

SUSTAINABLE INTERIOR MATERIAL AND INDOOR AIR QUALITY: IMPACT ON HUMAN HEALTH

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Abstract

In the modern-day life, human beings spend a significant duration of time indoors and as such, the interior environment has become a significant aspect with regards to human health and well-being. This study is aimed at the connection between sustainable interior design and indoor air quality, and their effects on human health. It also emphasizes the release of toxic chemicals by the materials used in interiors including paints, furniture, finishes, and adhesives, which can interfere with indoor air quality.

The paper also describes the role of using sustainable and environmentally friendly products such as low-VOC products, natural finishes, and recycled materials in alleviating indoor pollution. In addition to the choice of materials, other aspects such as adequate ventilation, natural lighting and plants have a significant role in ensuring clean and healthy indoor air.

This study observes that, inadequate indoor air quality may cause health complications like allergy, breathing complications, fatigue, and stress, whereas sustainable interior practices can enhance physical and psychological health. As highlighted in the research, interior design is not merely about aesthetics, but also the ability to create safe, healthy, and comfortable spaces.

All in all, the study finds that through careful design decisions and selection of materials that do not harm the environment, it is possible to develop indoor environments that can contribute to the sustainability of the environment and human health.

Keywords

Sustainable Interior Design, Indoor Air Quality, Eco-Friendly Materials, Human Health, Low-VOC Materials, Ventilation, Natural Lighting, Indoor Plants, Healthy Spaces, Green Design

1. Introduction

In the modern way of life, individuals are now spending majority of their time in the indoor environment, be it at home, in colleges, offices, and other constructed environments. Due to this, the quality of indoor conditions has gained great priority in regards to our health and comfort. The air we breathe is one of the primary elements of this environment, yet other than that, the materials that are used within the space also have a significant role to play.

Most individuals believe that indoor pollution is only possible outside, but indoor spaces can be extremely polluted as well. This occurs not only in case of poor ventilation but also because of the materials used in interiors. Normal materials such as synthetic furniture, paints containing chemicals, glues, laminates, and plastics emit toxic elements to the air. The pollutants have the ability to stay in confined areas and gradually impact the health of humans.

Now sustainable and eco-friendly interior design is of interest. Sustainable design is concerned with the use of materials that are natural, less harmful to the environment and human health and use. Green products like natural wood, bamboo substitutes, recycled products, clay finishes, and low-VOC paints can be used to minimize indoor pollution and make a healthier home.

Sustainable interiors also involve the right ventilation, natural light and use of plants to enhance the quality of air in the interiors, in addition to material selection. All these come together to produce spaces that are aesthetically attractive as well as beneficial in terms of physical and mental health.

Environmental protection is also supported with the help of the use of sustainable materials, waste reduction, resources conservation, and minimization of carbon impact. This renders sustainable interior design an environmentally friendly and progressive movement.

The research paper is aimed at grasping the interaction between the quality of indoor air and the application of sustainable and environmentally friendly materials in combination with their effects on human health. It emphasizes the need to make a wise design decision and come up with healthier, safer, and more sustainable indoor environments.

2. Literature Review

Research indicates that individuals spend approximately 8090 percent of their time indoors (Deng & Deng, 2018), and indoor air quality is known to be extremely significant to the health of humans. Daily living activities such as cooking, dampness, tobacco use, and construction materials and furnishings, are the main sources of indoor pollution (WEF, 2020).

Garg, Pal, Jain, and Garg (2021) argue that building materials and activities emit many pollutants that include aldehydes, asbestos, lead, carbon monoxide, and particulate matter, which are classified as indoor pollutants. Such pollutants may be a source of severe health conditions such as breathing difficulties, allergies, lung diseases, and even cancer. The indoor air quality and human health are also impacted by such biological pollutants as mold, bacteria, and dust mites.

The biophilia concept has been used to explain the relationship between human beings and nature, which justifies the application of plants in the interiors. It is proven that indoor plants enhance the quality of air and mental state (Rania, Ziad, and Sarah, 2021). According to the study conducted by Begum (2017), there are a few indoor plants that are effective in air purification.

Additional research shows the psychological advantages of house plants. Indicatively, Bringslimark et al. (2007) and Dijkstra et al. (2008) discovered that indoor plants help to reduce stress and enhance comfort and productivity. Equally, Raanaas et al. (2011) found enhanced cognitive performance in the presence of plants in spaces.

Limitation has been noted in some studies, however. According to Iris and Theo (2010), there was absence of clear measurement of plant related productivity. In a healthcare setting, Gould et al.,

(2004, 2005) and Lass-Florl (2000) indicate that indoor plants can also be dangerous to patients who have weak immunities.

On the whole, the literature indicates that the quality of indoor air depends on the materials used indoors and the environment. Sustainable materials and natural resources such as plants could be used to improve the quality of air and enhance the human health.

3. Aim

The primary goal of this study will be to learn how sustainable interior design and, in particular, the use of environmentally-friendly materials, can enhance the quality of air inside the building and contribute to the health of people. Nowadays, individuals spend the majority of their time inside, and it may be necessary to make sure that these areas are not only comfortable but also safe and healthy.

The present study is devoted to the specifics of the influence of various interior materials (paints, furniture, finishes, and flooring) on the quality of air in a space. It also tries to discuss the way in which the decision to use sustainable and low-chemical materials can help to minimize indoor pollution and establish a healthier environment.

Together with the choice of materials, the goal is to learn how the design features such as adequate ventilation, natural light, and natural plants can be combined to enhance the indoor environment.

The second significant goal of the research is to create awareness that the interior design is not merely about beauty but also health and sustainability. By conducting this research, it is hoped to demonstrate that even a simple and conscientious design can make spaces eco-friendly and healthy to human health.

4. Objectives (with Materials Focus)

- The aims of this study assist in the clear understanding of the purpose of the study. These are explicated in a clear and easy manner as follows:
 - To get a feel of what the concept of indoor air quality (IAQ) is:
- This paper will discuss the definition of indoor air quality and its significance to our lives and well-being.
- To determine the factors that influence the indoor air quality, particularly interior materials:
- The study is centered on the effects of various materials such as paints, furniture, adhesives and finishes which might leech out toxic chemicals and contaminate air in a room.
- To research the issue of sustainable and environmentally-friendly materials in interior design:
- The other goal is to learn about various forms of sustainable materials, including low-VOC materials, natural materials, and recycled materials and their role in promoting healthier interiors.
- To examine the effects of sustainable materials on human health:
- This paper also examines the role of environmentally friendly materials in minimizing health risks such as allergies, respiratory distress and pain.
- To research the sustainable interior design strategies to improve indoor environments:
- It involves the knowledge of the role of ventilation, natural light, space planning, and plants and material selection.

- To recommend effective and convenient design solutions:
- The last aim is to present easy and practical concepts to make the indoors spaces to be sustainable and healthy.

5. What is the Indoor Air Quality (IAQ)?

Indoor Air Quality is the degree of purity or impurity of air within a building. Good air quality refers to fresh and clean air whereas poor air quality refers to air having dust, chemicals or harmful gases.

5.1 What is the Indoor Air Quality (IAQ)?

The term Indoor Air Quality (IAQ) means the air quality of a building and the extent to which people can safely and comfortably inhale the air. It is influenced by the pollutants, ventilation, temperature and humidity of the indoor environment.

5.2 Importance of IAQ

The quality of indoor air is of great concern since individuals spend the majority of their time in the indoor environment. Pollution of air within a space may lead to health related problems like, headaches, allergies, breathing problems and fatigue. The health of the environment is impacted by poor air quality in the long term as it can cause severe health issues, such as asthma and other respiratory conditions. Health, comfort and productivity can be enhanced by good indoor air quality. It also establishes a new and nice living and working atmosphere. Thus, in the interior design of sustainable design, good IAQ is very important to provide the healthy and safe interior environment.

6. Factors that have an influence on indoor air quality.

There are numerous factors that influence indoor air quality, but one of the most crucial is the nature of materials that are found in an interior space. Together with ventilation and maintenance, interior materials contribute significantly to the determination of a healthy or polluted air. The following are some of the major reasons:

6.1 Materials-indoor pollutants.

Most of the interior materials that are used emit toxic air chemicals. These comprise paints, polishes, adhesives, laminates, carpets and synthetic furniture. They emit substances known as VOCs (Volatile Organic Compounds), which are invisible but may have health consequences.

The air quality in spaces that have more chemical-based materials is generally worse. Conversely, greener and low-VOC materials do not emit so many pollutants and contribute to the cleaner air.

6.2 Poor Ventilation

Ventilation can be an issue even when good materials have been used. In case new air cannot get into the building and the polluted air cannot get out, the toxic substances remain locked in the building.

Ventilation is even more crucial in scenarios where the interiors contain materials that emit chemicals. Proper ventilation is beneficial in minimizing their effect.

6.3 Moisture and Dampness

The damp walls, molds and fungus are caused by excess moisture in a space. This does not only destroy materials but it also impacts on air quality and health. The fact that some of the materials are easily absorbed by water exacerbates the problem.

This can be controlled using moist and natural materials, sunlight and ventilation.

6.4 Synthetic and Non-Sustainable Materials.

In the contemporary interior, there is the extensive use of materials such as plastics, foam, and chemical-based finishes. Such materials are not greener and usually emit dangerous elements as time goes by. They are also not easily degradable and therefore are also detrimental to the environment.

Air quality and environmental impact would be improved by substituting them with more sustainable materials such as natural wood, recycled materials, bamboo materials, and environmentally friendly finishes.

6.5 Insufficient Cleaning and Maintenance.

Pollutants, dust and dirt accumulate with time unless the spaces are cleaned regularly. Unhealthy particles can be trapped on carpets, upholstery and air filters. Good materials may have an impact on air quality even when not properly maintained.

To maintain fresh and healthy indoor air, regular cleaning and good maintenance are necessary.

6.6 Excessive use of Artificial Finishes.

Application of excessive chemical-based finishes such as strong paints, varnishes and coating can also increase indoor pollution. These finishes can appear good but emit toxic fumes, especially when it is in a closed space.

The selection of environmentally friendly finishes and their minimum use could contribute to the establishment of a healthier indoor environment.

7. Sustainable Interior Design Strategies.

Sustainable interior design is concerned with the development of healthy and safe spaces of people and the environment. The choice of materials is one of the most crucial aspects of this, as well as appropriate design planning. We can enhance the quality of indoor air and comforting by selecting the appropriate materials used in designing and the design techniques.

7.1 Working with Sustainable and Eco-Friendly Materials.

The correct choice of materials is the initial stage to a healthy interior. Eco-friendly materials are those that are natural, recycled or those with low levels of chemicals.

Examples include:

- Stone, clay and natural wood finishes.
- Rapidly renewable and bamboo.
- Wood, metal and glass that is recycled.

Low-VOC paints, adhesives, and polishes.

These materials do not emit so many harmful chemicals thus the indoor air is clean and safe to breathe.

7.2 Selecting Non-Toxic and Low-VOC Products.

Numerous paints, varnishes, and adhesives emit toxic gases to the atmosphere. Low-VOC or non-toxic products can be used to minimize indoor pollution. These are products that are specially engineered to be more environmentally and human safe.

7.3 Proper Ventilation Design

Good ventilation assists in eliminating contaminated air and introducing fresh air. Ventilation is also essential to ensure air quality even in the case of sustainable materials.

Design strategies include:

- Cross ventilation
- Windows and ventilators
- Open air plans with ventilation.

7.4: Use of Indoor Plants.

Plants indoors are natural air cleaners. They take up dangerous chemicals and give out oxygen, enhancing the quality of the air in a natural way. They are also used to give the space a fresh and relaxing feel.

7.5 Maximizing Natural Light

Sunlight will aid in the drying of moisture and the growth of mold and bacteria. It also saves energy by minimizing the use of artificial lighting. Spaces can be developed to be more open to natural light by designing spaces with more windows, skylights, or open spaces.

7.6 Intelligent Space Planning and Minimal Material Use.

Proper planning assists in lessening wastage of materials. Staying uncluttered with furniture and simple spaces enable the room to have more air and minimized sources of pollution.

Sustainable design also involves the use of fewer materials of better quality.

7.7 Durable and Long Lasting Materials.

Durability is also considered with sustainable design. Long-lasting materials will not require frequent change, thereby minimizing wastage and environmental pollution.

7.8 General Upkeep and Care.

Even environmentally friendly materials require maintenance. Washing surfaces, ensuring that the air systems are kept clean and observing dampness assist in ensuring the loved ones maintain a healthy environment in the long run.

8. Impact of Indoor Air Quality and Materials on Human Health

The quality of air in the indoors and the materials employed in the interior places are both directly related to human health. Finishes, furniture and products utilized within a space have an impact on the air we breathe indoors. When these materials contain toxic chemicals, they are able to creep up and make an impact on our body. Conversely, sustainable and eco-friendly materials are beneficial in building a healthier environment.

8.1 Short-Term Effects

Unhealthy indoor air quality and material with chemical basis may lead to instant discomfort in everyday life. These impacts might be minor but can impact our lives and comfort.

Typical short-term effects are:

- Headaches

Eye, nose or throat irritation.

- Feeling fatigued or anxious.
- Allergies or sneezing

The issues are more prevalent in areas with poor quality materials, intense paints or ventilation.

8.2 Long-Term Effects

Constant contact with indoor air and toxic substances under polluted conditions may cause severe health issues. These effects build up gradually but may be intense with time.

Long-term effects include:

- Breathing problems and asthma.
- Chronic respiratory diseases
- Sensitivity and irritation of the skin.
- Heart-related issues
- Weak immune system

By using sustainable resources, these risks can be minimized, and the indoor environment will be safer.

8.3 Effect on Mental Health and Comfort.

The interior environment and the materials also influence our mental conditions. Areas that are crowded with bad odors or chemicals, or those with poor air circulation can be stressful and uncomfortable.

Conversely, natural materials, fresh air and good lighting make the interior designed with these features calm and relaxing. This enhances mood, focus and morale- particularly at work and school.

8.4 Sustainable Materials Benefits to Health.

There are a number of benefits of using environmentally friendly materials on human health:

- Lessens contact with toxic substances.
- Enhances breathing and general comfort.
- Makes the environment more natural and relaxing.
- Promotes long-term health and well-being.

9. Case Study

To realize the actual effect of sustainable interior design, we will refer to a simple example of an office space created with the help of environmentally-friendly materials and healthy design practices. In this case study, it is demonstrated that the combination of the choice of material and the quality of air has an impact on human comfort and health.

9.1 Sustainable Office Interior

An office was planned in this case with emphasis on sustainable materials and indoor air quality.

Design Features:

- Big windows were also given to provide natural light and air.
- Cross ventilation was to be utilized in order to have adequate air flow.
- Low-VOC paints and adhesives were utilized to minimize detrimental emissions.
- Furniture, which was recycled wood and environmentally friendly, was chosen.
- Natural finishes such as wood and stone were used in place of synthetic finishes.
- The addition of indoor plants was done to enhance the quality of air naturally.
- The design was maintained free and open to allow more air flow.

9.2 Observations

Once these design strategies were implemented, the following positive changes were observed in the space:

- Low-chemical materials made the air fresher and cleaner.
- Less strong odor of paints and finishes.
- The space was more natural, comfortable and less suffocating.
- Less artificial lighting and cooling systems.

9.3 Results and Impact on users.

The alterations in the material choice and quality of air directly impacted the individuals who worked in the office:

- Reduced complaints of fatigue, allergies, and headaches.
- More comfortable breathing because of the cleaner air.
- Better attention, concentration and energy.
- More relaxed and good working environment.

9.4 Case Study Conclusion.

It is well established in this case study that the indoor air and human health may be significantly enhanced by the use of sustainable and environmentally friendly materials, efficient ventilation and planning of design.

It is also a demonstration that interior design is not just about the look, but also about providing the spaces that are safe, comfortable, and conducive to everyday life. It is also a demonstration that interior design is not just about the look, but also about providing the spaces that are safe, comfortable, and conducive to everyday life.

10. Findings

Upon learning the role of sustainable interior design, indoor air quality, and material selection, certain valuable findings were made. These discoveries effectively demonstrate that design decisions can have a direct impact on air that we inhale and health in general.

Sustainable interior design enhances indoor air quality:

Interiors that are planned and designed using environmentally friendly techniques and methods have cleaner, fresher and healthier air than traditional interiors. indoor. pollution: The choice of material contributes significantly to indoor pollution:

It was discovered that most of the ordinary substances such as chemical based paints, adhesives and synthetic finishes emit harmful substances to the air. This pollution can be reduced by using low-VOC and environmentally friendly materials.

1. Green materials make healthier surroundings: Wood, stone, and recycled products are natural and sustainable and emit fewer harmful chemicals and thus make the indoor spaces safer and more comfortable.

- Adequate ventilation helps in material performance:

Ventilation is still required even with the use of good materials so that any pollutants that are left can be cleared out, and fresh air can be supplied in the space.

- Plants and natural features indoors enhance the quality of air:

Plants and natural elements add can be used to purify air and make the environment more relaxing and healthier.

- The quality of indoor air has direct influence on the human health:

Health issues, such as allergies, breathing issues, and discomfort, are reduced due to cleaner air and safer materials. It also enhances mental health, concentration and productivity.

Simple design and choice of materials can count a lot:

The quality of indoor air can be greatly enhanced by small actions such as the use of environmentally-friendly materials, better air circulation, and cleanliness.

11. Conclusion

Based on this research, it is evident that sustainable interior design is a very significant aspect of ensuring the indoor air quality and the health of people. In our modern lifestyle where majority of individuals spend most of their time indoors, the contents utilized in interiors and the quality of air in interiors cannot be overlooked.

The study reveals that most of the materials used nowadays including chemical paints, synthetic finishes, and adhesives may emit toxic substances into the air, making the indoor environment to be unhealthy. Nevertheless, indoor pollution can be significantly minimized by selecting environmentally friendly and sustainable materials such as low-VOC products, natural finishes and recycled materials.

In addition to the choice of materials, other considerations such as adequate ventilation, natural lighting, and use of indoor plants are also used in ensuring the indoor air remains clean and fresh. These factors combine to produce spaces that are not just beautiful but also comfortable and secure to individuals.

Physical health issues like allergies, breathing problems and fatigue can be reduced with good indoor air quality and the use of healthy materials. They also enhance psychological health by making the atmosphere peaceful, fresh and free of stress.

Finally, sustainable interior design does not just concern environmental protection but also human health. Designers must emphasize on the use of environmentally friendly materials and considerate design solutions in order to create spaces that are people and planet friendly. We can achieve a healthier and more sustainable future by making responsible design decisions.

12. Recommendations

- According to the research on sustainable interior design, indoor air quality, and choice of materials, it is possible to provide such simple and practical recommendations to facilitate the creation of healthier indoor environments:
 - Work with sustainable and environmentally-friendly materials:
 - Use natural, recycled and low-chemical products including wood, bamboo substitutes, stone, clay finishes, and recycled products. Such materials produce fewer toxic compounds and are more environmentally friendly and safe.
 - Select low-VOC and non-toxic:
 - Always use low-VOC paints, adhesives, polishes and finishes. These products lessen indoor air contamination and enhance air quality.
 - Use of synthetic materials should be avoided:

- Maximize on the use of plastic, laminate and chemical based finishes since they emit dangerous gases after some time and have health effects.
- • Make sure that all spaces are well ventilated:
- Architectural interiors should be designed to allow fresh air in and the polluted air to come out of the building through the windows, ventilators and cross ventilation.
- • Add greenery to design:
- Plants also contribute to the natural enhancement of air quality and cool and soothing atmosphere.
- • Maximize natural light:
- Admit the sunlight into the space by means of windows and apertures. It can cut down moisture content, enhance spirits, and reduce the use of artificial lighting.
- • Take long-lasting and durable materials:
- Using longer lasting materials will save time on replacement and waste will be minimized.
- • Keep clean and in good condition:
- Frequent cleaning of surfaces, furniture and air systems can assist in reduction of dust and ensuring good air quality.
- • raise awareness of healthy material choices:
- To be more responsible and make better decisions, designers and users should be familiar with the impact of materials on indoor air and health.

12. References

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- United Nations Environment Programme – Sustainable Buildings
<https://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/sustainable-buildings>

Websites & Online Resources

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<https://www.usgbc.org>
(Information on green buildings, materials, and sustainability)
- International WELL Building Institute
<https://www.wellcertified.com>
(Focus on health, air quality, and well-being in interiors)
- Building and Construction Authority
<https://www1.bca.gov.sg>
(Guidelines for sustainable and green interiors)

Articles & Design Platforms

- ArchDaily
<https://www.archdaily.com>
(Case studies and articles on sustainable interiors)

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<https://www.dezeen.com>
(Latest trends in eco-friendly and sustainable design)