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# Codes of Practice for Indoor Air Quality Management in India

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***ABSTRACT***
*Indoor Air Quality (IAQ) has emerged as a critical determinant of public health, productivity, and environmental sustainability in India. With rapid urbanization, energy-efficient construction, and increased indoor occupancy, exposure to indoor air pollutants often exceeds outdoor levels. This paper reviews and analyzes the existing codes of practice, standards, and regulatory frameworks governing indoor air quality management in India. Key documents from the Bureau of Indian Standards (BIS), Central Pollution Control Board (CPCB), National Building Code (NBC), and international benchmarks such as ASHRAE and WHO guidelines are discussed. The paper identifies significant gaps in enforcement, monitoring, and awareness, and proposes an integrated framework combining regulatory codes, smart monitoring, and occupant-centric design for maintaining healthy indoor environments. The adoption of an Indian Standard Code for IAQ management is recommended as an essential step towards sustainable building operation, occupant well-being and mitigation of global warming and climate change.*

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## I. INTRODUCTION

Indoor air quality (IAQ) directly influences human health, comfort, and productivity. With urban populations spending nearly 90% of their time indoors, the quality of indoor air is often more critical than outdoor air. Sources of indoor pollution include building materials, paints, furnishings, fuel combustion, biological contaminants, and outdoor air infiltration.

In India, growing concerns over air pollution and "sick building syndrome" have led to the need for systematic IAQ management. While various sectoral codes (2, 3, 4, 5, 6, 10) address air quality indirectly through ventilation, building design, and occupational health, there is no single, comprehensive IAQ code of practice in India. This paper examines the current landscape of codes and standards, identifies gaps, and outlines a framework for integrated IAQ management.

## II. IMPORTANCE OF INDOOR AIR QUALITY MANAGEMENT

### 2.1 Health Impacts

Poor IAQ can cause respiratory illness, allergies, asthma, headaches, fatigue, and long-term cardiovascular and neurological disorders. Vulnerable populations like infants, children, elderly and the immune-compromised, are particularly at risk.

### 2.2 Cognitive Impacts

Studies have shown that the poor IAQ particularly with increased CO2 level adversely affect the cognitive capacity of human beings (33 to 39). Tests have shown that human beings can exercise their cognitive capacities best at the CO2 concentration in breathing air between 300 to 500 ppm. Their cognitive powers are reduced by 15% at CO2 levels around 945 ppm and by 50% at 1400 ppm. When CO2 levels are high, people are less satisfied, report more acute health symptoms, work more slowly and are more likely to be absent from work or school. Even the symptoms of psychological discomfort, high blood pressure, irritation and anger, have been observed in human beings when subjected to a longer stay in closed and isolated rooms with high CO2 levels in indoor air.

**2.3 Economic Impacts**

Reduced productivity and increased absenteeism due to poor IAQ lead to measurable economic losses. Studies suggest that improving IAQ in offices, can increase worker productivity by 5 to 10%. A good, healthy and comfortable indoor environment promotes a positive attitude and creative thinking in executives and workers which gives rise to innovation and development.

**2.4 Environmental and Energy Considerations**

IAQ management must balance pollutant control with energy efficiency. Modern HVAC systems can optimize fresh air intake, humidity control, and filtration to minimize energy use while maintaining health standards. A recently introduced indigenous technology of **Direct Carbon Capture at Negative Cost (DCCNC),** is proving to be a revolutionary approach in this direction (7, 8, 31). The technology has been practically implemented in a large number of projects in India over the past about 3 years. The case studies of these projects have proved a great success to ensure the desired indoor air quality, achieve 30 to 40 power saving in AC plants and contribute significantly in mitigation of Pollution, Global Warming and Climate Change in the environment (11 to 31).

## III. KEY TECHNOLOGICAL CONSIDERATIONS

**3.1 Sources of Indoor Air Pollutants**

The main sources of indoor air pollutants are summarized in Table 1 below.

**Table 1 : Main Sources of Indoor Air Pollution in Buildings**

| Category | Common Pollutants | Sources |
|---|---|---|
| **Combustion** | CO, $NO_2$, $SO_2$, $PM_{2.5}$ | Cooking, heating appliances |
| **Building Materials** | VOCs, formaldehyde | Paints, adhesives, furnishings |
| **Biological** | Molds, bacteria, pollen | Dampness, poor ventilation |
| **Outdoor Ingress** | $PM_{2.5}$, $O_3$, heavy metals | Traffic, industrial emissions |
| **Human Activities** | $CO_2$, odours | Occupant density, smoking |
| **Pets & Animals** | $CO_2$, odours | Occupant density |
| **Equipment, Batteries, Stores** | VOCs | Heating of Electronics, emission of gases |

A comprehensive code of practice must address all these sources through control measures, permissible exposure limits, and building design strategies.

**3.2 CO2 Emission by Respiration**

While most of the people blame the fossil fuels, industries and vehicles for carbon emission, a close study of statistical data of CO2 emission in India for the year 2021, conducted by BUNKERMAN, revealed some surprising facts as shown in Table 2 and figures…….. It is revealed from this study that about 13% CO2 emission in India is added to the environment just by natural respiration by human beings. Another 15% is added by respiration by other live stock in India like pet animals, wild life, birds, rodents etc. Thus, about 28% of CO2 emission in India is created by mere respiration by human beings and live stock; which unfortunately has been found being neglected so far in all such studies reported in the published literature. This 28% is a very significant figure which can not be neglected; and it proves that fossil fuel and industries may be held responsible only for the balance of 72% carbon emission in India and not for 100% which generally has been a myth so far observed amongst general public and even in some Govt officials dealing with the subjects of air pollution, global warming and climate change.

**3.3 Equivalence with Number of Trees**

It is important to understand the relation between the amount of pollution (particularly CO2 emission) produced by human respiration and the capacity of green trees and forest cover available in India to absorb the CO2. It is a well established fact that while a person emits approximately 450 kg of CO2 in a year just by natural respiration process, but a fully grown tree (having 10-15 years of age) can absorb only approximately 25 Kg of CO2 in a year. Thus if we want to arrest the rising trend of CO2 in atmosphere, we in India have to plant about 17 trees per person to absorb the CO2 emitted by human respiration, 20 trees per person for respiration by our live stocks and 94 trees per person to absorb the CO2 emitted by our industries, vehicles and other equipment. Thus India needs today about 131 trees per person for our population of 140 million. But the bitter truth is that as per statistical data available on record, we have only 28 trees per person in India. Now with these factual figures available on record, can we ever achieve this target of planting 131 trees per person in India? The clear cut answer is, "NEVER". Therefore, we have to think for other practical and feasible solutions like Direct Air Capture (DAC) or Direct Carbon Capture (DCC) to bring down the CO2 level in atmospheric air which is responsible for causing global warming in the world. But here, the main limitation for DAC has been its high energy consumption and high cost. The cost of DAC in international market is presently ranging from USD 300 to 600 per metric ton of CO2 absorbed which is still considered a very high cost, as far as India is concerned. But here comes the BUNKERMAN's indigenous technology of **Direct Carbon Capture at Negative Cost (DCCNC)**, which is now becoming popular in India due to its several advantages (11 to 31).

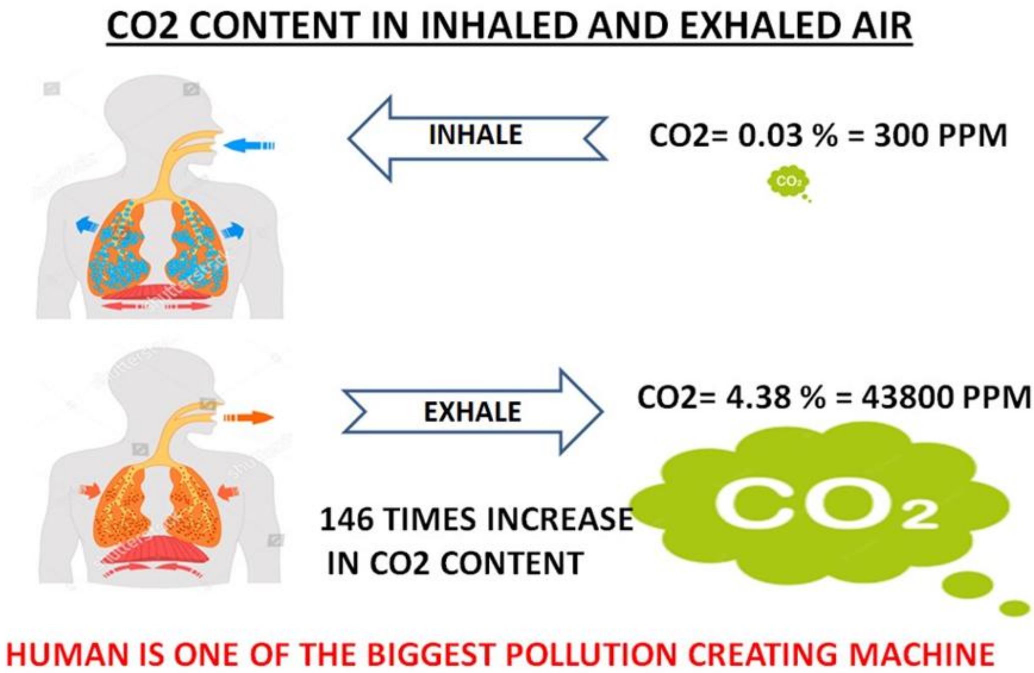


**Figure 1. CO2 Content in Inhaled and Exhaled Air by Human Respiration**

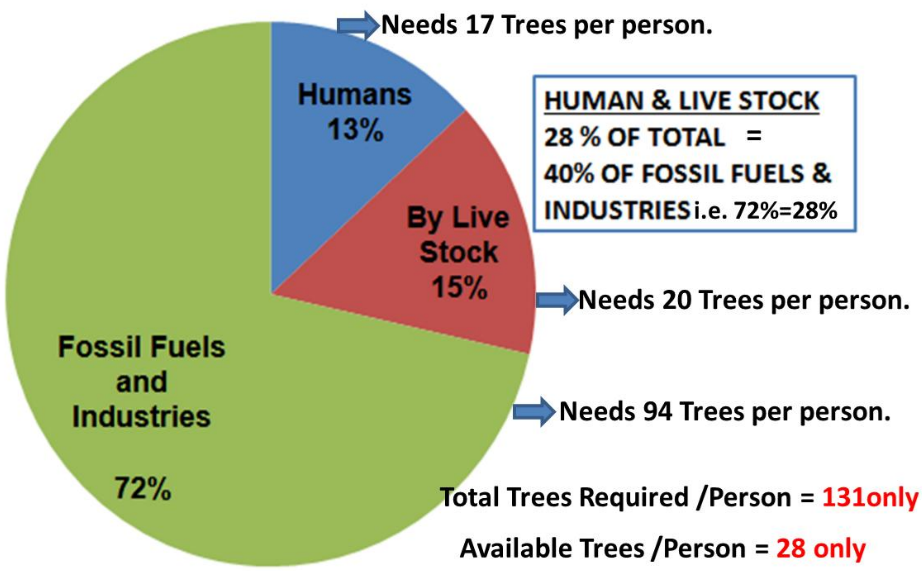


**Figure 2. CO2 Emissions in India : Statistical Data 2021**

### 3.4 Rising Trend of CO2 and other Green House Gases in Atmosphere

The Industrial Revolution disrupted Earth's natural carbon cycle. Before onset of industrial era, Mother Nature maintained a balanced ecosystem as shown in Figures 3 and 5. But since then anthropogenic $CO_2$ emissions have surpassed the capacity of natural sinks due to uncontrolled industrialization, transportation, air conditioning and change of life style by people on earth as shown in Figure 6. Many countries in the world are adopting decarbonization measures such as: afforestation, green buildings, alternative fuels, CNG/electric/hydrogen vehicles etc, but they are hardly able to stop the rising trend of Green House Gases

(GHGs) in the atmosphere which are resulting into the rise in Global Warming and Climate Change in the world. The rate of increase in the GHGs and the global temperature over the recent years is now becoming a serious cause of concern to the environmentalists world over. The situation has now become so dangerous that it has become almost essential to adopt the process of Direct Carbon Capture, Utilization and Storage (DCCUS) by adopting the advanced technologies such as suggested by BUNKERMAN in India (Figure 6).

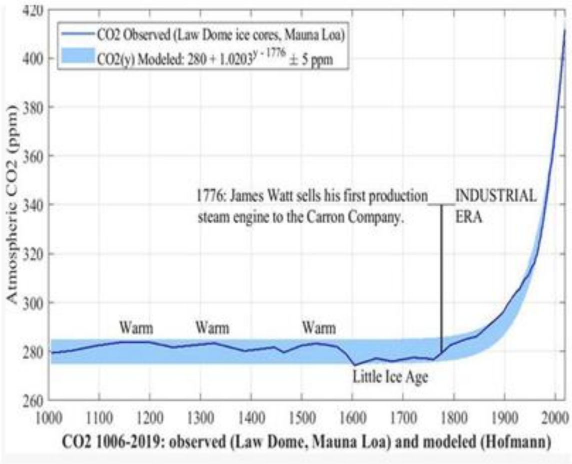


**Figure 3. Variation of CO2 in Atmosphere from Year 1000 to 2000**

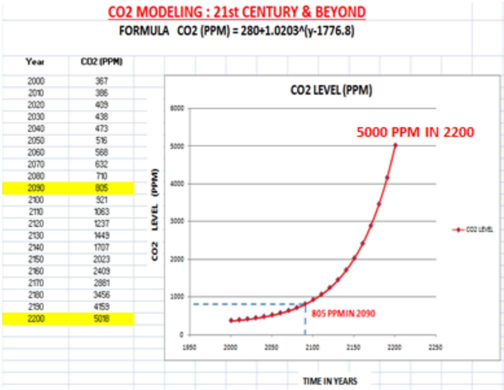


**Figure 4. CO2 Modelling 21st Century and Beyond**

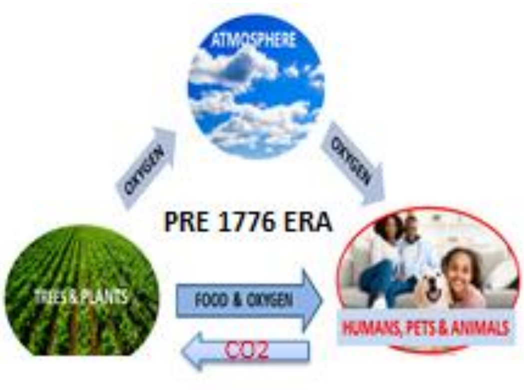


**Figure 5. Sustainable Eco System Prior to Industrial Era**

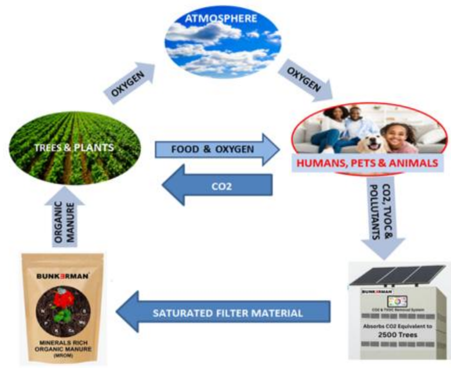


**Figure 6. Sustainable Eco Friendly System by BUNKERMAN**

It is important to be understood here that as the level of CO2 in ambient air is increasing rapidly over the years, it is narrowing the gap between the CO2 in ambient air and the permissible value of CO2 (800-100 ppm) in indoor air to maintain a good Indoor Air Quality in buildings. This will result into making the concept of Air Changes Per Hour (ACH) in AC design, less and less effective in the coming years, as the CO2 content in ambient air moves closer to the permissible value of 800-1000 ppm for the indoor air. Thus the concept of direct carbon capture will almost become essential to be adopted in designs of all AC buildings in future, if this rising trend of CO2 in atmosphere is not arrested.

### 3.5. Review of Codes and Standards

### A. Bureau of Indian Standards (BIS)

The following codes of practice published by the Bureau if Indian Standards, are considered in this study:-

(a) **IS 3362:1977** – Code of Practice for Natural Ventilation of Residential Buildings.
(b) **IS 3103:1975** – Code of Practice for Industrial Ventilation.
(c) **IS 5182:2006 ( Part 6)** – Methods for Measurement of Air Pollution.
(d) **IS 15879:2009**– Breathing Air Compressor Package-Specifications

These standards provide methods for measurement and design recommendations but lack enforceable IAQ limits. However, IS 15879:2009 specifies the Breathing Air Quality requirements in Table 1 as under:-

(a) Oxygen Concentration- 21 ± 1%.
(b) CO Concentration- Not exceeding 15 ppm
(c) CO2 Concentration – Not exceeding 500 ppm
(d) Odour, flavour substances and taste – free of any significant odour or taste

**B. National Building Code of India (NBC 2016)**

NBC 2016, Part 8 (Building Services), Section 3 (Air Conditioning, Heating, and Mechanical Ventilation) prescribes minimum ventilation rates based on occupancy. However, it does not define comprehensive IAQ performance standards such as pollutant concentration limits. However, this code is currently under revision.

**C. Central Pollution Control Board (CPCB)**

CPCB has issued Ambient Air Quality Standards in the form of **Air Quality Index (AQI)** and has also formulated the methods of measurement and monitoring of the same in various cities of the country. The following types of air pollutants are considered to define AQI in India:-

(a) Particulate Matter 2.5 micron size (PM2.5)
(b) Particulate Matter 10 micron size (PM 10)
(c) Carbon Monoxide (CO)
(d) Sulphur Dioxide (SO2)
(e) Nitrogen Dioxide (NO2)
(f) Ground Level Ozone (O3)
(g) Ammonia (NH3)
(h) Lead (Pb)

The carbon dioxide (CO2) is not included as a pollutant in AQI since its concentration in ambient air has still not expected to cross the critical value of 800-1000 ppm in outdoor air. However, it is observed in certain highly polluted cities like Delhi that in some pockets, particularly those in close vicinity of roads with heavy traffic, the CO2 level has been found exceeding the limits of 800 ppm, 900 ppm and even 1000-1100 ppm. But in indoor air the CO2 level in India is generally found exceeding significantly beyond the permissible limit of 1000 ppm. Therefore, it becomes necessary to monitor CO2 and TVOC for indoor air quality in addition to monitoring the above eight parameters used for defining the AQI.

The AQI has been categorised in India as given in Figure below.


**Figure 7. Air Quality Index (AQI) in India**

**D. National Programme on Clean Air (NCAP)**

Ministry of Environment, Forest and Climate Change (MoEFCC) launched National Clean Air Programme (NCAP) in January, 2019 with an aim to improve air quality in 131 cities (non-attainment cities and Million Plus Cities) in 24 States/UTs by engaging all stakeholders. The programme envisages to achieve reductions up to 40% or achievement of National Ambient Air Quality Standards for Particulate Matter10 (PM 10) concentrations by 2025-26. While NCAP focuses on ambient air, integration of IAQ under this framework is limited. IAQ monitoring in public buildings remains largely voluntary.

**E. Green Rating for Integrated Habitat Assessment (GRIHA)**

Criterion 12 of the Green Rating for Integrated Habitat Assessment (GRIHA) is pivotal in ensuring that the design and on-going operation of ventilation systems are aligned to maintain a high standard of Indoor Air Quality (IAQ). Also, the clients to ensure continuous monitoring of CO, CO2, temperature and RH levels.

**F. International Benchmarks**

Various international codes, manuals and standards generally follow the following benchmarks described in their different publications as given in Table 2 below:-

**Table 2 : International Benchmarks for Indoor Air Quality Standards**

| Agency | Standard | Key Features |
|---|---|---|
| **WHO (2021)** | Indoor Air Quality Guidelines | Limits for $PM_{2.5}$, CO, $NO_2$, formaldehyde, benzene. |
| **ASHRAE Standard 62.1** | Ventilation for Acceptable IAQ | Design-based ventilation and contaminant control. For Indoor Air Quality, the CO2 concentration should not exceed 1000 ppm in buildings. |
| **EN 16798-1:2019** | European IAQ Standard | Performance-based IAQ categories (I–IV) |
| **US EPA** | IAQ Tools for Schools & Buildings | Monitoring and management protocols |

India can harmonize its IAQ codes with these international frameworks for global equivalence and export readiness of building products.

**3.6. Survey Report: Indoor Air Found More Toxic Than Outdoor Air:**

During a recent survey conducted by BUNKERMAN in the major cities in India, it has revealed that while the pollution is increasing in the outdoor environment particularly in some big cities like Delhi, Mumbai, Pune, Guwahati, Bangalore, Chennai, Vishakhapatnam etc, it is the indoor environment in houses, offices and public places like airport lounges, railway waiting rooms etc, which is found to contain more toxic air than the outside environment. The main reason to this situation is that most people prefer to keep their doors and windows closed fearing the entry of dust and pollution from outside environment. This disturbs the natural and manmade ventilation of the buildings and CO2 and other toxic gases keep on accumulating in the indoor environment. With a result, in most of the houses and offices, the CO2 and total Volatile Organic Compounds (TVOC) are found to be much beyond the acceptable limits for human health. This is the basic reason why more and more people are suffering from different kinds of ailments including asthma, bronchitis, lung cancer, heart diseases, low immunity etc. During the above survey, the CO2 levels in indoor air in most of the above places were recorded to be exceeding the safe limit of 800-1000 ppm prescribed by ASHRAE/ISHRAE and other international codes and manuals. In majority of places the CO2 level was found to be around 1200-1600 ppm while in some cases it was recorded even around 2100- 3100 ppm which is alarming and needs immediate attention.

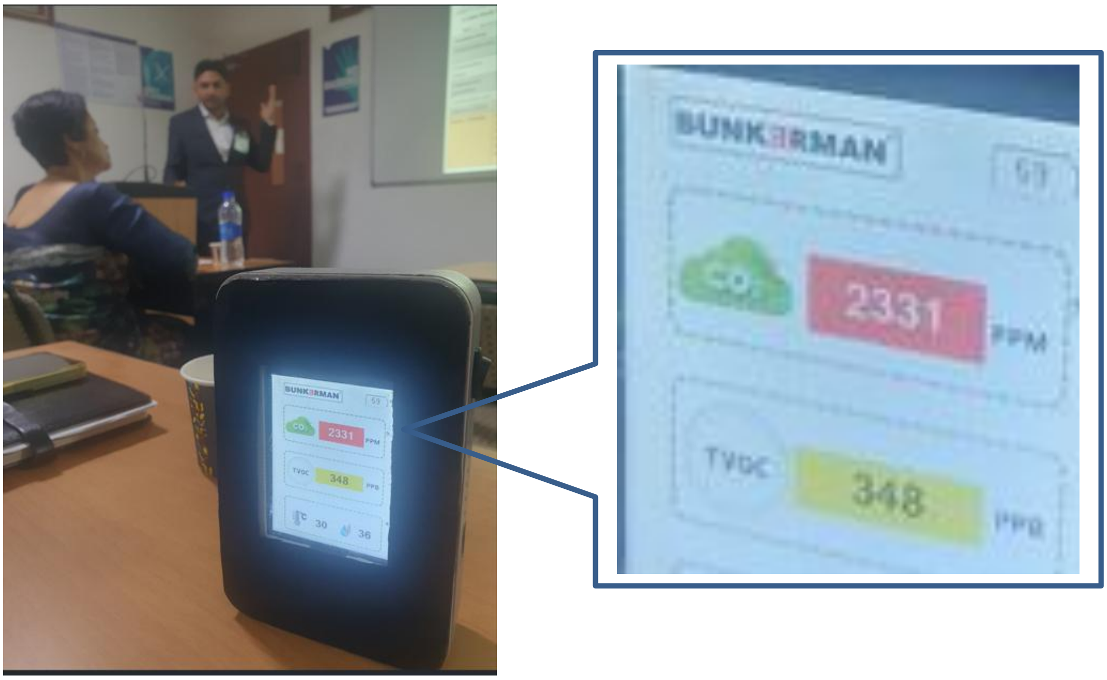


**Photo 1: Indoor Air CO2=2331 ppm, TVOC=348 ppb Recorded inside a Class Room of a Private University in NCR having a Green Building Complex**


**Photo 2: Indoor Air CO2=1372 ppm, TVOC=35 ppb Recorded inside 5 Star Hotel in Delhi during Rising Bharat Summit 2024**

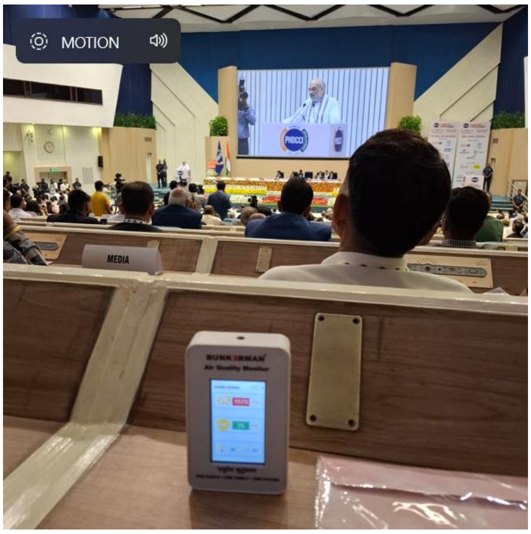



**Photo 3: Indoor Air CO2=1624 ppm, TVOC=22 ppb Recorded inside Vigyan Bhawan New Delhi During a Function being addressed by Home Minister**

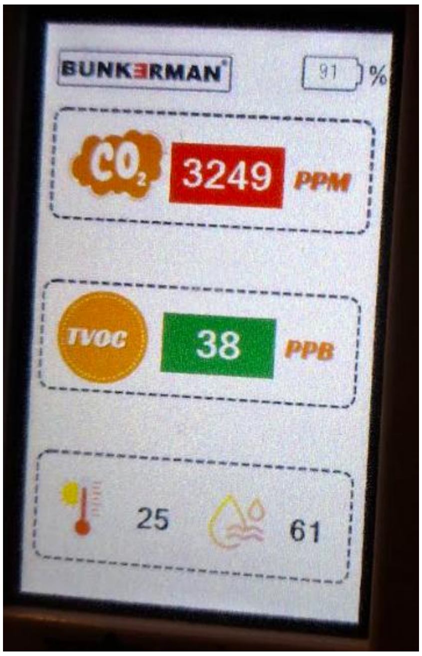


**Photo 4: Indoor Air CO2=3249 ppm, TVOC=38 ppb Recorded inside a Multiplex Cinema Hall in Baddi, Himachal Preadesh**


**Photo 5: Indoor Air CO2=1581 ppm, TVOC=41 ppb Recorded inside a Passengers Waiting Hall at an Airport in India**


**DURING BOARDING**
**CO2:2552 ppm, TVOC: 243 ppb**

**DURING FLIGHT**
**CO2:1402 ppm, TVOC: 46 ppb**

**Photo 6: Inside a Domestic Flight in India**

Similar observations have been recorded earlier based on some studies by ASHRAE India Chapter in 1994 as contained in Table 34 of ISHRAE's HVAC Handbook 2007, reproduced in Photo 7 below.

1.38 ISHRAE Handbook

**Table 34 $CO_2$ levels measurements in Delhi**
**(Measurements taken by ASHRAE India Chapter in the year 1994)**

The ASHRAE - India Chapter had recently conducted a survey in Delhi to measure Indoor Air Quality levels in dense and select areas of the capital using $CO_2$ as the measurable variable to arrive at some indication about the quality of air inside and outside. A wide spread sample of hospitals, hotels, restaurants, banks, offices, showrooms were taken to gauge the pollution levels existing indoors and outdoors. An interesting data emerged.

| Type of Spaces (Airconditioned) | Time (AM - PM) | Outdoor $CO_2$ level (PPM) | Indoor $CO_2$ level (PPM) |
|---|---|---|---|
| Hotels | | | 960 - 1400 |
| Fast Food joints/ Restaurants | | | |
| Showrooms | 10AM - 5PM | 440 TO 650 | 1550 - 2000 |
| Departmental Stores | | | 1002 - 1460 |
| Hospitals / Nursing Homes | | | 784 - 1025 |
| Offices | | | 1050 - 1340 |

**Photo 7: CO2 Levels Measured by ASHRAE India Chapter in Delhi in 1994**

### 3.7. Split ACs : The Silent Killers

The trend of using Split Air Conditioners is increasing in India. It must be understood that the Split ACs only cool and circulate the indoor air within the rooms without adding any fresh air from outside. With a result, the CO2 levels in such rooms keeps accumulating and it exceeds the permissible value of 800-1000 ppm. During our recent survey in India the CO2 level is most of such buildings is found to exceed even 1500 ppm, 2000 ppm and in some cases like classrooms it is found to exceed even 3100 ppm. Such situations are very dangerous for human health and these are adversely affecting the cognitive skills and learning potential of our students at their tender age. Its effects on infants and old people are even more dangerous. High concentrations of CO2 in such rooms/buildings results into a sort of slow poisoning effect on its occupants over a prolonged period. Therefore, it is recommended that it should be made mandatory to provide a suitable CO2 Removal System or at least a proper ventilation system if Split Air Conditioners are used in a building or a room. The concerned Govt authorities must ensure to make a suitable law by legislation in this respect in the interest of public health and public safety.

## IV. RESULTS AND DISCUSSION

### 4.1 Concept of Air Changes Per Hour (ACH) Versus CO2 Removal Systems

In India, though the problem of maintaining the desired indoor air quality in air conditioned buildings was being faced since many decades, as is evident from the facts explained above; yet the designers were trying to manage this problem simply by increasing the number of air changes per hour (ACH) in buildings since the CO2 removal systems were very costly that time. Even in most of the advanced countries, the use of CO2 removal techniques could be only limited to the space missions, under water submarines and underground nuclear hardened bunkers and facilities, due to their forbidding costs. But with more economic CO2 removal systems now being available in the market including the BUNKERMAN systems in India, it has now become possible to integrate CO2 removal systems in HVAC design. This has resulted into following advantages:-

(a) With removal of CO2, VOCs and other toxic gases from the indoor air by absorption/adsorption/chemisorption techniques, the occupants of the buildings get the desired quality indoor air for their safe and healthy living.
(b) Since the techniques like those employed by BUNKERMAN Technology, the air pollutants are permanently absorbed into the chemical filters, these do not travel back to the environmental air and are converted into Minerals Rich Organic Manure (MROM); so the environment air gets continuously cleaned over a time.
(c) Since the MROM prepared from air pollution, is used as a nutrient to farmers crops, trees and plants, it forms a sustainable cycle of mutual survival of human beings and the trees and plants on earth as shown in Figure 6 above.
(d) Integration of CO2 Removal System with AC Plants has resulted into a saving of 35% to 40% in the power consumption in AC Plants as observed in several projects in India ( Please refer case studies explained in references 3,5,7 ).

**4.2. National Green Tribunal (NGT) Orders on IAQ**

In May 2022, the National Green Tribunal (NGT) took cognizance of the growing concern over deteriorating indoor air quality (IAQ) and issued a directive to the Central Government of India to formulate comprehensive national guidelines for regulating IAQ in public buildings such as offices, malls, theatres, hospitals, and educational institutions. The Tribunal observed that while India had established extensive frameworks for outdoor or ambient air pollution under the Air (Prevention and Control of Pollution) Act, 1981 and the National Clean Air Programme (NCAP), there were no binding standards or monitoring mechanisms specifically addressing indoor environments, despite the fact that most people spend nearly 80–90% of their time indoors. The NGT stressed that poor ventilation, use of low-quality building materials, emissions from furnishings, and infiltration of outdoor pollutants contribute significantly to indoor air pollution and have severe health implications, particularly for vulnerable populations like children, the elderly, and those with respiratory illnesses.

The NGT's directive required the Ministry of Environment, Forest and Climate Change (MoEFCC), in coordination with the Central Pollution Control Board (CPCB) and Bureau of Indian Standards (BIS), to draft and implement uniform IAQ guidelines within a stipulated time frame of four months. The order emphasized the need for establishing acceptable limits for common indoor pollutants such as carbon dioxide ($CO_2$), volatile organic compounds (VOCs), particulate matter ($PM_{2.5}$ and $PM_{10}$), formaldehyde, and radon, along with recommending ventilation and filtration standards suitable for different categories of buildings. The Tribunal also called for the inclusion of monitoring mechanisms and periodic assessments of IAQ in public and commercial establishments. This landmark move marked the first formal step toward recognizing indoor air quality as a distinct environmental and public health priority in India, aligning national policy efforts with global best practices for healthy indoor environments.

**$.3 Actions by Ministry of Environment, Forests and Climate Change**

The Ministry of Environment, Forest and Climate Change (MoEFCC) has taken several measures that indirectly address indoor air quality (IAQ) in India through broader environmental and building regulations. Environmental clearance (EC) conditions for construction projects now require compliance with the National Building Code's ventilation provisions to maintain acceptable indoor air quality. The Draft Building Construction Environment Management Regulations, 2022, also link construction and operational practices to air-quality governance. Additionally, the ministry introduced the Environment Protection (Manner of Holding Inquiry and Imposition of Penalty) Rules, 2024, to strengthen enforcement against air pollution violations. Through the EC process, the MoEFCC mandates dust control, exhaust management, and greenbelt development measures that minimize pollutant infiltration indoors. Furthermore, the ministry's National Clean Air Programme (NCAP), though focused on ambient air, contributes indirectly to improving indoor environments by reducing outdoor pollution sources.

Despite these efforts, MoEFCC has yet to establish a dedicated national framework for indoor air quality standards specifying pollutant limits such as $CO_2$, VOCs, or formaldehyde. Most of the ministry's actions address IAQ indirectly through ventilation or construction-phase dust control rather than through comprehensive building-specific monitoring or enforcement. Implementation challenges, limited budget utilization, and the continued focus on ambient rather than indoor air highlight existing policy gaps. While foundational progress has been made, India still needs stronger, stand-alone IAQ regulations, systematic monitoring, and stricter compliance mechanisms to ensure healthier indoor environments in line with global best practices.

**4.4. Supreme Court Orders on Air Quality**

The Supreme Court of India has issued several significant orders concerning air quality management, which, though primarily focused on outdoor or ambient air, have indirect implications for indoor air quality (IAQ) as well. In November 2024, the Court reaffirmed that the Centre and state governments are constitutionally bound under Article 21 to ensure a pollution-free environment, emphasizing that the right to clean air is an integral part of the right to life. It directed Delhi-NCR states to immediately implement Stage 4 of the Graded Response Action Plan (GRAP IV) — the most stringent set of anti-pollution measures — and to maintain them even if the Air Quality Index (AQI) temporarily improves. The Court also demanded strict monitoring and accountability from the Commission for Air Quality Management (CAQM) after learning that only a fraction of air monitoring stations were operational during the Diwali period. In earlier proceedings, the Court had asked the Ministry of Housing and Urban Affairs (MoHUA) to issue mandatory directions for the use of anti-smog guns and smog towers in major urban construction projects, recognizing the critical role of construction-phase pollution in degrading air quality around and inside buildings.

While these rulings underline the judiciary's proactive stance on environmental protection, they largely address ambient air pollution rather than setting explicit national standards for indoor air quality in buildings such as offices, malls, and theatres. No Supreme Court order to date has mandated specific IAQ parameters like permissible levels of carbon dioxide, volatile organic compounds (VOCs), or particulate matter within indoor environments. Instead, the matter has been taken up by regulatory and technical bodies such as the Central Pollution Control Board (CPCB) and the National Green Tribunal (NGT), which have initiated the process of developing guidelines and standards. Nonetheless, the Supreme Court's emphasis on the constitutional right to a healthy environment provides a strong legal foundation for extending these protections indoors, paving the way for future policy and judicial interventions that explicitly address indoor air quality in India's built environment.

**4.4 Requirements for Proposed Code of Practice for Indoor Air Quality Management**

Since the monitoring of following air pollutants are already clearly specified in Air Quality Index (AQI) for ambient air, the same must be used for as guideline to maintain the indoor air quality in buildings:-

(a) Particulate Matter 2.5 micron size (PM2.5)
(b) Particulate Matter 10 micron size (PM 10)
(c) Carbon Monoxide (CO)
(d) Sulphur Dioxide (SO2)
(e) Nitrogen Dioxide (NO2)
(f) Ground Level Ozone (O3)
(g) Ammonia (NH3)
(h) Lead (Pb)

Since CO2 and TVOCs are the additional prominent pollutants in indoor air, these also must be included for monitoring the indoor air quality in buildings, in addition to the above eight parameters for AQI. Therefore, it should be logical to classify the IAQ Categories in buildings based on the AQI of the indoor air and the concentration of CO2 and TVOC in the indoor air. The cognitive effect of CO2 in indoor air must be also given due consideration while categorising the IAQ in buildings since it is also an important parameter for human performance. Therefore, based on the above logics, the categorisation and evaluation of indoor air quality in buildings in India is suggested as given in Table 3 below. This table is recommended to be included in the proposed Code of Practice to be formulated by Bureau of Indian Standards (BIS) for Indoor Air Quality Management in buildings in India.

**Table 3 : Indoor Air Quality (IAQ) Recommended for BIS Code of Practice in India**

| Ser No | Category of !AQ | CO2 (ppm) | TVOC (ppb) | AQI | Cognitive Capacity | Remarks |
|---|---|---|---|---|---|---|
| 1 | Green + (G+) | 300-500 | <100 | 0-50 | 100% | Good (Essential for patients in hospitals, infants and senior citizens |
| 2 | Green (G) | 501-1000 | 100-200 | 50-100 | 85% | Satisfactory |
| 3 | Amber (A) | 1001-1500 | 200-400 | 100-150 | 60% | Poor |
| 4 | Red (R) | 1501-2000 | 400-600 | 150-200 | 50% | Very Poor |
| 5 | Red+ (R+) | 2001-2500 | 600-800 | 200-300 | 30% | Severe |
| 6 | Red++ (R++) | >2500 | >800 | 300-500 | <30% | Hazardous |

## V. CONCLUSION

Indoor Air Quality Management is a vital yet under-regulated aspect of environmental governance in India. While existing codes offer partial coverage, a unified and enforceable national standard is urgently needed. Integrating IAQ into building codes, health policies, and smart city initiatives can significantly improve public health, productivity, and energy efficiency. The future of sustainable living in India lies not only in clean outdoor air but in ensuring that every building breathes safely from within. The adoption of an Indian Standard Code for IAQ management as brought out in this study is, therefore, recommended as an essential step towards sustainable building operation, occupant well-being and mitigation of global warming and climate change.

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