



Green Building & Sustainable Construction (TCM 5330)

Sustainable Design Terminology



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What do we mean by **sustainable transportation design** in cities?

- Sustainable transportation design in cities refers to the planning, development, and implementation of transportation systems that prioritize environmental, social, and economic sustainability.
- The goal is to create efficient, accessible, and environmentally friendly transportation networks that minimize negative impacts on the environment, improve quality of life for residents, and support economic vitality.



Watch the video

Cities Rise to the Challenge – Sustainable Mobility

- Link:

https://www.youtube.com/watch?v=8Fj2ARn1WMY&ab_channel=WFIInternational

(you may also click on the YouTube Logo)



What are the key concepts of sustainable transportation design in cities? *(slide 1 of 2)*

Public Transit Systems

Investing in and expanding public transportation options, such as buses, subways, trams, and commuter rail, to reduce reliance on private cars and decrease traffic congestion.

Active Transportation

Promoting walking and cycling as viable modes of transportation through the development of pedestrian-friendly sidewalks, bike lanes, and shared-use paths.

Integrated Transport Networks

Designing integrated and multimodal transportation networks that seamlessly connect different modes of transportation, allowing for easy transfers and efficient travel.

Urban Planning and Land Use

Implementing transit-oriented development (TOD) strategies that encourage mixed-use development around transportation hubs, reducing the need for long commutes and promoting walkability.

Electric and Low-Emission Vehicles

Encouraging the adoption of electric vehicles (EVs) and other low-emission technologies to reduce air pollution and greenhouse gas emissions from the transportation sector.

Carpooling and Ride-Sharing Programs

Supporting and incentivizing carpooling, ride-sharing, and shared mobility services to optimize vehicle occupancy and reduce the number of single-occupancy vehicles on the road.

Smart Traffic Management

Implementing smart traffic management systems that use technology to optimize traffic flow, reduce congestion, and minimize travel times.

What are the key concepts of sustainable transportation design in cities? *(slide 2 of 2)*

Park-and-Ride Facilities	Establishing park-and-ride facilities at transit stations to encourage commuters to use public transportation instead of driving all the way to their destinations.
Low-Impact Infrastructure	Designing transportation infrastructure with low environmental impact, considering factors such as stormwater management, green infrastructure, and wildlife corridors.
Access for All	Ensuring that transportation systems are accessible to people of all ages and abilities, including those with disabilities, through the design of accessible infrastructure and services.
Urban Green Spaces	Integrating green spaces and urban landscaping along transportation routes to enhance the aesthetic appeal, improve air quality, and provide recreational areas.
Innovative Technologies	Embracing emerging technologies, such as autonomous vehicles and smart mobility solutions, to optimize transportation efficiency and reduce environmental impact.
Data and Analytics	Utilizing data and analytics to monitor and optimize transportation systems, providing real-time information to commuters and planners for informed decision-making.
Community Engagement	Involving the community in transportation planning and decision-making processes to ensure that projects align with the needs and preferences of residents.

The background image shows a vast, multi-story indoor garden. The structure features a complex, thatched roof made of natural materials. Concrete walkways and balconies are integrated with the design, surrounded by a dense variety of trees and climbing plants. A person in a white dress is visible on one of the upper levels, providing a sense of scale to the large space.

What do we mean by **biophilic design**?

- Biophilic design is an innovative approach to architecture and environmental design that seeks to incorporate and emphasize connections to the natural world.
- The term "biophilia" refers to humanity's innate affinity for nature, and biophilic design aims to enhance well-being, productivity, and overall quality of life by fostering a strong and positive relationship between people and the natural environment.

Watch the video

An Eco-Friendly Home That Uses Biophilic Design Principles to Connect With Nature

- Link: https://www.youtube.com/watch?v=D-apuc1IWGc&ab_channel=SimpleDwelling

(you may also click on the YouTube Logo)



What is social equity in design?

- Social equity in design refers to the principle of ensuring fairness, justice, and inclusivity in the planning, development, and execution of design projects.
- It emphasizes the importance of creating environments, products, and systems that benefit all individuals and communities, regardless of their background, socioeconomic status, race, gender, age, or other characteristics.
- Social equity in design seeks to address historical and systemic inequalities by promoting accessibility, diversity, and equal opportunities for everyone.



What are the key aspects of social equity in design? *(slide 1 of 2)*

Inclusivity

- Ensuring that design decisions consider the diverse needs and perspectives of all individuals, including those from marginalized or underrepresented groups.

Accessibility

- Designing spaces, products, and services that are accessible to people with disabilities, promoting equal opportunities for participation and use.

Community Engagement

- Involving communities in the design process to understand their unique needs, preferences, and challenges, and incorporating their input into decision-making.

Affordability

- Striving to make designs and products affordable and accessible to a broad range of people, regardless of income levels.

Cultural Sensitivity

- Recognizing and respecting diverse cultural backgrounds, traditions, and values in design, avoiding cultural appropriation, and celebrating cultural diversity.

Equitable Resource Distribution

- Ensuring that resources, benefits, and opportunities resulting from design projects are distributed fairly among all members of the community.

What are the key aspects of social equity in design? *(slide 2 of 2)*

Representation

- Promoting representation and diversity in design teams to ensure that a variety of perspectives are considered in the decision-making process.

Anti-Discrimination

- Taking measures to eliminate discrimination, bias, and prejudice in design practices, ensuring that designs do not perpetuate or reinforce social inequalities.

Equitable Access to Public Spaces

- Designing public spaces to be inclusive and welcoming to all individuals, fostering a sense of belonging and community.

Equitable Employment Practices

- Implementing fair and inclusive hiring practices within design teams, promoting diversity and equal opportunities for professional growth.

Gender Equality

- Ensuring that design projects consider the needs of all genders and do not perpetuate gender-based stereotypes or discrimination.

Social Infrastructure

- Designing spaces and systems that support social interactions, community building, and the overall well-being of residents, with a focus on equitable access for all.

Equitable Urban Development

- Planning and designing urban spaces to avoid gentrification and displacement, prioritizing the needs and interests of existing communities.

Justice-Oriented Design

- Advocating for designs that contribute to social justice, environmental justice, and overall community well-being.

What are the **regulatory frameworks** for sustainable design?



- Regulatory frameworks for sustainable design vary across countries and regions, and they encompass a range of laws, codes, standards, and policies aimed at promoting environmentally responsible and socially conscious design practices.
- In the US, LEED, which stands for Leadership in Energy and Environmental Design, is a widely recognized green building certification system developed by the U.S. Green Building Council (USGBC).
- LEED provides a regulatory framework for designing, constructing, operating, and certifying buildings and neighborhoods with a focus on sustainability and environmental performance.

What do we mean by climate change?

- Climate change refers to long-term changes in temperature, precipitation, wind patterns, and other aspects of the Earth's climate system.
- These changes can occur over extended periods, ranging from decades to millions of years.
- In the context of contemporary discussions, climate change commonly refers to the shifts in global climate patterns that have been observed since the mid-20th century, primarily attributed to human activities.



Watch the video

Climate Change 2022: Impacts, Adaptation & Vulnerability - Full video

- Link:

https://www.youtube.com/watch?v=SDRxfuEvqGg&ab_channel=IntergovernmentalPanelonClimateChange%28IPCC%29

(you may also click on the YouTube Logo)



What are the key features of climate change?

Global Warming

- An increase in Earth's average surface temperature, primarily attributed to the buildup of greenhouse gases in the atmosphere. The term "global warming" is often used interchangeably with climate change.

Greenhouse Gases

- Certain gases, such as carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and water vapor, trap heat in the Earth's atmosphere. Increased concentrations of these gases, primarily from human activities like burning fossil fuels and deforestation, contribute to global warming.

Human-Induced Climate Change

- The current phase of climate change is largely driven by human activities, including the burning of fossil fuels (coal, oil, and natural gas), deforestation, industrial processes, and other practices that release greenhouse gases into the atmosphere.

Extreme Weather Events

- Climate change is associated with an increased frequency and intensity of extreme weather events, such as heatwaves, droughts, floods, hurricanes, and wildfires.

Sea Level Rise

- The melting of glaciers and ice sheets, along with the thermal expansion of seawater as it warms, contributes to rising sea levels. This poses risks to coastal communities and ecosystems.

Ocean Acidification

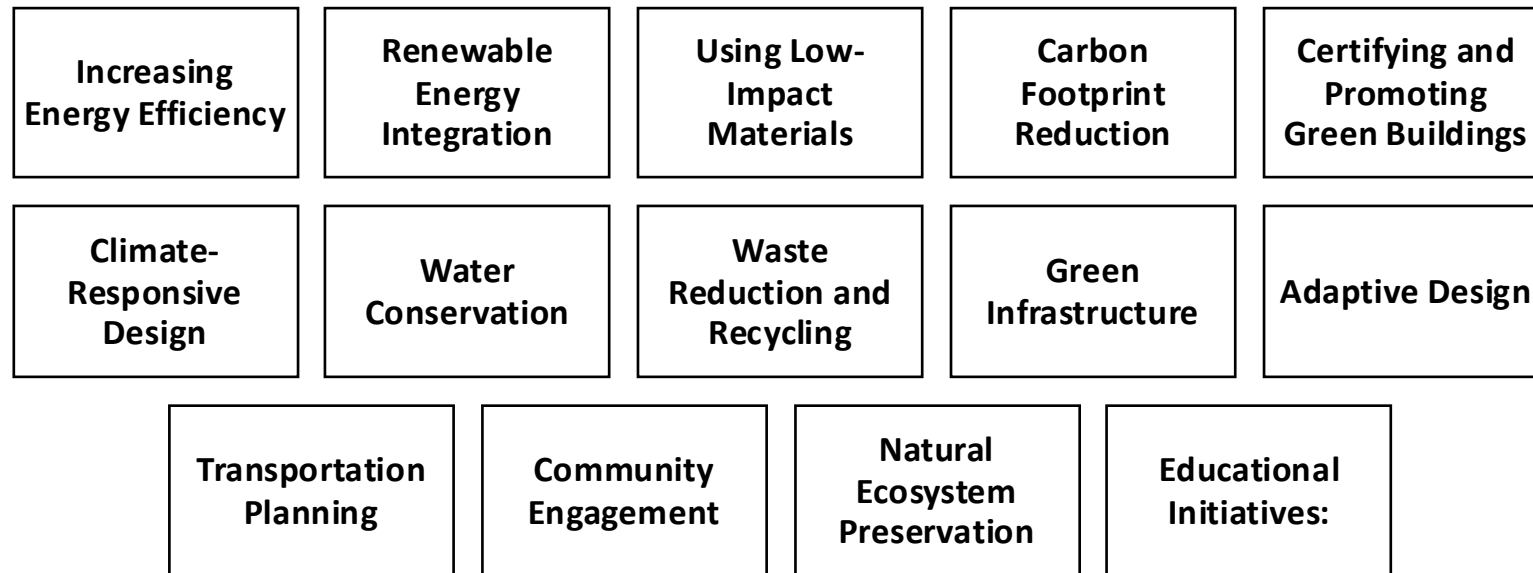
- Increased atmospheric CO₂ levels lead to higher absorption of carbon dioxide by the world's oceans, causing a decrease in pH levels. This phenomenon, known as ocean acidification, can have detrimental effects on marine life, particularly organisms with calcium carbonate shells or skeletons.

Impacts on Ecosystems

- Climate change affects ecosystems, leading to shifts in biodiversity, altered migration patterns, and disruptions in the timing of natural events like flowering and migration.

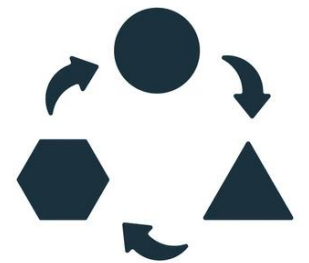
How can sustainable design mitigate climate change?

- Sustainable design plays a crucial role in mitigating climate change by reducing the environmental impact of human activities and promoting practices that contribute to a more resilient and sustainable future. Here are several ways in which sustainable design can help mitigate climate change:



What do we mean by **adaptive design**?

- Adaptive design refers to a design approach that anticipates and responds to changes in environmental conditions, user needs, and other variables over time.
- The goal of adaptive design is to create flexible, resilient, and responsive solutions that can adjust and evolve in the face of changing circumstances.
- This concept is applied across various disciplines, including architecture, urban planning, product design, and technology.



ADAPTABILITY

What are the key characteristics of adaptive design? *(slide 1 of 2)*

Flexibility

- Adaptive designs are inherently flexible and can accommodate changes without compromising their functionality or overall effectiveness. This flexibility allows for adjustments based on evolving requirements.

Resilience

- Adaptive designs are resilient to uncertainties and external pressures. They are designed to withstand and recover from shocks, disturbances, or unexpected events, ensuring continuity and functionality.

User-Centered

- Adaptive design often considers user needs and preferences, creating solutions that can be easily modified or personalized to better meet user requirements. This approach encourages user engagement and satisfaction.

Scalability

- Adaptive designs can scale up or down based on demand or changing circumstances. This scalability is particularly relevant in architecture and urban planning, where buildings and infrastructure may need to accommodate varying occupancy levels or usage patterns.

What are the key characteristics of adaptive design? *(slide 2 of 2)*

Scalability

- Adaptive designs can scale up or down based on demand or changing circumstances. This scalability is particularly relevant in architecture and urban planning, where buildings and infrastructure may need to accommodate varying occupancy levels or usage patterns.

Sustainability

- Adaptive design aligns with sustainable principles by minimizing waste, optimizing resource use, and supporting long-term environmental and economic viability. It often incorporates sustainable practices such as energy efficiency and the use of eco-friendly materials.

Future-Proofing

- Adaptive designs consider future trends and potential changes, allowing for the incorporation of technologies or features that may become relevant over time. This future-proofing ensures that designs remain relevant and effective in the long term.

Modularity

- In product and industrial design, adaptive designs often involve modular components that can be easily replaced or upgraded. This modularity supports maintenance, repair, and the integration of new technologies.

Iterative Process

- Adaptive design embraces an iterative process, where feedback from users or changing circumstances informs ongoing adjustments and refinements. This continuous improvement cycle ensures that the design remains effective and relevant.

Watch the video simpleshow explains the Carbon Footprint

- Link:

https://www.youtube.com/watch?v=8q7_aV8eLUE&ab_channel=simpleshow

(you may also click on the YouTube Logo)



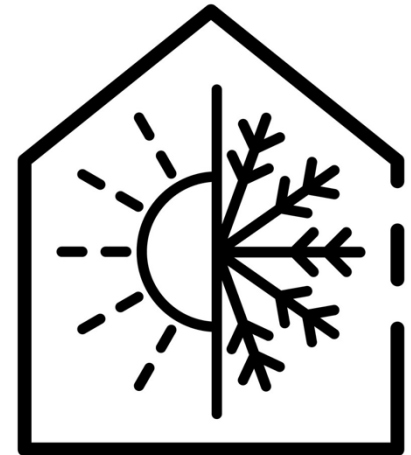
What do we mean by **carbon footprint**?



- The term "carbon footprint" refers to the total amount of greenhouse gases, expressed in terms of carbon dioxide equivalents (CO₂e), that are directly or indirectly associated with an individual, organization, event, product, or activity throughout its life cycle.
- Greenhouse gases, including carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and fluorinated gases, trap heat in the Earth's atmosphere, contributing to global warming and climate change.
- The carbon footprint is a measure of the environmental impact in terms of the release of these greenhouse gases into the atmosphere.
- It encompasses various stages of the life cycle, including production, transportation, use, and disposal.
- The calculation is typically standardized to express the total impact in terms of CO₂, which represents the equivalent warming effect of carbon dioxide.

What do we mean by **climate-responsive design**?

- Climate-responsive design, also known as climatic design or climate-sensitive design, refers to an approach in architecture and urban planning that takes into account the local climate conditions to create buildings and spaces that optimize comfort, energy efficiency, and environmental performance.
- The goal of climate-responsive design is to enhance the well-being of occupants while minimizing the reliance on mechanical systems for heating, cooling, and ventilation.



What are the key principles of climate-responsive design? *(slide 1 of 2)*

Passive Solar Design

- Leveraging the sun's position and movement to maximize natural light and heat. This includes orienting buildings to capture solar gain in winter and implementing shading devices to reduce heat gain in summer.

Natural Ventilation

- Designing buildings to facilitate natural airflow and cross-ventilation, reducing the need for mechanical ventilation systems. This involves strategic placement of windows, vents, and building openings.

Thermal Mass

- Incorporating materials with high thermal mass (e.g., concrete, stone) to absorb and store heat during the day and release it slowly at night, helping to regulate indoor temperatures.

Shading Strategies

- Employing shading devices such as overhangs, louvers, and vegetation to minimize solar heat gain and glare during hot periods while allowing for sunlight during colder times.

Cool Roofs and Reflective Surfaces

- Using reflective roofing materials to reduce the absorption of solar radiation, thus lowering indoor temperatures and decreasing the urban heat island effect.

Ventilated Roofs and Green Roofs

- Implementing roofs with ventilation pathways or incorporating green roofs with vegetation to provide insulation, reduce heat absorption, and enhance stormwater management.

What are the key principles of climate-responsive design? *(slide 1 of 2)*

Water Conservation

- Integrating water-efficient landscaping, rainwater harvesting, and greywater reuse to address water scarcity and promote sustainable water management.

Adaptive Design Strategies

- Designing spaces that can adapt to different climatic conditions or changing weather patterns. This may include flexible use of spaces, movable partitions, and responsive building elements.

Microclimatic Design

- Considering the creation of microclimates within and around buildings to optimize comfort. This involves manipulating factors such as wind, sunlight, and vegetation to enhance the overall thermal experience.

Energy-Efficient Building Envelope

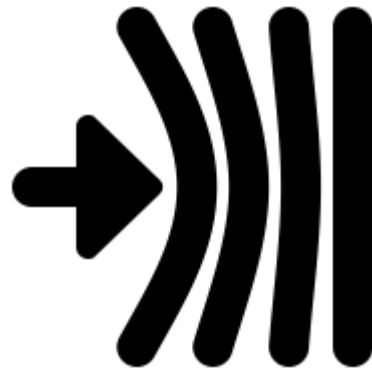
- Implementing energy-efficient materials and insulation in the building envelope to minimize heat transfer and improve thermal performance.

Harvesting Natural Resources

- Integrating technologies like solar panels or wind turbines to harness renewable energy sources and reduce dependence on non-renewable energy.

What do we mean by **resilient design**?

- Resilient design refers to an approach in architecture, urban planning, and various other disciplines that emphasizes the ability of a system, structure, or community to absorb shocks, adapt to changing conditions, and quickly recover from disturbances or disruptions.
- The goal of resilient design is to create environments that can withstand and bounce back from various stressors, including natural disasters, climate change impacts, social disruptions, and other unexpected challenges.



Watch the video Resilient Design

- Link:

https://www.youtube.com/watch?v=sIlKMZlZAdU&ab_channel=PAE

(you may also click on the YouTube Logo)



What are the key principles and characteristics of resilient design? *(slide 1 of 2)*

Adaptability	• Designing structures and systems that can adapt to changing conditions, such as rising sea levels, temperature fluctuations, or evolving user needs.
Redundancy	• Building in redundancy in critical systems to ensure that if one component fails, there are backup systems in place to maintain functionality.
Resource Efficiency	• Making efficient use of resources and materials to minimize waste and environmental impact, while also considering the long-term availability of resources.
Community Engagement	• Involving communities in the design and planning process to ensure that local knowledge and needs are considered, and fostering a sense of ownership and cooperation.
Diversity and Inclusivity	• Promoting diversity in design solutions and ensuring that resilience strategies address the needs of diverse populations, including vulnerable or marginalized communities.
Nature-Based Solutions	• Integrating natural elements, such as green infrastructure, wetlands, and vegetation, to enhance resilience and provide natural buffers against environmental hazards.
Flexible Land Use Planning	• Planning for land use in a way that allows for flexibility and easy adaptation to changing circumstances, including shifts in population density or land functions.

What are the key principles and characteristics of resilient design? *(slide 2 of 2)*

Infrastructure Resilience

- Designing critical infrastructure, such as transportation networks, utilities, and communication systems, to be resilient to extreme events and to recover quickly in the aftermath.

Risk Assessment

- Conducting comprehensive risk assessments to identify potential hazards and vulnerabilities, allowing for the implementation of targeted resilience measures.

Energy Independence

- Incorporating renewable energy sources and energy-efficient technologies to ensure a more resilient and self-sufficient energy supply.

Cross-Sector Collaboration

- Promoting collaboration across different sectors, including government, business, academia, and community organizations, to develop holistic and integrated resilience strategies.

Education and Training

- Providing education and training programs to raise awareness about resilience and empower communities to take proactive measures to enhance their own resilience.

Innovative Technologies

- Integrating cutting-edge technologies, such as smart sensors and data analytics, to enhance monitoring, early warning systems, and decision-making processes during crises

What is the role of technology in sustainable design?

- Technology plays a crucial role in advancing sustainable design by providing innovative solutions and tools that enhance environmental performance, energy efficiency, and overall sustainability.
- The integration of technology in sustainable design practices contributes to more efficient resource use, reduced environmental impact, and improved resilience.



What are some of the ways in which technology supports sustainable design?

Energy-Efficient
Building Systems

Renewable Energy
Integration

Energy Storage
Solutions

Smart Grids and
Microgrids

Green Building
Information
Modeling (BIM)

Environmental
Monitoring and
Sensors

Internet of Things
(IoT)

Waste Reduction
and Recycling
Technologies

Life Cycle
Assessment (LCA)
Tools

Green Materials
and Sustainable
Manufacturing

Water
Conservation
Technologies

Digital Twin
Technology

Augmented Reality
(AR) and Virtual
Reality (VR)

Artificial
Intelligence (AI) for
Energy
Optimization

What is **cradle to cradle** design?

- Cradle to Cradle (C2C) design is an innovative approach to product and industrial design that emphasizes the creation of products and systems with a positive impact on both human and environmental health throughout their entire life cycle.
- Cradle to Cradle design challenges the traditional linear "cradle to grave" model, where products are created, used, and eventually discarded as waste. Instead, it promotes a circular economy where materials are perpetually cycled and reused in closed-loop systems.
- The philosophy envisions a regenerative and restorative approach to design, where products contribute positively to the health of ecosystems and communities.

Watch the video

What is Cradle to Cradle? Measuring Sustainability Performance

- Link:

https://www.youtube.com/watch?v=82T_tsesn70&ab_channel=InterapePolymerGroup

(you may also click on the YouTube Logo)



What do we mean by **community engagement** in sustainable design?



- Community engagement in sustainable design involves actively involving and collaborating with the local community throughout the planning, design, and implementation phases of a project.
- The goal is to ensure that the design process incorporates the needs, values, and aspirations of the community, fostering a sense of ownership and creating spaces that genuinely serve the people who live, work, and interact within them.
- Community engagement is a key aspect of socially responsible and sustainable design practices.

What are the key elements of community engagement in sustainable design? *(slide 1 of 2)*

Inclusive Decision-Making

- Ensuring that diverse voices within the community are heard and represented in the decision-making process. This includes engaging with various stakeholders, such as residents, local businesses, community organizations, and marginalized groups.

Listening and Empathy

- Actively listening to the concerns, preferences, and ideas of community members. Empathy is essential to understanding the unique needs and challenges faced by different individuals and groups within the community.

Transparent Communication

- Providing clear and transparent communication about the design process, project goals, and potential impacts. This helps build trust and ensures that community members are well-informed and involved in key decisions.

Cultural Sensitivity

- Respecting and incorporating the cultural identity, heritage, and values of the community into the design. This includes acknowledging and preserving cultural assets and ensuring that design solutions are culturally sensitive.

Participatory Design Workshops

- Facilitating participatory design workshops and sessions where community members actively contribute ideas, share local knowledge, and collaborate with designers and planners. This empowers community members to play a role in shaping their environment.

What are the key elements of community engagement in sustainable design? *(slide 1 of 2)*

Education and Awareness

- Providing educational opportunities to inform the community about sustainable design principles and the environmental benefits of the project. This fosters a sense of shared responsibility for the project's success.

Capacity Building

- Building the capacity of the community to actively participate in decision-making processes. This may involve training programs, workshops, or other initiatives that enhance community members' understanding of design concepts and their role in the process.

Feedback Mechanisms

- Establishing mechanisms for ongoing feedback and communication throughout the project's lifecycle. This allows for adjustments and refinements based on community input, ensuring that the design remains responsive to evolving needs.

Social Equity and Justice

- Prioritizing social equity and justice by addressing disparities and promoting inclusivity in the design. Sustainable design should contribute to creating environments that enhance social well-being and reduce inequalities.

Long-Term Engagement

- Fostering long-term relationships with the community beyond the initial design and construction phases. Continuous engagement helps maintain a positive relationship, address evolving needs, and adapt the design to changing circumstances.

What is the role of **human behavior** in sustainable design?



- Human behavior plays a critical role in the success and effectiveness of sustainable design.
- The choices and actions of individuals, communities, and organizations significantly influence the environmental impact of the built environment.
- Understanding human behavior helps designers and planners create sustainable solutions that align with the needs, preferences, and habits of the people who interact with and inhabit designed spaces.

What are the current challenges of sustainable design?

Cost and Economic Considerations

- Initial cost barriers, perceived trade-offs, and economic priorities can hinder the widespread adoption of sustainable design.

Awareness and Education

- Limited awareness and understanding of sustainable design principles among stakeholders pose a challenge, necessitating enhanced education and outreach efforts.

Regulatory Complexity

- Divergent and evolving regulations, along with fragmented certification processes, create challenges for designers working across different regions.

Equity and Social Justice

- Ensuring that sustainable design practices prioritize social equity and justice remains a critical concern, addressing issues related to access, affordability, and equitable benefits distribution.

Technological Advancements and Innovation

- Staying abreast of rapidly evolving technologies, integrating them into sustainable practices, and fostering material innovation present ongoing challenges in the field of sustainable design.

What are the economic benefits of sustainable design

- Sustainable design offers a range of economic benefits that contribute to long-term financial savings, improved operational efficiency, and overall economic resilience. These benefits extend to various sectors, including construction, real estate, manufacturing, and beyond.



How can economic benefits of sustainable design be explained despite their higher initial costs?

Operational cost savings

Energy efficiency leading to lower energy consumption and reduced utility costs over time.

Water efficiency leading to lower water bills and operational costs.

Waste reduction leading to lower waste disposal costs.

Long-term savings through life cycle cost analysis:

Increased asset value

(The enhanced environmental performance and lower operating costs contribute to increased property value and market appeal).

Government incentives and rebates (Many governments and municipalities offer financial incentives, tax credits, or rebates for sustainable projects)

Improved marketability (businesses that embrace sustainable design may gain a competitive edge and attract environmentally conscious consumers)

Employee productivity and well-being (Sustainable design in workplaces, such as green building features and access to natural light, has been linked to improved employee productivity, health, and satisfaction)

Risk mitigation (Sustainable practices can help mitigate risks associated with resource scarcity, regulatory changes, and climate-related events).

Resource efficiency (Strategies like using recycled or reclaimed materials and implementing circular economy principles contribute to resource efficiency.

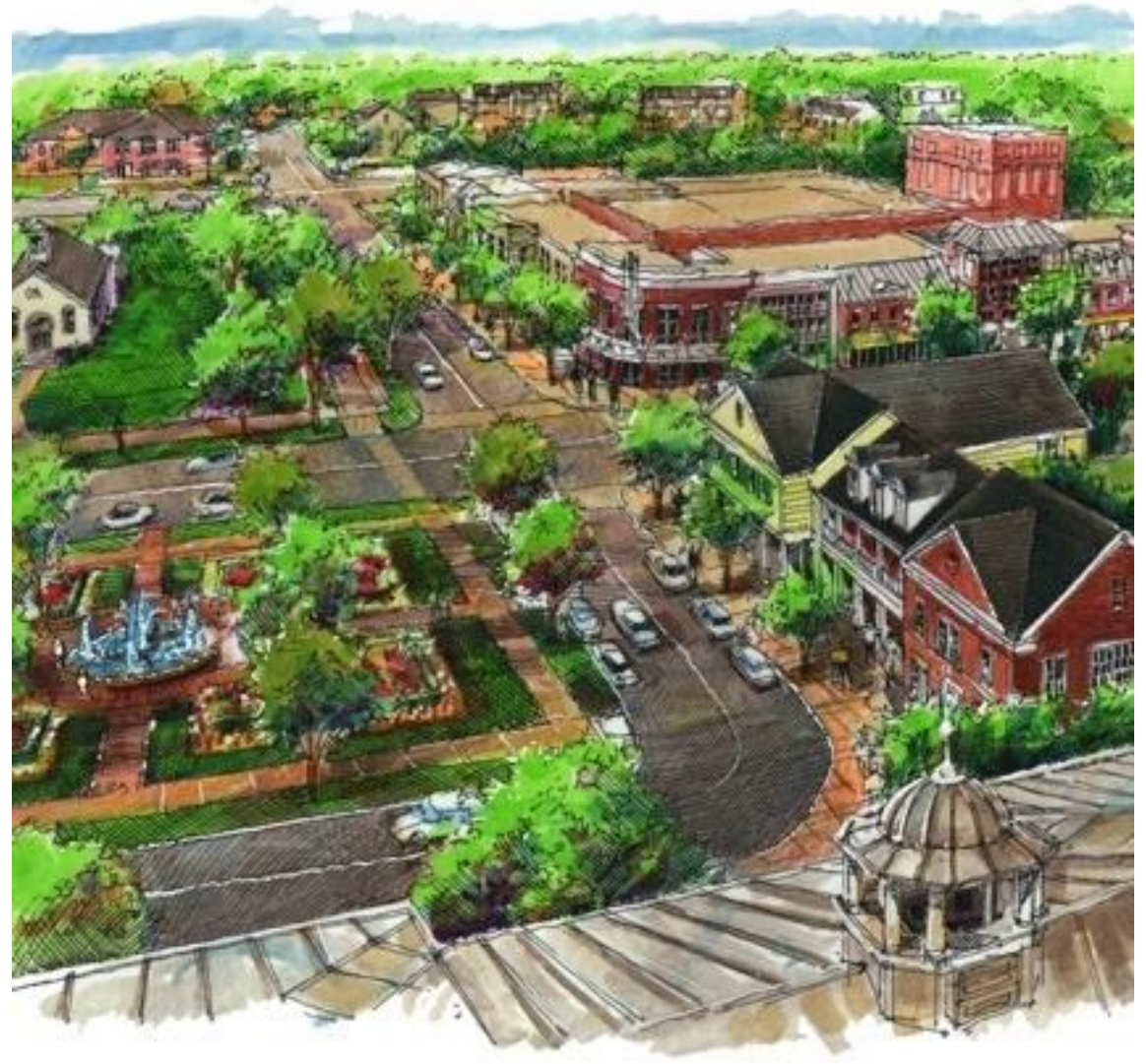
Adaptation to regulatory changes (By proactively meeting or exceeding regulatory requirements, businesses can avoid penalties and costly retrofits)

Reduced liability (lower insurance costs and reduced legal liabilities.

Innovation and competitiveness (enhances competitiveness and positions businesses for future economic opportunities)

What do we mean by smart growth?

- Urban planning and development that emphasizes sustainable land use, transportation, and community design to foster healthy, vibrant communities.



Watch the video

Smart Growth: Curbing Urban Sprawl

- Link:

https://www.youtube.com/watch?v=uinQ1wwRGHo&ab_channel=EnyaPan

(you may also click on the YouTube Logo)



What do we mean by **green washing**?

- Misleading marketing or communication that exaggerates or falsely claims the environmental benefits of a product or service.

