

# Indoor Environment Quality - Measures for Healthy Assured Returns

Durga Raghavi T

Department of Civil Engineering, Andhra University College of Engineering (A), Visakhapatnam, Andhra Pradesh, India

## ABSTRACT

Indoor Environment Quality is a very important parameter to be considered for making a building more efficient. People spend 2/3<sup>rd</sup> of their lives at home, where the quality of indoor environment has a significant impact on the health and well-being of the occupants. Indoor contaminants such as dust mites, cockroaches, pet dander, smoke and some chemicals can trigger asthma attacks. A building should be designed such that the regularly occupied areas have access to sunlight, natural ventilation, cross ventilation. Many materials used in the constructions and interior fit-outs contain Volatile Organic Compounds (VOC) which poses serious health risks to building occupants. However, many alternative low/ zero VOC products are available in the market. Such materials include paints, polish coatings, wood and glass sealants, adhesives for plywood, laminate and veneer applications. So, by optimizing the need, implanting measures and improving the environment, one can achieve more efficiency in any building.

**Keywords:** Ventilation, Low VOC paints, strategy, benefits.

## I. INTRODUCTION

A healthy, comfortable and productive indoor environment is highly needed and can be achieved by better indoor environment quality measures. Some of the measures like providing a building design, which affords the best possible conditions in terms of indoor air quality, ventilation, thermal comfort, access to natural ventilation, day lighting and also effective control of the acoustical environment. It is also important to run a flush out after the interior fit-out is complete and before occupying the building.

## II. STRATEGIES INVOLVED

- Use building materials, adhesives, sealants, finishes and furnishings which do not contain or release any contaminants.
- Maximize the use of natural day lighting by optimising solar orientation and design the building accordingly.
- Provide smoke free building. When smoking is accommodated, provide completely dedicated

smoking areas are physically dedicated HVAC systems and locate outdoor smoking areas so that non-smokers do not pass through these areas when using primary building entrances or exists.

- Design building envelope and environmental systems that not only treat air temperature and provide adequate ventilation.
- Prevent contamination of building during construction.
- Provide clean and healthy building. Use biodegradable and environment friendly cleaning agents that do not release VOCs or other harmful agents and residue.
- Maximize the use of operable windows and natural ventilation.

## III. INDOOR ENVIRONMENT QUALITY MEASURES

### A. Ventilation

Ventilation is very important factor in maintaining healthy indoor air quality as it is responsible for air exchange which supports the health and comfort of

building occupants. Effective design and planning taking care of ventilation is necessary to reduce the requirement of artificial ventilation.

❖ Cross ventilation:

Cross Ventilation is a part of natural ventilation and is based on the paths of breeze and wind. Cross ventilation techniques use high and low pressure zones created by wind and breezes to draw fresh air through a building. The wind flow pattern, correct orientation of the building, placement of windows, doors and other openings is crucial for implementing this strategy.

## B. MECHANICAL VENTILATION

❖ Wind Towers:

Sites having good wind speeds deploy wind towers. The tower has opening at top that directs wind into the building through many other openings in different parts depending on the direction of wind flow.

❖ Induced Ventilation:

In this method, difference in temperature of air is created for its movement. Section designing is done so as to ensure that hot air rises up and escapes out drawing cooler air from atmosphere thereby making the ambience cooler.

❖ Earth air pipe system:

A pipe is buried at a depth of 4-5meters where temperature is equal to the annual average temperature. Air from Blower passes through the pipe and gets cooled in summer and heated in winters. Automated Building System techniques like HVAC (Heating, Ventilation and Air Conditioning) systems regulate the heating equipment's and air conditioners on the basis of their sensor based network. The sensors control the equipment's on the basis of indoor environmental conditions.

Similar to this, Sensor controlled lighting system which monitors the lighting appliances based on the availability of natural light are also used.

❖ Exhaust systems:

The exhaust systems help in removing the stale air/smoke from bathrooms and kitchens thereby enhances indoor air quality within buildings. It is not just adequate to install exhaust fans, but sizing these systems to purge-out sufficient quantities of indoor air will

determine the performance. We often see how, due to insufficient exhaust, carbon is deposited around the exhaust system, perhaps due to cooking oil kitchens require to be designed with adequate exhaust and fresh air provisions.

## C. WASTE MANAGEMENT

Homes generate a large amount of house hold waste on daily basis. Disposing such waste properly is critical as otherwise it would arise hygiene and disposal issues. Segregation of waste at source is one of the major issues in handling of domestic waste. By effective segregation, waste materials which are likely to be dumped in landfills can be converted into value added products. Therefore, every household should be encouraged to segregate the waste generated within. Provide separate bins to collect dry waste (paper, plastic, metals, glass, etc.) and wet waste (organic). Educate residents and maintenance personnel about various recycling and disposal methods, during post occupancy. For example, the building occupants can reduce the generation of waste volumes by reusing bottles, jute bags, containers, etc.

## D. LOW VOC PAINTS

Paint has three major components: a pigment of colour, a binder that holds the pigment to the surface and a carrier or solvent (mineral spirits or water) to dissolve and maintain the pigments. Latex, water based paints have significantly lower environmental impacts than oil or solvent-based paints since they don't use petroleum carriers or have nearly as many smog-forming emissions. According to the US Environmental Protection Agency (USEPA), 9% of the airborne pollutants creating ground level ozone come from the VOC's in paint. Low and zero VOC paints have litter or no smog-forming emissions.

Volatile organic compounds are gases emitted by various solids or liquids, many of which have short and long term adverse health effects. Solvents in traditional paints often contain high quantities of VOCs. Low VOC paints improve indoor air quality and reduce urban smog. The beneficial characteristics of such paints include low odour, clean air and safer technology as well as excellent durability and a washable finish. Recent technologies include antibacterial products like

anti-bacterial paints, anti-bacterial fixtures are in much demand.

❖ Benefits of VOC paints:

- Environmental:

VOC's react with sunlight and nitrogen oxides in the atmosphere to form ground level ozone, a chemical that has a detrimental effect on human health, agricultural crops, forest and ecosystems. These problems can be eliminated using low VOC paints.

- Economic:

Healthy occupants are more productive and have less illness-related absenteeism. Use of high VOC content materials can cause illness and may decrease occupant productivity. These problems result in increased expenses and liability for building owners, operations and insurance companies.

- Indoor Environment:

Selecting materials that are low in VOC helps reduce sources of pollution during the construction process and in the finished building. Also low VOC paints have little odour.

Not only paints, there are other components like adhesives, binders and finishes produce VOC.

- Double glazed glass and Tinted glass:

The high performance double glazed glass, which is laminated or coated, are used to moderate interior temperatures by controlling heat loss and gain. The coating filters the heat producing aspects of solar rays.

- Low-Emissivity glass:

Low-Emissivity (Low-E) glass is specially treating with a microscopically thin, transparent coating. The coating reflects back into the building, thereby reducing the heat loss through the window. It also reduces the heat transfer from the warm (inner) pane of the glass to the cooler (outer) pane, thus further lowering the amount of heat that escapes from the window. These properties thus reduce the demand for energy in order to heat the building. In addition, the coating allows the large amount of free solar energy to enter the building, thereby heating it passively. Low -E insulating glazing can therefore be a net contributor of energy in buildings. Other innovations such as triple glazing products can offer additions improvements in the window's insulating properties while the use of low-iron glass can increase light transmittance and free solar-heat gain. These technologies offer additional benefits in terms of energy efficiency.

- Solar controlled glass:

Solar control glass is a high performance coated product that reflects and radiates away a large degree of sun's heat while allowing daylight to pass through a windows or façade. The indoor space stays bright and much cooler than would be the case if normal glass were used. It incorporates invisible layers of special materials on the glass which have the dual effect of allowing sunlight in, while repelling solar heat.

F. BUILDING FLUSH-OUT:

The odors and toxins released from recently installed building materials and finishes – such as flooring, paints, caulks and sealants, cabinets and work surfaces made from composite lumber products – reduce indoor air quality. Flush out needs to be carried out just before the occupancy and will be effective once the home is ready including the interiors and paints & coatings, adhesives & sealants have been applied. According to Indian Green Building Council (IGBC), the building flush-out is performed for ten-days by keeping all windows open before the building is occupied. If forced ventilation

Low VOC Paints	Conventional Paints
Cleaner air; reduced ozone depletion	Contribute to environmental pollution
Minimal health risks	Significant health risks
Total costs: same as any high quality paint & Low O&M costa	Low but with high O&M costs

E. GLAZING:

Glass provides many advantages such as Transparency, Natural Day-lighting, Blending of Exteriors with Interiors and Acoustic control. Glass, a wholly recyclable material, plays a noteworthy role in accomplishing greater indoor environment quality and energy efficiency. The design and placement of glass is a fundamental constituent. It permits the natural light and puts together the interior of office and residential buildings with the exterior. There are different types like:

systems are used, the flush out can be carried out for five days.

#### G. GREEN CLEANING:

Green cleaning is the use of biodegradable chemicals and recycled cleaning products, and uses cleaning equipment that has little to no environmental impact. It may also include daytime cleaning, the training of employees, use of microfiber cleaning cloths, and the use of concentrated cleaning chemicals that require less packaging.

#### H. SOME MORE MEASURES:

Some more measures are adopted to make indoor environment quality which provides more efficiency:

- Plantations of indoor plants:  
Plants not only provide aesthetics but also reduce the carbon emissions and regulate the fresh air for breathing inside the building.
- Providing acoustic comfort:  
Many factors like noise pollution, speech privacy are major concerns in public usage areas like offices, etc. A place with good acoustics can improve the work and confidential conversations with more collaboration without affecting their individual work.
- Providing Thermal comfort:  
Many factors like over cooling, over heating of Air conditioners in offices, etc. can cause discomfort to the occupants. Design is to be done to regulate this effect and provide strategies like operable windows, individual thermostats, and under floor air diffusers, etc.
- Usage of floor mats at the door entrances
- Cleaning the carpets and floor regularly.
- Usage of air filters, anti-bacterial products, etc.
- Provide pleasant colour wall paints which enhances the mood of the occupant
- Check for moisture control, occupant control, Sick Building syndrome, etc. factors during pre and post occupancy.
- Check for pest management.
- Provide proper drainage and sanitation facilities.

### IV. BENEFITS

- ❖ Tobacco smoke control:
  - i. Reduces health hazards caused due to passive smoking.
  - ii. Improves air quality thereby improving health of the community as a whole.
- ❖ Minimum Day lighting & Fresh air ventilation:
  - i. Lower electricity bills.
  - ii. Improves quality of life.
  - iii. Connectivity to exterior environment.
  - iv. Better health and well-being of occupants.
  - v. Reduces respiratory problems like asthma, etc.
- ❖ Low VOC products:
  - i. Improves the health of occupant.
  - ii. No sick building syndrome.
- ❖ Building Flush-out:
  - i. Reduces exposure to air-borne contaminants.
  - ii. Eliminates odour from recently installed building materials and finishes.
- ❖ Cross ventilation:
  - i. Enables good circulation of fresh air.
  - ii. Controls humidity and eliminates odour.
  - iii. Flushes out toxins and provide better indoor environment.
- ❖ Improves work of occupants in productive manner.
- ❖ Enhances long life of the occupants and many more.

### V. MEETING INDIAN STANDARDS

According Indian Green Building Council (IGBC), the following are the criteria to achieve better indoor environment quality. On a scale of 100 points which is the general way of IGBC for certifying a building whether it meets green standards or not, Indoor environment quality (IEQ) measures alone contribute 15 points.

The threshold criteria for certification levels are as follows:

Requirement	Measures Taken	Points credited
Mandatory	Tobacco Smoke	Required

Requirement 1	Control	
Mandatory Requirement 2	Minimum Day lighting:50%	Required
Mandatory Requirement 3	Fresh Air Ventilation	Required
Credit 1	Enhanced Day lighting:75% ,95%	4
Credit 2	Enhanced Fresh Air Ventilation	2
Credit 3	Exhaust Systems	2
Credit 4	Low VOC Materials, Paints & Adhesives	2
Credit 5	Building Flush-out	1
Credit 6	Cross Ventilation: 50%, 75%	4
		<b>15</b>

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Certification Level	Individual Residential Unit	Recognition
Certified	38-44	Best Practices
Silver	45-51	Outstanding Performance
Gold	52-59	National Excellence
Platinum	60-75	Global Leadership

## VI. CONCLUSION

Utilising the above strategies increases the construction cost which is important concern. Green buildings cost 2-5% more than usual design but on evaluation on long term yields around 10 times more. By employing the above technologies, the occupants gets healthy indoor atmosphere and improves their well-being. So the increased cost is as good as investment with guaranteed results. Although we have seen these many advantages, these are still lacking in India. Measures have to be taken to provide better indoor environments to all classes of society.

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