Environmental Sustainability in Interior Design

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***Abstract*— As society is becoming increasingly aware of the importance of environmentally responsible building and interior design, more and more clients seek to incorporate sustainability principles in their interiors. Environmentally sustainable interior design is involved with such factors as selecting construction materials/ methods that offer low environmental impact and lowering pollution, waste and energy consumption. The architect or interior designer plays a key role in achieving sustainability in interior design because they are the ones deciding which materials and products will be used and how ecologically people will be able to interact with their surrounding spaces. The aim of this research is to first develop a comprehensive understanding of why sustainability is important in interior design and subsequently undertake a study to ascertain the various approaches through which environmental sustainability can be achieved in the design of interior spaces. The research concludes that sustainability must be present in the design of interior architecture in order to minimize the adverse effects on our environment.**

Keywords*— *Environmentally sustainable interior design, sustainability, interior spaces, interior architecture

I. INTRODUCTION

Global environmental crisis which we face today occurred as a consequence of long-lasting negative impacts on the environment, and by development of industries and technologies [1]. The world has limited resources and has experienced steady population growth for centuries, this situation creates an unsustainable condition for our environmental resources; consequently, an awareness of the importance of sustainable practices is needed. Interior designers or architects have a moral responsibility to help protect, preserve, and restore the global ecosystem [2]. Traditionally the interior design profession has concerned itself with a one-dimensional practice, concentrated more on the aesthetic enhancements of an interior space. Traditional interior design which focused on fashion, luxury design in small environments, was an approach that ignores energy savings and emissions reduction. This approach also ignored the harmful effects of design on consumers health, and environmental pollution. However, in recent years interior design practice has seen a dramatic shift with design strategies that now focus on providing healthy and sustainable built environments [3]. The concept of sustainability which means "meeting today's needs without compromising those of the future" has been increasingly used [4]. Society is beginning to recognise the importance of an environmentally responsible built environment. Clients who have begun to understand their role and impact on the environment are seeking interiors that are environmentally sustainable [3].

Although sustainability can be viewed through social, economic and environmental aspects, this research focuses on the environmental aspects of sustainability. This paper aims to first develop a comprehensive understanding of why sustainability is important in interior design and subsequently undertake a study to ascertain the various approaches through which environmental sustainability can be achieved in the design of interior spaces. Following is the structure of the paper.

Section II will discuss the importance of sustainability in interior design. Environmental issues that designers contribute to will be addressed such as climate change, depletion of earth's resources, loss of biodiversity, waste generation and water scarcity. Section III will explore the concept of sustainability and the role of interior designers. This section also will discuss about how this concept can be brought in to a building interior. Section IV will discuss the various approaches for achieving environmental sustainability in interior design. Topics such as energy efficiency, water conservation, reducing environmental impact of materials and creating a healthy indoor space, will be reviewed extensively. Section V concludes the research work.

II. THE IMPORTANCE OF SUSTAINABILITY IN INTERIOR DESIGN

We face so many environmental challenges today [5]. The main dangers worldwide are "population growth and resource consumption", "climate change and global warming", "habitat conversion and urbanization", invasive alien species, "over-exploitation of natural resources and environmental degradation" [6]. Climate change, is perhaps the most alarming of the environmental issues which we face. Human activities such as burning fossil fuels for energy and transportation, cutting down trees for wood or agriculture, allowing waste to decompose in landfill sites, are the major reasons of climate change. These kinds of activities produce excess greenhouse gases, particularly CO2 and methane, which intensifies the natural greenhouse effect [4]. Loss of biodiversity and depletion of natural resources are another environmental concern [5]. Humans are using up natural resources faster than they can be replaced by nature. This creates an unsustainable situation. Some resources, such as fossil fuels and stone, are finite, once they are used up, many of the resources we depend on will not be available for future generations [4]. If we allow this trend to continue, we are bound to exhaust those natural resources on which we are

dependent, and thus dig our own graves [5]. Waste generation is another concern. Many of our production methods are inherently wasteful, some of the wastes get degrade to release pollutants, including greenhouse gases, into the soil, water and atmosphere; whereas some others like plastics get accumulated indefinitely and create huge waste 'mountains' [4]. Overpopulation is another major global environmental issue. When population increases human activity also increases which in turn magnifies the various environmental problems described above.

The construction industry has a massive ecological impact and the decisions designers make are major contributors to the environmental problems outlined above. Buildings which account for about 30% of global greenhouse gas emissions, are the main source of carbon dioxide emissions in the developed world. Also, buildings are responsible for 40% of global energy use, more than any other industrial sector. Embodied energy in buildings, from the extraction, processing and manufacture of new materials, is another significant factor [4]. In addition to this the resource consumption and waste generation is more in construction industry.

Sustainability is one of the key components in addressing the global environmental problems. In construction, it can be implemented through sustainable design. As the construction industry has a very big impact on the environment, designers can take a significant step towards an ecological future [1]. Designers can easily make a positive difference to environmental problems through their design choices, and indeed they have a responsibility to do this. Interior designers in particular can help, as they are the ones who decide various elements of the interior like materials, finishes, lighting systems and other appliances [7].

III. SUSTAINABILITY AND THE ROLE OF INTERIOR DESIGNER

Sustainability is mainly about the people's awareness of environmental protection [8]. Sustainable design which preserves the resources for the present and future generations, can be defined as a design which reflects human respect towards our planet [1]. Sustainable design is an inherent part of good design and many examples can be seen in traditional, vernacular buildings from around the world. These buildings were responsive to the site and climate; typically used local, natural materials, simple construction methods and local skills; and exploited passive design principles [4]. Sustainable interior design is an approach that recognizes environmental impacts throughout the life cycle of an interior. It significantly reduces or eliminates the negative effects of interiors on the environment. Factors related to the reduction of the use of harmful building materials, recycling and pollution prevention are the important aspects of sustainability in the context of interior architecture [7]. The designer is responsible for selecting the right finishing, lighting, carpentry, equipment, plumbing, and other interior details. In fact, a truly sustainable approach means considering the whole life cycle of a project, optimizing its functionality, quality, and therefore the experience of its users. It is important to understand that every project has an impact on the environment during each stage of its life cycle, and that these impacts can be mitigated by sustainable design [4].

IV. VARIOUS APPROACHES TO ACHIEVE ENVIRONMENTAL SUSTAINABILITY IN INTERIOR DESIGN

Designers can make a considerable change and improvement in creating environmentally sustainable interiors using the appropriate methods. The changes can be achieved by understanding various sustainable design principles, analysing the existing examples and through adoption of new technologies [1]. In order to obtain a quality and environment friendly design, the interior designer must adhere to certain principles and answer key questions which are given below in figure 1. This is a universal scheme of the problem-solving process in which seven issues have been singled out that follow the life cycle of a space, and it is important that each stage of the project is approached with a focus on sustainability and eco-friendliness. The scheme also shows the most important steps that a designer takes in sustainable interior design. During the whole design process, the designer or architect must be prepared to compromise and think about the consequences of each step taken. As mentioned above, interior designers, through their work, can make significant changes and create the conditions for implementing the idea of sustainability and environmental conservation [4].

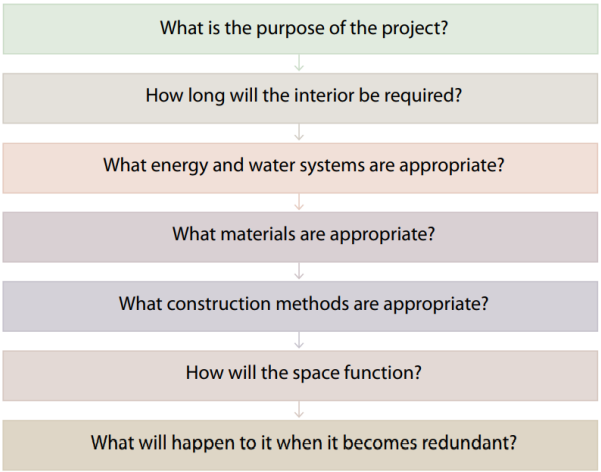

Fig. 1. *Figure showing the set of questions to be asked by the designer [4]*

Sustainable design principles include the ability to optimize site potential, minimize non-renewable energy consumption, use environmentally preferable products, protect and conserve water, enhance indoor environmental quality, and optimize operational/ maintenance practices. Utilizing a sustainable design philosophy encourages decisions at each phase of the design process that will reduce negative impacts on the environment and the health of the occupants, without compromising the bottom line. It is an integrated, holistic approach that positively impacts all phases of a building's life-cycle, including design, construction, operation and decommissioning. [9]. Four sustainable design principles determined as part of this research work and the design measures for environmentally sustainable interiors evaluated with the help of these principles are summarized below.

A. Energy Efficiency

Energy saving is the leading principle of sustainable interior design. The two main energy conservation measures are "design and selection of energy efficient equipment" and "use of renewable energy sources" [7]. Architects and interior designers can improve a building's energy efficiency by reducing the amount of energy needed for heating/cooling, lighting, running appliances, etc. and by providing renewable, non-carbon-based energy to the building [4]. Energy used for lighting can be reduced by increasing natural lighting with skylights or atriums, optimum opening area, light shelves, energy-efficient lighting equipment and lighting control systems. Benefit from natural ventilation is the most important measure for reducing energy used for ventilation [7]. The energy used to heat and cool a room can be reduced by using passive systems, preventing heat loss through special types of windows and curtains. Lastly, use of renewable energy sources such as sun, wind, geothermal energy etc., can partially or fully meet user needs.

B. Water Conservation

In interior, water consumption can be reduced by collecting rainwater or filtering wastewater, as well as by selecting the adequate plumbing equipment [1]. Interior designers should specify sanitary equipment, such as water-efficient sinks and smart faucets, to reduce water consumption. They should advocate plumbing systems that encourage greywater reuse for toilet flush or irrigation purposes. In the long term, this will reduce the energy required for water purification and conserve potable water [2].

C. Reduce Environmental impact of materials

The materials we select to build and decorate the interior can further exacerbate resource depletion; influence climate change, lack of drinking water, loss of biodiversity, waste accumulation; cause pollution during production or manufacturing and endanger our health. Resource depletion is the most pronounced effect of using certain materials. Material use has an indirect impact on the global warming, especially because of the energy consumed during their life cycle. This is called embodied energy which means the energy necessary to obtain, process, manufacture, transport, install, maintain, demolish and dispose of a material [1]. The lower a material's embodied energy is, the more favourable it is towards the environment. For example, the material, wood has a low embodied energy since it is already processed in nature and only requires transportation and refinement. In contrast, aluminium is highly energy intensive due to various stages involved in its life cycle like mining, fabricating, refining, and transporting the material. So embodied energy of aluminium is high. In order to avoid high embodied energy levels from transportation, designers can shop locally available materials for all of their required materials [10].

Material conservation principle includes three main measures, namely flexible design, the use of eco-friendly materials and the reduction of waste. The first step for material saving is choosing furniture and equipment that has a flexible, modular, demountable, and expandable features. Also, significant amounts of materials can be reduced if long-lasting, durable, easily maintained local materials are used [7]. In order to reduce pollution and environmental damage, designers should try to reduce the construction waste [2]. The amount of waste can be reduced through the use of recyclable materials such as wood, stone, steel and aluminium, as well as the reuse of certain equipment in the space.[1]

D. Creating a healthy interior environment

We spend 90% of our time indoors, where off-gassing from chemicals in various finishes and furniture exposes us to allergies, asthma and Sick Building Syndrome. US studies show that the indoor levels of air pollutants to be almost three times higher than outdoor levels [4]. Health conservation principle involves three criteria, namely "improving air quality", "thermal, visual and acoustic comfort" and "use of non-toxic materials". Allowing sufficient natural ventilation is the best way to improve indoor air quality. It can further be improved by avoiding harmful and volatile materials such as radon and formaldehyde [7]. The optimum room temperature is achieved through the use of appropriate equipment and sensors, while the acoustic comfort is ensured by the use of high-quality sound proofing methods. Lastly, surface coatings with harmful vapours should be avoided [1, 7].

V. CONCLUSION

The architect or designer plays a key role in achieving sustainability in interior architecture. The right selection of materials and finishes for each and every element of an interior is totally under the discretion of a designer who have nothing to lose and plenty to gain from embracing sustainable design. In order to create an environmentally sustainable interior, designers must consider the environmental impact of the materials which they plan to use in the interior; encourage recycled-content materials, avoid endangered tropical hardwoods and limit VOCs that harm human health. Avoiding chemicals, for example in paints and fabrics, including plants, daylight and natural ventilation promote wellbeing. Interior designers also can influence the energy efficiency and water consumption of buildings in use by selecting low-energy and water-saving products. From this research it can be concluded that sustainability must first and foremost be present in the design of interior architecture to improve human health and minimize the adverse effects on our environment.

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