Green or eco-friendly interior design focuses on improving indoor air quality as well as reducing the impact that furniture purchases have on the environment.

Sustainable and Eco-friendly Interior Design

A THOROUGH RESEARCH

DEEPIKA AGARWAL

Table of Contents

What is “Eco-friendly” Interior Design?

Most people have heard the term “eco-friendly” or “green” interior design. But not everyone understands exactly what it means. Green or eco-friendly interior design focuses on improving indoor air quality as well as reducing the impact that furniture purchases have on the environment.

Society is becoming increasingly aware of the importance of environmentally responsible building and interior design. As a result, more and more clients seek to incorporate sustainability principles in

their interiors.

It is critical that you pay proper attention to the furniture and products that you bring home. The pain that you use to decorate your home and the material that is used to build furniture in your home and office spaces have a huge effect on the indoor air quality of your surroundings.

Interior designers have a tremendous impact on the sustainability of an environment 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.

As we become more aware of the impact our daily lives have on the environment, our interior designers are always on the hunt for the best in eco-friendly, sustainable interior design techniques to maximize our clients home efficiency, and to help reduce their impact by keeping everything green. Eco-friendly or green interior design emphasizes on enhancing indoor air quality as well as decreasing the effect that furniture buying can have on the atmosphere.

Case 1: The Environmental Protection Agency evaluates that most Americans spend roughly 90% of their time at home, where the concentrations of some chemicals are habitually twice to five times greater than usual outdoor concentrations of these chemicals.

Case 2: One of the major challenges right now is the California Technical Bulletin 117 that entails furnished stuff to be created with damaging flame-retardant elements.

A lot of sustainability-related things are happening currently in the interior design space. Traditionally, environmental concerns may not have been the focus of interior design, but that is changing. Increasingly, designers and brands are starting to consider the environmental impact of the interior design process from design and production to shipping and recycling. The era of eco-design has started, and I think we'll see a lot more brands incorporating sustainable practices into their operations, as well as coming out with a range of new eco-friendly innovations.

In the recent years, the concepts of sustainable interior design and eco-friendly interiors have been increasingly used. A new approach to the design of interior architecture has been implemented. Sustainable interior design is focused on the living quality of users, but also on the effect of applied principles on the environment.

5 Principles of Sustainable Interior Design

Figure 1- A diagram of questions to be answered by a designer [4].

1. Design for energy efficiency

Energy consumption is one of the major contributors to climate change. Buildings are responsible for a big share of the world's greenhouse gas emissions, caused by energy consumption. **Architects and interior designers can do a lot to improve a building's energy efficiency, mainly by reducing the amount of energy needed for heating, lighting, running appliances, etc., and by providing renewable, non-carbon-based energy to the building.**

- Heating and lighting are the two most crucial factors interior designers have influence over. Since most of the building's heat escapes through windows, it's important that the installed windows are of high quality and provide good insulation.
- Curtains and drapes keep both cold air and the sun's heat outside. Window coverings, blinds and shades enable residents to control the building's temperature in an energy efficient way by opening and shutting them as needed.
- Carpets are excellent thermal insulators; according to estimations, a carpet retains as much as 10 % of a room's heat.

- To save energy spent on lighting, a lot can be done just by picking the right colours. Lighter colours reflect more light, while rooms with darker walls and furnishing need more artificial lighting.

Figure 1 Since carpets insulate against both cold and heat, retain warmth in rooms, and give the psychological feeling of warmth, they're great to help save on heating energy.

- Using reflective surfaces increases the amount of light in a room by bouncing it around, decreasing dependency on artificial lighting.

Installing home automation and so called "green gadgets" makes it possible to control heating and lighting systems remotely. This also help residents and occupants use the building's energy more efficiently and economically.

2. Design for low environmental impact

From a sustainability perspective, it's very important to pick materials and products with the lowest environmental impact.

- Organic materials (e.g. wood, wool, natural stone) seem the obvious choice, but we mustn't forget that natural resources need to be treated responsibly.
- Choose materials that are quickly renewable (such as fast-growing bamboo) and are extracted in an environmentally responsible way.
- There are labels, standards and certifications that give credible information about the products' origin and help you identify eco-friendly products.
- **For example,** an F
- SC label on wood products ensures that the wood used in the product was harvested sustainably.

- The environmental impact of materials and products must be evaluated throughout their entire life cycle — from extraction, production, transportation and processing, all the way to how they are discarded after use.

Figure 2 Because ECONYL® nylon yarn used in carpets is made from waste materials, such as abandoned fishing nets, discarded carpets and other discarded plastics, the environmental impact of an ECONYL® yarn-made carpet is much lower than one made with nylon from crude oil.

There are standardized tools and labels that help designers understand, compare and evaluate a product's environmental impact in distinct phases of their life cycle, such as the LCA (Life Cycle Assessment).

3. Design for waste reduction

Interior designers have a lot of power in their hands when it comes to waste reduction, and at the same time, a big responsibility to act sustainably.

The planet's precious resources are limited, so the mentality of discarding products as soon as they go out of style and replacing them with those that are currently trendy is no longer justifiable.

- Fortunately, the world of design is becoming increasingly aware of the need for sustainable thinking and is experiencing a growing interest in sustainable trends, such as recycling, upcycling and repurposing. Instead of discarding ''old-fashioned'' objects while they are still functional, designers can (and should) come up with creative ways to give them a new life.
- Another way in which interior designers can help reduce the depletion of natural resources (and divert waste from landfills) is by opting for synthetic materials that were made from recycled

waste or can be renewed/recycled at the end of their life cycle — when they are spent or people grow tired of them.

With this cradle-to-cradle approach, **waste becomes raw material for new products and a circular loop of manufacturing is formed**, effectively minimizing or even eliminating waste all together.

Figure 3 ECONYL® nylon yarn is not only 100% regenerated, it is also regenerable. These discarded fishing nets, fluff (upper part of the carpet) and plastic components will be transformed into nylon for carpets, having the same quality as virgin nylon. When the carpets reach the end of their lifecycle, the fluff can be regenerated back into new fibre, without any loss of quality.

4. Design for longevity and flexibility

To prevent materials and products getting discarded too often, interior designers should consider the lifespan of any material they plan to use, especially for those elements that experience a lot of wear and tear (such as flooring). **The goal of designing for longevity is to design durable and timeless spaces and suppress the urge to change the whole design every couple of years.**

- The best way to achieve timelessness is to choose quality over quantity, classics over trendy, and simplicity/functionality over embellishments.
- Throughout the years, however, people grow and change, and they want surrounding spaces to grow with them and reflect those changes.
- In anticipation of that, interior designers should consider the flexibility of spaces — how well can they be adapted to fit the changing needs of people who are using them. Designing flexible spaces is one of the keys to longevity.
- When you can easily replace or adapt individual elements of a room, there is no need to demolish and renovate it in its entirety.

Innovation has brought many options for flexible design:

- walls that can be modified to create more spaces when children get bigger and need their own rooms,
- adjustable and mobile furniture that can be re-assembled to fit the needs of the flexible modern workplace,
- modular flooring that allows personalization and easy replacement of individual pieces, and so on.

Easy maintenance is an important part of designing for longevity;

- when spaces are hard to maintain,
- regular changes are inevitable
- and result in more resource consumption and waste creation.

Figure 4 Interface offers modular flooring solutions. With modular carpets, made from ECONYL® yarn, it's possible to lift, move around and replace individual carpet tiles without having to demolish the entire flooring.

The application of flexible elements in the interior makes the interior easier to maintain.

- With modular carpets for instance, you can replace just the worn-out pieces instead of the whole carpet, which effectively keeps waste out of landfills.
- Maintenance of spaces with lots of easy-to-clean materials and surfaces requires fewer cleaning products, which are often harmful for the environment.

Therefore, **investing in elements that are sturdy, durable and easy to clean or replace means that less renovations will be needed; and, consequently, less waste will be generated.** Saving money that would go toward cleaning and maintenance cost is an additional benefit.

5. Design for healthy environments

People spend most of their time indoors; in offices, schools, at home, etc. Although we've saved it for last, **considering the health of an environment should be at the top of the interior designer's priority list. There are several factors to keep in mind when trying to design healthy**

spaces, such as the quality of the air, heating, ventilation, lighting and acoustics.

- Indoor air pollution is the result of products and materials with high levels of toxic emissions.
- **For example,** furniture or equipment that has been treated with harmful chemicals releases dangerous toxins in the air.

Figure 5 Choosing carpets that are easy to clean improves the sustainability of buildings. ECONYL® Stay Clean nylon yarn is a stain-resistant sustainable yarn for carpets that can be easily cleaned with a water-only treatment. Because the stain protection is permanently built into the fibres, the carpets can be stained and washed several times without losing this anti-stain characteristic.

Designers should look for materials with low emissions of VOC (volatile organic compounds) and other air pollutants.

- To improve indoor air quality, it's important that the air in a room can regularly circulate and remain fresh.
- Plants act as natural air filters, and — contrary to common beliefs — so do carpets.
- Carpets improve air quality by trapping the dust particles from the air and holding them until vacuumed.
- With regular, sustainable carpet cleaning, the room environment remains healthy and free of germs and allergens contained in dust particles.
- Carpets are also excellent sound insulators; they help to reduce noise by absorbing sound vibrations — an important benefit to the well-being of occupants and residents.
- Exposure to natural light is another beneficial aspect for both physical and psychological health. This is especially relevant for workplaces, as natural light reduces stress and increases productivity.

In fact, being surrounded by elements from nature (or ones that mimic nature) has a calming effect in general. **Biophilic design is a type of**

design that recognizes this need to include natural elements into our buildings and interiors and aims to restore the connection between humans and nature.

MATERIAL AS ONE OF KEY FACTORS OF SUSTAINABILITY

The search for materials and products that have the least environmental impact becomes imperative rather than a matter of choice or luxury. The construction industry, as one of the most demanding industrial sectors in terms of environmental impact, needs to shift towards eco-friendly and recycled materials and their more widespread use. A wide range of building materials, which have a complex impact on our environment, is one of the main areas of sustainable design that can be influenced by designers.

1. Material impact

The use of materials has an indirect impact on the global warming, especially because of the energy consumed during their life cycle. This is called embodied energy and describes the energy necessary to obtain, process, manufacture, transport, install, maintain, demolish and dispose of a material. **For example,** the stone that will be used in the interior design of a space must first be processed in a quarry, then transferred to a factory, cut and formed into slabs, transported to a construction site, and eventually mounted.

This problem can be solved with less intensive processing of natural materials. Similarly, the selection and treatment of materials affects the water consumption over the life cycle of the material. Eventually, choosing the inadequate materials in interior design can also result in an unhealthy environment for the users of the space itself. Harmful fumes from coatings, adhesives and furniture can cause indoor air pollution. In addition to moisture and dust, this is one of the causes of asthma and "sick building syndrome".

2. Life cycle of materials

Figure 3- Potential of producing furniture from the recycled materials or used products [4, 8]

Figure 4-Housing and public spaces within LEED certified buildings [8]

The life cycle of materials is a vital link in addressing sustainability issues. The life cycle design implies certain principles. The impact of every step of the production process from raw material collection, production, distribution and installation to completion of use and disposal is examined. Thus, the life cycle of a material can be divided into three phases.

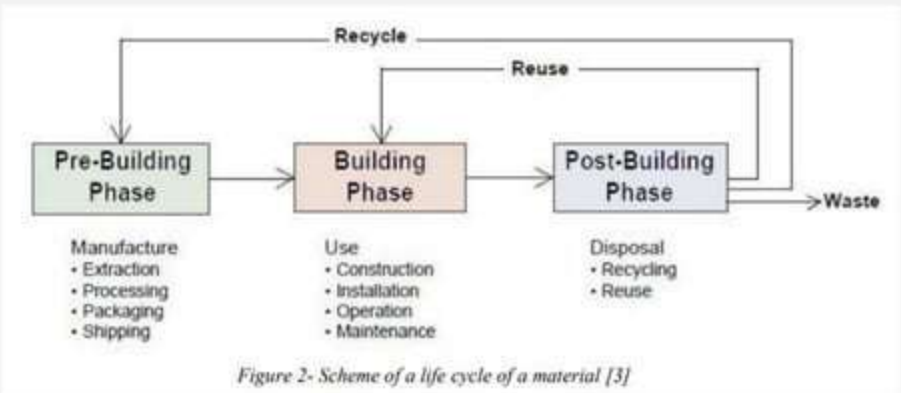


Figure 2- Scheme of a life cycle of a material [3]

3. Material choice – eco-friendly and recycled materials

Choosing the right materials to design the interior architecture of a given space is one of the most important factors in terms of sustainability.

- The most common materials (Base materials) used in eco-friendly interior design are wood panels, glass, metals and gypsum board. They can form a finished surface or be the basis for finishing.
- Wood panels include particle board, plywood, cement board and fibreboard.

When choosing this type of material, care should be taken and boards containing resins residues without formaldehyde should be sought and certify whether the timber is recovered or procured from certified sources. Such panels represent the efficient and minimal use of timber to produce quality furniture and panels of different sizes.

- Glass has medium energy consumption over the life cycle, as it is obtained from natural and abundant resources; it is non-toxic and recyclable.
- Recycled glass can be used as addition to a material, or for production of tiles and work surfaces.
- Metals are characterized by higher energy consumption, and it is recommended to use recycled metals that reduce losses and contribute to the savings of raw materials.
- Plasterboard has very low energy consumption (low embodied energy) and is a good insulator. The biggest problem is waste generated after installation or dismantling, however recycled content plasterboard is available and helps divert waste gypsum from landfill.

Properties of Eco-Friendly Building Materials and Techniques

1. Renewable source.

Sources are rapidly renewable, e.g. wood and bamboo from certified forests.

Figure (3): Properties of Eco-Friendly Building Materials and Techniques.

2. Reuse of waste product.

Waste can be reused or recycled, e.g. agriculture or industrial waste. There's also needed to use materials associated with less waste.

3. Embodied energy.

It is the scalar total energy required to produce the materials including transporting them to the building site. According to Figure (2), steel has much more embodied energy than ceramics, timber, bricks, gypsum, fiberglass insulation and concrete due to its high production energy.

4. Local availability.

It is preferred to search for and to use suitable local alternatives to save cost.

5. Reduction in air, land and water pollution.

- Reduce air pollutions, e.g. use materials with low emissions.
- Reduce water pollution, e.g. use materials that prevent leaching.
- Reuse waste that would otherwise have resulted in landfill, e.g. Fly-ash bricks.

6. Durability and life span.

Use materials that are exceptionally durable or require low maintenance. The longer the life of a material the lesser it is required to be replaced and thus reduces the quantity required to produce.

7. Aid energy efficiency in buildings (Energy Conservation).

It means using materials that require less energy during construction, operation and maintenance.

8. Reuse / recycle.

Reuse or recycle as different product, e.g. steel, aluminium.

9. Biodegradable.

It means that material can decompose easily, e.g. wood or earthen materials.

HOW TO DECORATE WITH SUSTAINABLE INTERIOR DESIGN

1. SELECT LIGHTER COLOURS

To save you money and energy spent on lighting, reconsider your approach to your main colour scheme as paler hues will reflect more light, while darker walls and décor need more artificial lighting. To help you skip out on toxic chemicals and fumes that are in most paints, there's also a variety of paint companies now creating fewer abrasive options that are better for the environment and your home.

Another sustainable interior design practice our designers often take advantage of is incorporating reflective surfaces to increase the amount of light bouncing from room to room while lowering the use of artificial lighting.

2. SOURCE ECO-FRIENDLY FURNISHINGS

Seek out companies committed to sustainable interior design with the use of eco-friendly materials and ethical production practices. Study the companies you're ready to invest in and research their approach to environmentally conscious construction built to last a lifetime while considering their waste production.

And like you would with any purchase, source pieces built to last that you won't get sick of after a few years.

3. CHOOSE MATERIALS + SURFACES WISELY

You might be surprised to read this as they're often considered a far cry from luxury, but sourcing synthetic materials and upholstery can actually help the environment in the long run as they generally stay clean and last longer – just be sure you'll be happy to see them around your home years.

Even better is to source materials created from recycled fabrications and waste as sustainable interior design takes never considered approaches for the best results.

Similarly, seek surfaces like counters and tabletops that are easy to clean, require less time, and product. Teak for one is a great alternative to more delicate wood as it is ultra-durable and quick to manage.

4. BRING IN CARPET

Though we tend to often forget and think of them as purely decorative, rugs and carpets do double-duty as thermal insulators while retaining up to 10 % of a room's heat.

They also work as brilliant sound insulators and can reduce noise by soaking in sound vibrations and believe it or not, they also work to improve air quality by trapping in dust from the air until vacuumed. As we're dedicated to sustainable interior design, we suggest organically produced fabrications that are easy to clean and won't require an environmentally devastating trip to the dry cleaners or chemical ridden products.

5. INSTALL WINDOW TREATMENTS

When it comes to sustainable interior design, heating and lighting are two of the easiest routes our designers utilize to make our client's homes as eco-friendly as possible. As most building's heat escapes through windows, it's essential that your windows are of the best quality while ensuring proper insulation.

And if you aren't blessed with the best windows and upgrading them is out of your budget, window treatments are a smart, easy to manage and install option as they keep cold air and the sun's heat outside while allowing you to control your home's temperature by opening and shutting them when needed.

6. INSTALL EFFICIENT SHOWER HEADS + FAUCETS

Save water and energy by updating your faucets and shower heads with more efficient models as today's options boast up to 70% less water use. As you can see, most often, sustainable interior design updates don't really require unlimited funds, just a thoughtful, well-studied approach.

7. UPGRADE YOUR APPLIANCES

As Energy Star-certified appliances can now be found in just about any modern home, we suggest swapping out older washing machines, dishwashers, and refrigerators for updated, energy-saving options as they'll also save you money in the long run.

We love the functionality and eco-friendliness of LG's Signature Refrigerator which boasts a cleverly designed transparent front that allows you to see what's inside without having to open the door.

8. INVEST IN NEST

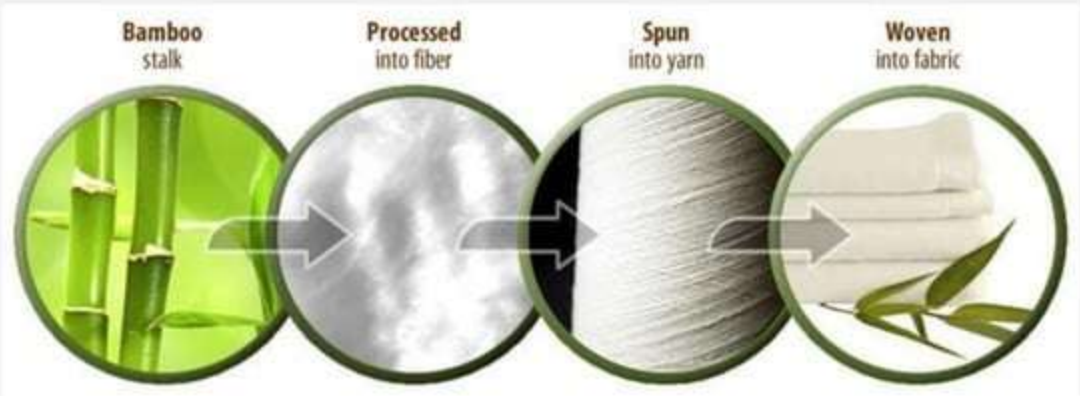
Brands like Nest provide beautifully designed, easy to use automation services to control heating and lighting systems from anywhere to help use your home's energy more efficiently and economically.

And speaking of lighting, did you know that traditional light bulbs give off 90% of their energy as heat, which makes them more expensive to use and keeps your house warmer. As it's probably one of the least expensive sustainable interior design hacks to try, we suggest using energy-efficient bulbs including halogen incandescent, compact fluorescent lamps, and LED lights as well as using timers and dimmers to save the most while helping the environment.

The Most Eco-Friendly Materials

1. Bamboo fibre

Bamboo-derived textiles may not be the most perfect option for a fully sustainable and eco-friendly material, but no fabric is perfect.



2. Bamboo Hardwood

When looking for truly eco-friendly bamboo, make sure the material is treated according to environmental standards. The Forest Stewardship Council (FSC) certificate makes sure that the harvest of bamboo and

timber preserves the natural biodiversity and ecology of the forest. It is used in flooring.

3. Cork

Cork isn't just used to top wine bottles! In addition to household items and personal accessories, cork can be made into flooring, wall coverings and adapted into textiles for fashion. It is one of the best alternatives to leather and plastics.

4. Teak

Teak is known for its durability and elegance, but it will come with an expensive price tag. In comparison to pine and oak, teak will save you from annual waterproofing and upkeep, lasting for many years.

5. Bioplastic Compostable

Bioplastic compostable products will look and feel just like regular plastic. Products such as compostable cutlery, tableware, straws, cups, plastic bags, and packaging are commonly made from bioplastics.

6. Hemp

Hemp is an eco-friendly material that is replacing plastic-based materials for both clothing and home decor. It is resistant to mildew and will soften with age making it an ideal fabric for clothing and linens.

7. Organic Cotton

When looking for an eco-friendly organic cotton option, avoid dyes and go for textiles that come in the natural shades that cotton is grown in, light brown, cream, and pale green. Organic cotton can cost more than conventional cotton due to farming and manufacturing processes but may be worth the extra price to help promote a sustainable and eco-friendly industry.

8. Soybean Fabric

Soybean fabric is a renewable resource as it is made from a by-product of soy foods such as tofu and soybean oil. It has a soft texture comparable to silk when it drapes and can be used for many textiles in the home. It's also a cruelty-free alternative to silk and cashmere production, which both involve the use of animals.

9. Recycled Glass

Glass can also be easily upcycled or reused in a creative way. Save your bottles and jars and turn them into reusable storage containers in the kitchen or garage. Some companies are even using recycled glass bottles to create mosaic-style countertops.

10. Recycled Paper

Most curb side recycling programs allow you to recycle most paper, including newspaper, white office paper, and mixed-colour paper. There are many eco-friendly household paper products that are made from recycled paper. Look for these options when next time you are buying toilet paper, paper towels, or napkins. You can also reduce your use and reuse your paper when possible.

11. Recycled Polyester Plastic

PET stands for Polyethylene Terephthalate. Most PET plastic containers are used to package food, water, soft drinks, salad dressings, oil, toiletries, and cosmetics. PET is a popular choice for manufacturers because it is a safe, inexpensive, lightweight, durable, and most importantly a recyclable plastic.

12. Felt

Synthetic felt can be made from recycled PET plastic bottles (see above) and turned into furniture or wall panelling with excellent acoustic performance. Felt can also be made into a more rugged and durable material used in construction for roofing or siding on houses.

13. Reclaimed Wool

Reclaimed wool may not be commonplace in the fashion industry yet, but some small brands and manufacturers have taken a step towards sustainability and lowering the environmental impact of wool production.

14. Stainless Steel

Stainless steel can be used for pipes in drinking water systems and is effective against preventing bacteria growth and minimize potential corrosion. In addition to its shine and beauty, it serves as an eco-friendly alternative to many commonly used plastic materials and appliances in the kitchen such as refrigerators, storage containers, bins, and kitchenware.

15. Aluminium

Aluminium cans are also lightweight and can be stacked to ship efficiently thus lowering carbon emissions through logistics and supply chains. Aluminium cans are produced in a “closed-loop” recycling chain and are infinitely recycled.

16. BPA-Free Plastic

Most companies that produce high-quality products will have "BPA-Free" listed as a feature. Do your research to be sure. Avoid plastics that are marked #3 or #7 according to the resin identification code (RIC) as these have the highest possibility of containing BPA. You can also avoid BPA by switching from plastic to an alternative material such as glass or stainless steel.

17. Reclaimed Wood

In the past, reclaimed wood was a choice more common for the eco-friendly conscious and those willing to spend money. Now more than ever, individuals with a thrifty and DIY mindset are transforming old wood in a new and creative use bringing some character into your home. Not only will this save your wallet but also give you a sense of accomplishment if you decide to embark on a DIY reclaimed wood project.

18. Clay Brick

As one of the oldest materials used by humans, it serves as a durable and reliable building material lasting up to 100 years. Clay brick reduces the need for replacement and other resources needed during construction and has a lower environmental impact during its production compared to metals and other raw materials.

19. Eco-Friendly Paints and Finishes

Low-VOC which are eco-friendlier. They emit a much lighter odour to minimize any irritation. These tend to be water or oil-based paints and contain no chemical solvents and have no emissions during production. Some brands have even developed a paint that is made from milk protein, a super eco-friendly option!

Materials to Avoid

Non-organic cotton – do you have a piece of clothing labelled 100% cotton? Check again. Your average cotton item may not actually contain what you think. Read labels carefully and look for clothing labelled "organic cotton" with at least 95% of the fibres organically grown.

Acrylic fabric – this is a synthetic fabric that uses chemicals which according to the EPA, have been linked to causing cancer in animals. Due to these chemicals, it is not biodegradable or recyclable. Not an eco-friendly choice.

Polyester fabric – virgin polyester production requires crude oil (petroleum) making it a non-renewable resource and giving it a high environmental impact during its production. As a fabric, polyester is reported as a potential irritant to your skin. The only positive is that it can be recycled into PET plastic bottles.

BPA plastic – as a potentially toxic and harmful chemical and has shown to affect the reproductive system of lab animals. Now the jury is still out on the full effects on humans many choose to avoid BPA altogether. Watch out for plastics that are marked #3 or #7 according to the plastic identification code (PIC) as these have the highest possibility of containing BPA.

Conclusion

These are some of the eco-friendliest materials that you will commonly see different brands marketing as "good" for the environment. Be an educated and proactive consumer. Always do your homework before purchasing to find out how the material or product is manufactured and what exactly is its environmental impact. I hope this guide has been informative and helped you make eco-friendly choices for the future and betterment of our environment.

Theory of Sustainability in the Interior Environment

Sustainable interior design is defined as "interior design in which all systems and materials are designed with an emphasis on integration into a whole for the purpose of minimizing negative impacts on the environment and occupants and maximizing positive impacts on environmental, economic and social systems over the life cycle of a building"

1. Interior Design Element: Materials

In material selection, the most important criteria are to select the material according to the features of function. Each of every function has specific needs. **As an example**, materials used in the hospital interior and the shopping mall should be different due to the sterilization aspect. Especially, the selection should aim to long term use. It is very important to use a material in its maximum potential in order to reduce waste of resources.

Another important criterion in material selection is the recycling potential of the materials. There are many studies in the field of waste management which aim to innovate new construction materials. A Cierra Recycling can be **an example** to one of these. Basically, they collect and separate the waste, and then they transform it and remanufacture these waste products

Moreover, the level of emission of toxic gases both used in production process and during the using period of the materials is an essential criterion in achieving sustainability. Especially, most traditional techniques in construction and materials are widely sustainable. **As an example,** traditional materials like mud brick and adobe are highly sustainable in the means of level of toxic gases emission.

2. Interior Design Element: Furnishing

Rather than the production process, the old furniture also cannot be recycled. These wastes have a big role in increasing the amount of global waste. Achieving sustainable furniture, recycling is one of the important criteria. Recently, some of the furniture companies started producing furniture totally from waste.

Furniture produced from waste sometimes face with the problem of aesthetics. These types of furniture are sometimes considered as unaesthetic. This is the major problem in selecting this furniture. The aesthetic quality of the furniture should be considered. Then, it will both serve for the purpose of sustainability and widely used.

3. Interior Design Element: Lighting

Day light is the main source in natural lighting. It can be explained as "the practice of bringing light into a building interior and distributing it in a way that provides more desirable and better-quality illumination than artificial light sources". In this context, the building should be located according to gain maximum day light. Also, the size and the depth of the room should be appropriate to use maximum day light. Recently, there developed new technological tools to carry day light to the deep interior space of the building even to the basements. The main principal in these tools are to collect the sun light and reflect the light through the reflective tubes. Laser cut panels, light piping systems, horizontal and vertical light pipes **are examples of these systems.**

The day light in the context of sustainability in three categories as:

1. Resource sustainability (using day light to affect the energy of the building performance).

2. Economical sustainability (in the dimension of financial benefit).

3. Human sustainability (in the dimension of human physical and psychological health)

Conclusions

Interior environments are the places that meet the human needs. They are the most intimate environments to its users. The need of willing to create sustainable environments should be first met in the interiors. People should live in sustainable environments with the help of professionals; interior designers. Interior designer has an essential tool in their hands to lead sustainable environments and create consciousness in sustainability. Interior design elements are the major tools in creating long term used sustainable environments. Finally, interior design elements should be natural resources in the process of fabrication, manufacturing, installation, use, reuse, recycle and disposal.

WHAT IS GREEN BUILDING?

Green building design is a practical and climate conscious approach to building design. These buildings were generally made of locally available materials like wood, mud and stone and dealt with the vagaries of weather without using a large amount of external energy to keep the inhabitants comfortable. A green building uses minimum amount of energy, consumes less water, conserves natural resources, generates less waste and creates space for healthy and comfortable living and

amount of external energy to keep the inhabitants comfortable.

During the 20th century, the energy needs of a person taken

as a global average will increase by a factor of four. As life expectancies increase, populations increase, material and wealth increases, all these four things put a high demand on the ecosystem of the earth.

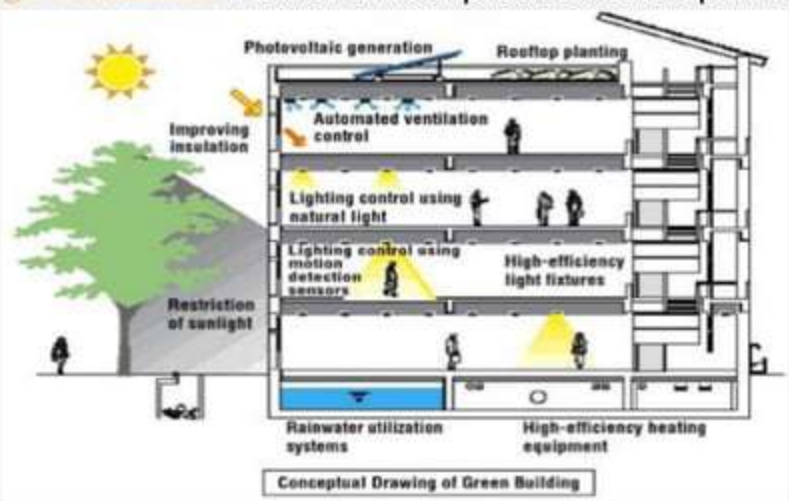
1. MATERIALS: 50% of all resources (sand, gravel, clay, and iron ore, wood) globally go into construction.

2. ENERGY: 45% is used to heat, light, and ventilate buildings and 5% to construct them.

3. WATER: 40% is globally used for sanitation and other use in buildings 16% is consumed in consumption.

4. LAND: 60% prime agricultural land lost to farming is used for building purpose.

5. TIMBER: 70% of timber products end up in building construction.



Green building is defined by the Office of the Federal Environmental Executive as "the practice of:

1) Increasing the efficiency with which buildings and their sites use energy, water, and materials.
2) Reducing building impacts of human health and the environment, through better siting, design, construction, operation, maintenance, and removal throughout the complete life cycle."

EXTERIOR

- Selecting siding materials that do not require painting, such as vinyl or brick instead of wood is required for a green building.
- Consider a roof made of metal instead of traditional shingles.
- Purchasing plant materials that do not require a lot of water or attention and are appropriate for your climate.
- Considering removing part or all your lawn and replace it with low maintenance plants or other ground cover, such as artificial grass or stone.
- Avoiding real wood decks that might require continual resealing. Swimming pools are also a source of continual maintenance

BUILDING MATERIAL

- Recycled glass an analysis of the eco properties of this material used in interior design and your home.
- Concrete There is a divide in the industry whether concrete is green or not. Durability versus extremely energy intensive manufacturing.
- Clay plaster an alternative to gypsum plaster with lower levels of embodied energy & excellent eco properties.
- Limes plaster the natural eco-friendlier alternative to gypsum plaster for your interior walls.

ENERGY CONSERVATION MATERIAL FOR BUILDING

- Energy Conservation: Materials that require less energy during construction e.g. precast slabs.
- Materials that help reduce the cooling loads- e.g. –aerated concrete blocks.
- Products that conserve energy–e. g. CFL lamps.

- Fixtures & equipment's that help conserve water e.g. Dual flush cisterns

CONVENTIONAL ECO-FRIENDLY MATERIAL

1. Bamboo, Bamboo Based Particleboard & Ply Board, Bamboo Matting
2. Bricks suns dried
3. Clay roofing tiles
4. Gypsum Board, Tiles, Plaster, Blocks, gypsum plaster fibre jute/sisal and glass fibre composites
5. Marble Mosaic Tiles
6. MDF Boards and Mouldings
7. Partial Boards
8. RCC Door Frames
9. Rubber Wood Finger Joint Board

10 Stone dust

Guiding Principles of Green Building Practices

Green building practices can serve a variety of purposes and are often categorized into multi-faceted designs and approaches that are beneficial for both communities and businesses. Both policy professionals and the building industry have categorized green building principles to help guide future development and design. The five principles of green building practices have been established that are organized around the life cycle performance of green buildings. An integrated and comprehensive approach, the principles encompass each of the green building phases, including construction, operation, maintenance, and decommissioning.

- **Sustainable Siting**—this approach optimizes land use and development to reduce adverse impacts and minimize the building's ecological footprint.

- **Energy Efficiency**—this technique focuses on the establishment of performance targets that account for intended use, occupancy and other energy operations for new construction and renovation projects.
- **Water efficiency**— this technique emphasizes the value of decreasing demands for fresh water and reducing the generation of wastewater through optimized landscaping, integrated rainwater catchments, grey water recycling, and wastewater treatment systems.
- **Building Materials**—by using sustainable construction materials and resources, green building materials have aided the reduction of extraction, processing, transportation, solid waste, and consumption.
- **Healthy Indoor Environmental Quality**—these processes have enhanced the sustainable communities through ventilation and thermal comfort, moisture control, daylighting, environmental tobacco smoke control, and protecting indoor air quality during construction.

Advantages of Green Building Materials

Green building materials offer some or all the following benefits to the building owner and building occupants:

- Reduced maintenance/ replacement costs over the life of the building
- Energy conservation
- Improved occupant health and productivity
- Life cycle cost savings
- Lower costs associated with changing space configurations.
- Greater design flexibility

Sustainable Development or Sustainable Building Concept

It is a development that meets the needs of present without compromising the needs of future generations to come. The concept of sustainable building incorporates and integrates a variety of strategies during the design, construction and operation of building projects. The use of green building materials and products represents one important strategy in the design of a building. As more than 40% population is living in the cities so these cites should be made Sustainable first.

Waste Generation

Huge amount of waste is generated every day in each city. For example, Delhi alone generates more than 6,500 tons of Garbage every day. By 2020 its amount will reach 1800 tons every day. Such amount of waste disposal is a Herculean task and will need space for dumping and fuel costs for transportation of waste up to disposal areas. In the cities the disposal areas are outside city which are miles apart. Therefore, this waste must be processed at nearby places and reused as much as possible.

Local processing of the waste will not only keep the city clean but also generate energy and resource materials. It will also generate huge employment opportunities and give several other advantages and thus sustainable.

Some Benefits of a Green Building Concept

- Green buildings are designed to be healthier and having more enjoyable working environment. Workplace qualities that improve the environment and which help in developing the knowledge of workers and may also reduce stress and lead to longer lives for multidisciplinary teams.

- Reduced energy and water consumption without sacrificing the comfort level.
- Significantly, better lighting quality including more day lighting, better daylight harvesting and use of shading, greater occupancy control over light levels and less glare.
- Improved thermal comfort and better ventilation.
- Limited waste generation due to recycling process and reuse.
- Increase productivity of workers and machines. It is reported that productivity can be increased by about 25% while following such greenhouse norms.
- Attracting and retaining the best employees, can be linked to the benefits and qualities of workers receive, including the physical, environmental and technological aspects.
- Green building activities result in reduction of operating costs by 25-30%.

Need to Develop A Green Building Policy (GBP) in INDIA

The Green Building movement in India was started in 2003 and received a major impetus when, CII –sohrabji Godrej Green Business Centre Building in Hyderabad became the first green building in India which was awarded with the prestigious and the much covered LEED (Leadership in Energy and Environmental Design) Platinum rating by the US Green Building Council (USGBS) and also became the world's greenest Building in 2003.

LEED India Concept

The Indian Green Building Council (IGBC) Designed and started. The Leadership in Energy and Environmental Design (LEED – India) system is called Green Building Rating System. It is an internationally accepted

benchmark for the design, construction and operation of high-performance green building.
LEED certified buildings utilize fewer toxic materials, low-emitting adhesives & sealants, paints, carpets, and composite woods, and indoor chemical & pollutant source control.

What Is to Be Done?

Essential to an effective green building policy that delivers energy efficiency is by using simple, standardized and better energy performance materials throughout the construction in all phases of building design and operation. Thus, to have green Building concept, some or all the following steps need to be followed.

- Plan each office / home's orientation to the sun to harness energy and shield it from heat i.e. Proper Building Orientation and Landscape and emphasis on natural light.
- High efficiency insulated glass windows can reduce requirements of energy during the operation or use of Building. Thus, it will emit minimum carbon dioxide CO_2
- Minimize Cement / concrete consumption through innovative architecture and Structural Design for optimum use of cement.
- Maximum use of waste Pozzolanic materiel like fly ash in Concrete Mixture along with Cement.

- Non – toxic paints should be used on the walls. These use water rather than petroleum-based solvents and do not emit smog producing pollutants. This will improve Indoor Air Quality.
- Use Sewage treatment and recycle the wastewater from bathroom and Kitchen.

- Organic waste, both solid and liquid, produce a large quantity of Methane which is 23 times stronger than CO_2 as greenhouse gases (GHG). Such organic waste must be processed to tap gas which can be used as cooking gas or fuel.
- Provide Rainwater Harvesting systems on the roof of Building to collect water, which can be used to flush Toilets or for general wash or recharge the ground.
- Use Solar Panels to heat bath water and generate little electricity for use when there are power cuts instead of using Invertors.
- Install simple Wind turbines on the roof, which can be used to generate electricity for use when there is no power.
- A rain garden can help reduce storm water runoff.
- Use Drip Irrigation to water the plants or Native landscaping around building. This requires less water for irrigation and maintenance.

- Government or Municipal corporations should provide enough incentives like tax rebates or tax breaks for green buildings during approvals.
- Government should make basic green norms – like grey water recycling and rainwater harvesting compulsory for all new buildings in all 5,161 cities, towns and urban agglomerations in the country.

Conclusion

The poverty alleviation in the developing countries can be effectively achieved by conservation of energy and creation of employment opportunities. The energy saved can be ploughed back for further development which creates a large employment opportunity. The technologies and the materials used for development should complement the use of local and waste resources. The labour forces enhancing their capability and standard of living be used to avoid the widening of gap between haves and have not. Processing of waste must be taken up at a large scale and locally in each of 5,161 cities and towns. This will not only generate jobs but also give out energy & resources of material which can be usefully utilized.
It can be a blessing for the fast developing country like India that the measures called for sustainable development can be the measures of poverty alleviation as well as illustrated in the theme of Seminar through sustainable development and reprocessing of waste.

Orientation of Green Office Buildings for Efficiency and Functionality

The orientation of a green buildings to be constructed is the position of the building on the site or the plot of land selected for the project with respect to the sidewalks, the roadways, and the landscaping features. The physical shape of how the building will appear to us forms the

shape of the structure. There are many options and choices when it comes to shape of office building construction. We can have a square, rectangular or even triangular shapes. These three are on the top list as these offer the strongest support systems than any other shape. The top logical positioning helps in determining the building orientation.

The choice of orientation largely depends on the space that is available. **For example,** in the case of building construction in a city like New York, there is only space for large tall and slim high-rise construction.

1. Good Orientation for Green Buildings

Managing the natural elements mainly the sun and wind features helps to evolve a building that have good orientation features.

If we let the largest part of the building to face towards the sun, then the area can receive maximum natural daylight. This is a type of natural ventilation that is earned without any power source.

But certain hot regions ask for less sun exposure at a period. This condition varies based on the geographical location of the building.

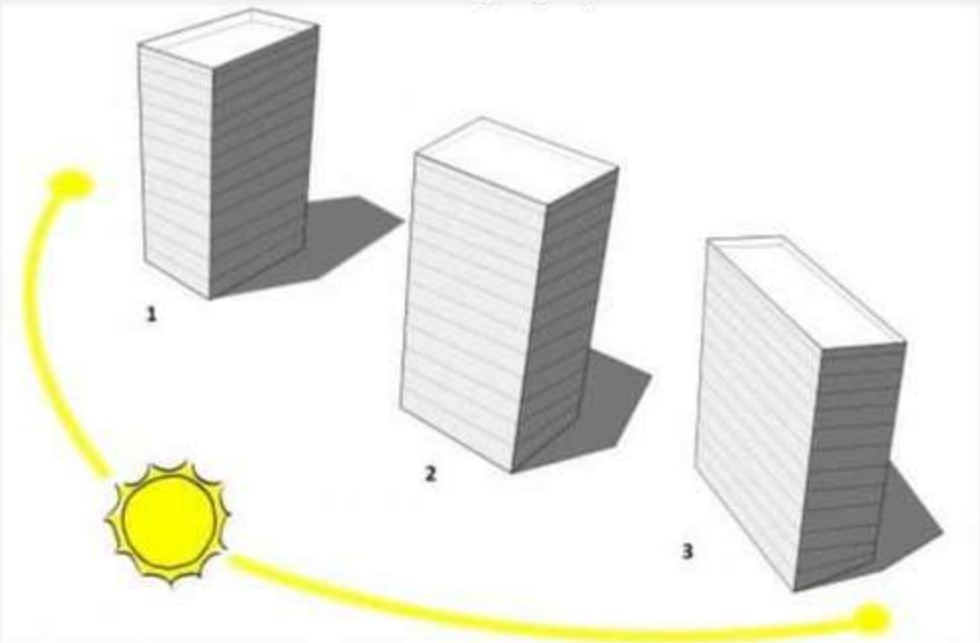


Figure 6 Building Orientation Based on the Sun Exposure

In Northern hemisphere, the plan to make the building orient towards the sun means letting the largest sides of the building to face the south. This side must have the maximum number of windows.

The sun stays long for southern walls of the structure. Hence this orientation helps to have maximum exposure to the sun that is not direct and harmful.

The arrangement of surfaces with more windows facing the east or the west lets the entering of excessive heat that makes the air conditioner work very hard. This also cause glare problems.

Maximum exposure to sun has daylight provisions and heat and energy. This reduces the HVAC system dependency.

Another important factor that must be considered is the wind energy. This is of greater importance if we have a plan to utilize the wind turbines for power generation.

The wind has a great role in bringing the building to additional stress. These also have an important role in the effective heating or the cooling of the building structure. This effect can be explained through certain examples:

1. The Shanghai Tower in China make use of a curved shape architecture. This shape will help in the reduction of lateral loads that is coming from strong wind action.
2. The Jie Fang Daily News and the Media Building too make use of a circular arch or a kind of indentation in order to reduce the production of wind that will affect the building as large loads.

When it comes to tall or short building feature, it is always advised to have tall thin buildings than wider & short ones. This is because tall buildings will have less space requirement and they don't affect the surrounding environment drastically.

These shapes have less space for the rain and Stormwater runoff problems and related pollutions.

2. Shapes and Orientation of Green Buildings

Both the factors of shape and orientation must move hand in hand during the construction of a green building. The shape and the design plan selected for the building must be evolved such a way that it will support an optimum orientation.

It is a wrong idea to believe that the facing of a building towards the sun is just enough to have a cost saving in the building performance. Improper provision of windows both in numbers and location also affect the energy efficiency.

The main concept is to make the building perform optimally within the designed orientation.

Mainly the concept of green building focus on taking large consideration on the needs of the occupants of the building. They also focus on how the shape of the building enhances the green environment.

This idea asks for larger open spaces, having appreciable access to the windows and the use of daylight efficiently.

CASE STUDY

- https://www.greenhotelier.org/our-themes/sustainable-interior-design/
- https://www.slideshare.net/hamzaaaaaah/green-building-delhi-case-study

VIDEO LINKS

- https://youtu.be/qr-GSvrnTaE
- https://youtu.be/9klc9BLqtGw

REFERENCES

- https://www.decoraid.com/blog/sustainable-interior-design/
- https://medium.com/@ECONYL/5-principles-of-sustainable-interior-design-b390503a5176
- https://www.slideshare.net/KarishmaKakoti1/green-sustainable-interior
- https://www.slideshare.net/diziner/eco-friendly-interior-design
- https://www.polytechnichub.com/properties-eco-friendly-materials/
- https://householdwonders.com/most-eco-friendly-materials/
- https://www.researchgate.net/publication/337194723_Sustainable_interior_design_-_use_of_eco-friendly_and_recycled_materials?enrichId=rgreq-01041ea22384a85ac99baf2b64a0e46a-XXX&enrichSource=Y292ZXJQYWdlOzMzNzE5NDcyMztBUzo4MjQzOTgyMjMyNjU3OTJAMTU3MzU2MzI2MTI3OQ%3D%3D&el=1_x_3&_esc=publicationCoverPdf
- https://www.researchgate.net/publication/322301823_Effectiveness_Durability_Fire_Resistance_and_Design_Procedures_of_Concrete_Members_Reinforced_using_Friendly_Environmental_Materials?enrichId=rgreq-e68495b27f8ee6a40481577f82fee19c-XXX&enrichSource=Y292ZXJQYWdlOzMyMjMwMTgyMztBUzo1ODE0MTMxMzQxODAzNTJAMTUxNTYzMTEwMTA4NA%3D%3D&el=1_x_2&_esc=publicationCoverPdf
- https://pdfs.semanticscholar.org/4309/314f900162ffd5732d0b6a2b6dd7339d432c.pdf
- https://householdwonders.com/most-eco-friendly-materials/
- https://www.nbmcw.com/tech-articles/tall-construction/15837-need-for-developing-green-building-concept-in-the-country.html
- https://www.completecommunitiesde.org/planning/sustainable/guiding-principles-gbp/
- https://theconstructor.org/building/orientation-green-buildings/17497/