidity level much lower than the room air humidity. This will leave the AHU to take care of Sensible load alone. Hence in systems using terminal devices such as fan coil units (fcus), cassette units connected with VRF System, problem of condensation will be reduced thus improving the comfort and reducing the potential for microbial growth. (6) A DOAS can also be used to provide demand control ventilation (DCV) based on room CO2 levels. Due to the flow modulation capabilities of DOAS system, the overall energy consumed by the air-conditioning system is reduced as less fresh air needs to be treated during partial loads A DOAS also reduces the Reheat requirements in the system by conditioning the only part of its air flow rate, this improves the overall efficiency of the cooling system with less over-cooling required to maintain space humidity requirements.



(Figure-02 & 03)

The Conclusion

Parallel Sensible Cooling Options, when using the DOAS approach the internal cooling devices work only as sensible cooling devices. The options available for internal cooling / heating are:

- Unitary equipment
- Terminal AHU / FCU
- VAV system
- Radiant cooling panels

Each one of these has its own distinct advantages for type of zoning required for specified HVAC application. The indoor air quality requirement of higher ventilation rates along with proper RH control and energy management will push the HVAC designer to the use of "Dedicated outside air systems" in the near future. DOAS holds a lot of promise with its ability to maintain the right humidity in all weather conditions. The DOAS approach definitely allows the designer to have better management of the two key elements of air conditioning i.e. temperature and moisture. (7)

The original definition of air conditioning can now be met in an energy efficient manner. With the DOAS approach, it is possible to have high potential of energy savings in nearly all applications and weather profiles.

In the words of Albert Einstein, 'Science is nothing more than a refinement of everyday thinking'.

References:

1. Steven J. Emmerich and Tim McDowell. 2005. Abstract. Initial Evaluation of Displacement Ventilation and Dedicated Outdoor Air System for US Commercial Buildings.
2. Retrieved from epa.gov/indoor-air-quality-iaq
3. Lewis Harriman, Plager D, Kosar D. ASHRAE Journal. November 1997. Dehumidification and Cooling Loads from Ventilation Air
4. (4) Charles E, Gulledge. 2016. Heating, Ventilation, Air Conditioning and Refrigeration (HVAC & R) Engineering
5. Stanley A. Mumma. 2001. ASHRAE Journal. Designing Dedicated Outdoor Air Systems
6. Charles E, Gulledge. 2016. Heating, Ventilation, Air Conditioning and Refrigeration (HVAC & R) Engineering
7. Wayne Morris. 2003.ASHRAE Journal. The ABC's of DOAS

INDOOR PLANTS
As Natural Air Purifiers

By
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The global pandemic has brought makeshift changes in lives around the world. People are suddenly confined to the indoors which has made people appreciate their home and indoor spaces more than before. It is a fact that people spend about 90% of their day inside a building; the reason why indoor environment and air quality alongside the declining air quality index in cities like Delhi, India have been in focus of all building engineers. This is also why Green buildings not only talk about sustainable materials, energy and water efficiency, but, puts occupant's comfort as an important criteria of judgment. Green buildings already promotes natural concepts like inclusion of daylight in occupied building spaces brining down artificial lighting needs. Providing all occupants access to views which helps in relaxing our minds and take breaks while working. Therefore, a highly efficient building would only be considered successful when the occupants feel happy, comfortable and productive working in the indoor environment. To achieve the perfect aesthetic balance, designers often incorporate indoor greens in the spaces such as areca palms and through vertical gardens. These add textures and a natural feel- a design much appreciated in most parts of the world.

Figure 1: Snake Plant

Moreover, people have also started acknowledging sustainability as the need of the hour and started incorporating the principles in their everyday lifestyle. More and more people are saying no to using plastic, encouraging slow fashion, adopting zero waste lifestyle and promoting organic and natural products. This attitude has also led to people curating home gardens and decorating the indoor spaces with plants. This provides people the perfect sustainable way add greens which not only acts as natural air-purifiers but comes with an array of advantages. Some of the many advantages of having plants indoors are:

- Direct constructive impacts on moods by relaxing minds and reducing stress levels
- Absorbing toxins, increasing humidity and releasing oxygen
- Greens can also influence productivity, creativity and concentration positively

The different most popular types of Indoor Plants and those very easily available are:

1. Snake Plants is a succulent plant that is absolutely low maintenance and requires zero effort. All that this plant requires is direct sunlight four to five hours a day and minimum watering to avoid moist soil. This plant is capable of removing toxins like formaldehyde, trichloroethylene, benzene and xylene [1].
2. Peace Lilies are not just elegant with their classy white flowers, but also easy and undemanding. They are known to thrive on low light, weekly watering and slow release fertilizer to promote growth. The best part about this plant is that the leaves wilt indicating need to be watered. These plants act as great air purifiers and release huge amounts of oxygen.
3. Areca Palms can cover bigger spaces and can add a lot of greens giving your spaces a fuller feel. Areca palms are essentially indoor plants and thrive very well in Indian conditions. Relatively low maintenance and cheap these plants are capable of removing toxins such as benzene, carbon monoxide, formaldehyde, trichloroethylene, xylene.

Figure 2: Boston Ferns

4. Spider Plants are small bushy and a perfect choice for those new at indoor gardening. These plants can thrive in indirect sunlight and survive in extreme conditions (even very low temperatures) Spiders are known to remove toxins formaldehyde and xylene.

5. Ferns and Aloe vera are commonly known, however, their air purification capabilities still remain unused. Ferns add texture to the indoor spaces with their different types such as the Boston and Bird nest ferns. Whereas, aloes need bright well lit rooms and low water to grow. The benefits of aloe are immense and the aloe juices can be directly used on skin. Aloes are known to absorb formaldehydes and turn brown when the extent of harmful chemicals in the rooms are high.

There are other indoor plants such as Aglaonema, Monstera, Anthurium and the many different types of palms such as Bamboo Palm, Lady Palm and Dwarf Date Plam which also possess the capability of cleaning the air and improving air quality. NASA through its extensive research on the benefits and air purification capacity of plants have found out that it is ideal to use 15 to 18 plants that have a container diameter ranging from 6 to 8 inches for a 1,800 square foot home [3], which means roughly one plant for every 100 square feet of floor space to appropriate clean the indoor air.

It is interesting to note that in mechanically ventilated spaces such as the office buildings which to achieve energy efficiency

Figure 3: Areca Palm

sometimes trades off with airflow. In these spaces, reduced airflow can lead to indoor air pollution and develop sick building syndrome. The indoor pollution in building spaces are enhanced by the indoor coatings and synthetic building materials such as paints, carpets. These indoor materials contain chemicals which releases VOCs in the internal spaces which make up almost 90% of the indoor air pollution [2]. All the indoor plants mentioned above remove CO2 thus cleaning the air and also harmful toxins which form the VOCs. These plants therefore act as a natural alternative to artificial air-purifiers in a cost effective way. The limitation of the air cleaning capabilities of indoor plants is that they do not remove solid particles such as dust and smoke like they remove the VOCs. This is the reason why artificial air purifiers and air purifying plants have always been a topic of debate. Nonetheless, plants can suffice air purification needs unless user suffers of asthma or there is a lot of dust in the indoor spaces or you do not have enough indoor spaces.

Once a building user starts growing an indoor garden it becomes addictive. You realize the influence they have on the mood, the air quality and sooner or later you have a jungle growing in a corner of your house!

Figure 4: Artificial Air-purifiers VS Natural Plants

References:

1. Lottie Dalziel, Breathe easy with these natural toxin removers. Online available at: https://www.bhg.com.au/best-air-cleaning-plants

2. Healthline, (September 12, 2016). The Best Air-Purifying Plants for Your Home. Online available at: https://www.healthline.com/health/air-purifying-plants

3. Home Air Guides, (2020). Air Purifier Vs Houseplants: Which Is Better And Why? Online available at: https://homeairguides.com/air-purifier-vs-houseplants/

Project Pravaah

A Holistic Solution to AIR POLLUTION

By

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Stubble Burning, a globally prevalent practice of setting crop residue on fire releases various greenhouse gases and particulate matter. In 2019, Stubble burning in the northern states contributed to 46 percent of air pollution according to SAFAR. It is one of the prime reasons for high air pollution levels in India. This stubble is deemed useless and thus burnt into ashes, emitting various pollutants at a humungous quantity. Moreover, it is high in nutrients such as phosphorous, iron, nitrogen, etc. which are very important nutrients for the growth of plants. Seeking a perfect solution to these co-existing problems, Project Pravaah was initiated in June 2019. Pravaah aims at providing holistic air purification solutions at affordable prices while reducing the harmful effects of stubble burning, sensitizing the community and providing employment to the underprivileged skilled youth. More than 11 million tons of stubble was burnt last year in Haryana and Punjab. Government and various companies have stepped in and tried to stop the mass stubble burning. The In-situ stubble extraction management technique promoted by the government ensures the nutrients of the stubble are sent back to the soil but the machines used in this process only sows the stubble on the top layer of

Subtle burning near Delhi-NCR

land and takes more time to decompose, causing problems in the next season of crop production as the roots of the crops find it difficult to grow. The other form of stubble extraction technique followed by most companies is Ex-situ management where the stubble is taken from the field which removes essential nutrients from the soil hampering its fertility. Another issue making this problem even worse is the usage of stubble in various industries ranging from paper to textile to packaging industries after being extracted from the fields. Stubble is sub partially burnt in such industries to attain the desired product which in another form causes air pollution, not making a difference from stubble burning. Although Ex-situ stubble extraction technique helps to reduce stubble burning, but doesn't go a long way in keeping in ensuring the quality of nutrients in the field or the air pollution under control to a greater extent.

Fig. 2 Pravaah Stubble Pot

Stubble pot is a unique blend of both the methods. In our partnership with Deutec the stubble is extracted and then made into pot forms which ensures that the nutrients go back to the soil and the problem of field burning gets discouraged as farmers get a decent return for their stubble which was earlier deemed useless. This method has been coined as "pseudo-in situ method" of stubble management by the team. The stubble pot is made in a self-designed machine, combined with a proprietary combination of other raw materials including an outer clay/cement pot to provide smooth texture as well as sturdiness to the pot. Stubble along with the various ingredients help in achieving higher growth and development for the plants as well as reduce water consumption substantially. Each pot reduces ~2kgs of carbon emissions,300g of ash, 18g of PM, 130g, of CO, and .5g of SO2 After an extensive market analysis, the product was launched officially with different outer designs and two sizes of 8 inches and 11 inches. By using the economies of scale, we sell the pots for Rs.129 and Rs.149 for the two different sizes of the pot and the cost reduces significantly if the consumer purchases 4 or more in one go. Currently, we are selling Direct to Consumer from our website with additional air purification plants as add-ons at 30% lower cost than nurseries. The customer feedback has been excellent with their plants growing at a much faster pace as compared to the conventional methods. The biggest learning from this

initiative has been to make efficient use of a widely found waste product and convert it into a utility through rigorous research and experimentation.

Another major issue that we are trying to solve is of brick kiln pollution and its effect on the various stakeholders. To get a better view of this fatal problem, we intervened in one of the largest potter communities in the country, Kumhar Gram. For years, this community made pots using wood kilns. However, In 2019, this practice was banned by the National Green Tribunal, leaving them with a fear of losing their identity and only source of income. Making such a big change in their core operations needed research and expert meetings to provide a better alternative to wood kilns. 'Electric bhattis", being eco-friendly posed to be a perfect substitute for such potters which is not only eco-friendly but also provided the same result with less effort. To bring about a change in the community, we sensitized the potters on various issues relating to the use, management and functioning of electric bhattis and encouraged its use over wood kilns. We have successfully managed to make electric bhattis easily accessible to the potters and many of them have started using them. Although we haven't been able to bring a 100% change in the mindset, we are working in the right direction to achieve our goal. We purchase the outer clay pot required for the stubble pot from those potters who make use of eco-friendly alternative, thus helping in building a circular economy for our model.

Fig. 3 Manufacturing of the Pravaah Pot

Glimpses of 2020

NEERI

SIE President Dr. Arun Sharma and Head of CSIR NEERI Delhi Zonal Centre, Dr. S.K. Goyal signed the MoU for a constructive research collaboration.

Enactus - SSCBS

SIE is pleased to announce its collaboration with ENACTUS SSCBS, (***Shaheed Sukhdev College of Business Studies, University of Delhi)*** for Project Pravaah. We look forward to a fruitful contribution to our environment together.

ENACTUS - LSR

SIE is pleased to announce its collaboration with ENACTUS LSR, ***(Lady Shri Ram College)*** is a community of passionate students committed to creating a new generation of socially responsible leaders.

IEQ - GA

SIE is happy to announce its affiliate membership to IEQ Global Alliance(IEQ-GA) IEQ-GA is an international consortium of government and non-government organizations across Europe and USA working towards providing an acceptable indoor environmental quality (thermal environment-indoor air quality-lighting-acoustic) to occupants in buildings and places of work around the world. This collaboration will make sure that the knowledge from research on IEQ gets implemented in practice across the globe.

Glimpses of 2020

Glimpses of 2020

Launch of SIE Chennai Chapter at IITM

Welcome 2021

Wishing you a very Happy New Year with the hope that you will have many blessings in the year to come.

SOCIETY FOR INDOOR ENVIRONMENT
SIE

Society for Indoor Environment (SIE)

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