MODULE 2

SUSTAINABILITY CONCEPTS

INTRODUCTION TO SUSTAINABLE DEVELOPMENT GOALS

SUSTAINABLE DEVELOPMENT GOALS

Under the auspices of the United Nations, the 17 Sustainable Development Goals (SDGs) were endorsed by 193 countries in September 2015 as an over-arching policy framework through 2030. They include,

No poverty	Reduced inequalities
Zero hunger	Sustainable cities and communities
Good health and well being	Responsible consumption and production
Quality education	Climate action
Gender equality	Life below water
Clean water and sanitation	Life on land
Affordable and clean energy	Peace, justice and strong institutions
Decent work and economic growth	Partnership for the goals
Industry, innovation and infrastructure	

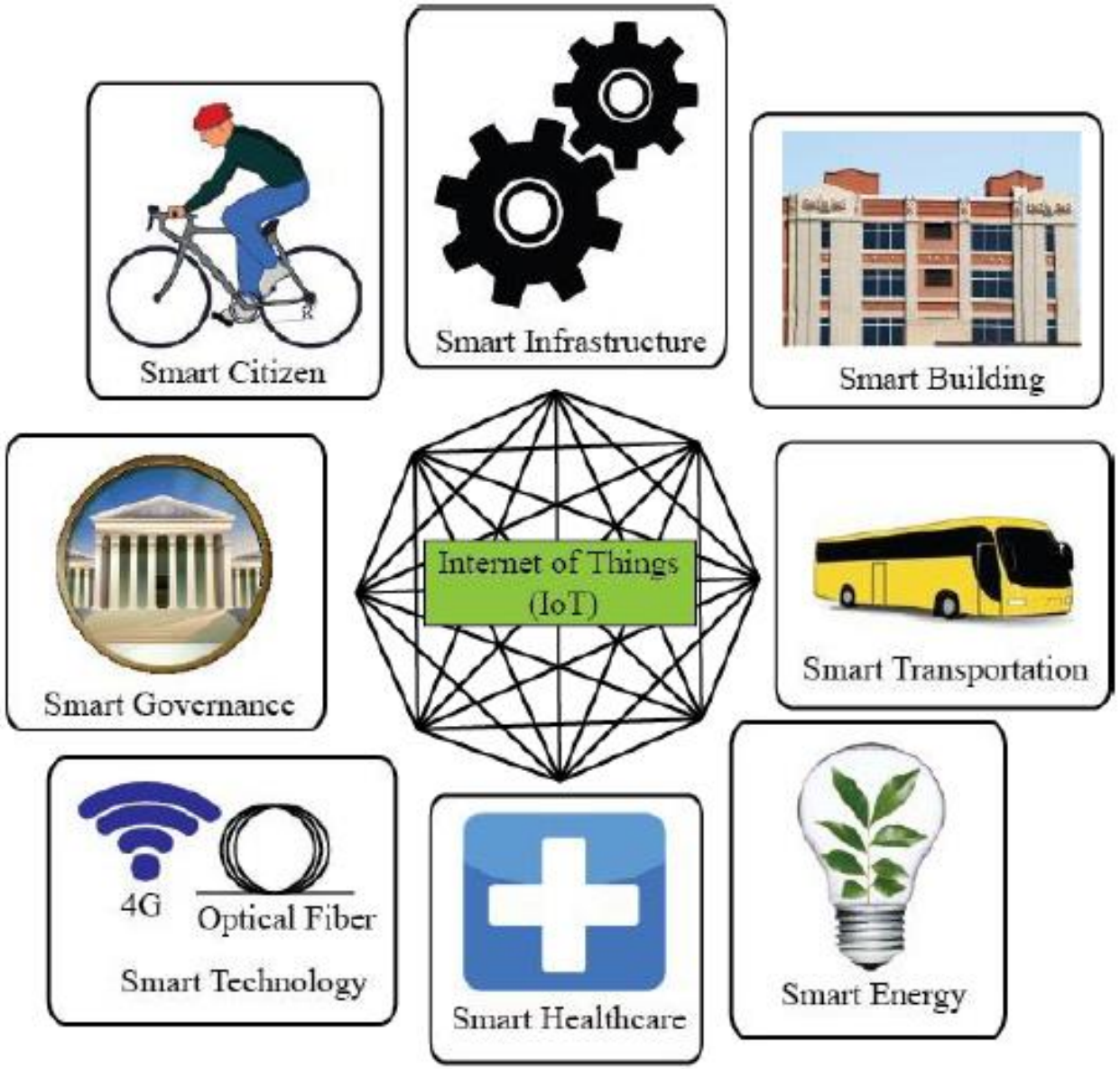

1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

SMART CITY CONCEPT

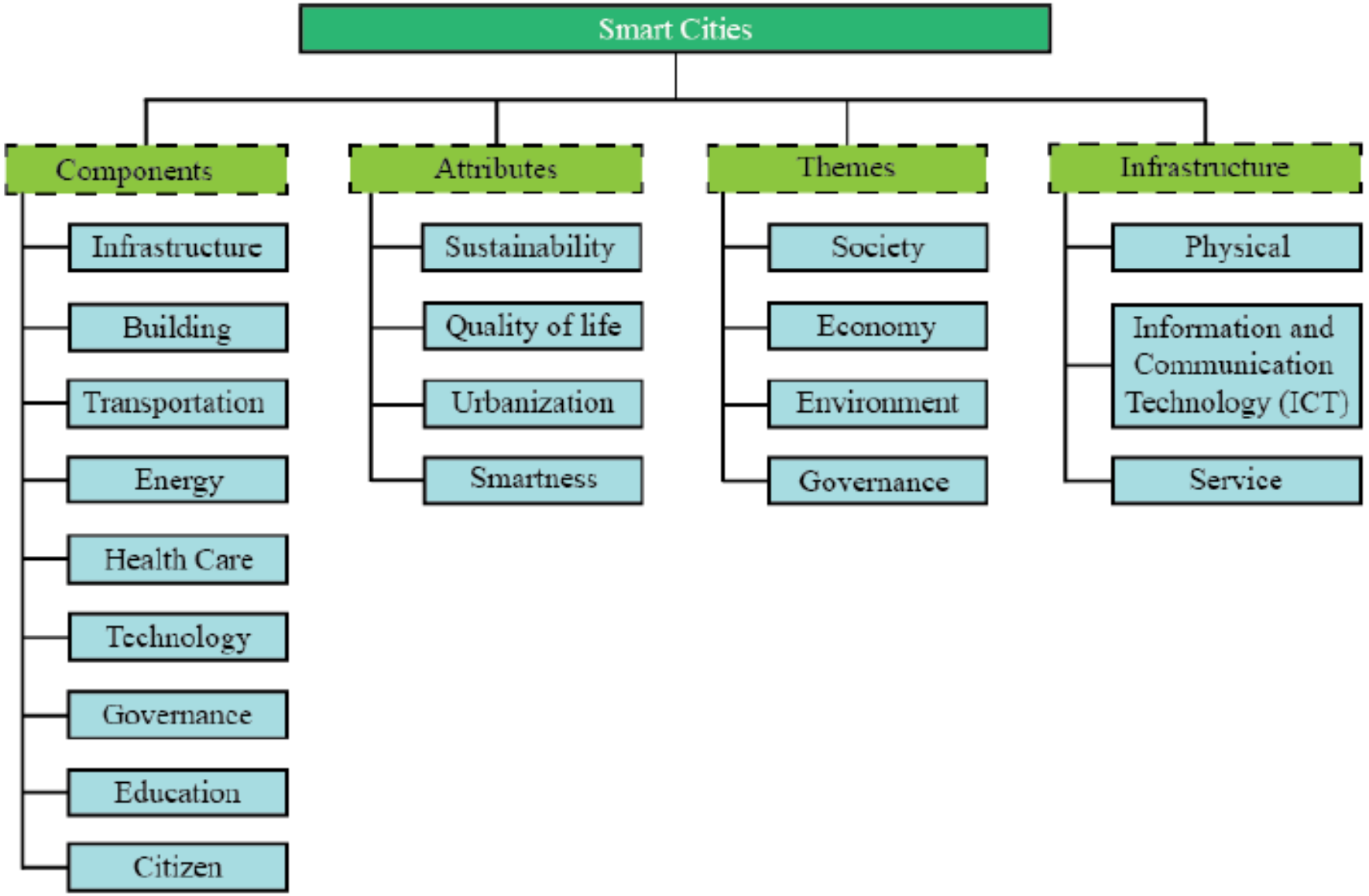
SMART CITY

- A smart city is a place where traditional networks and services are made more flexible, efficient, and sustainable with the use of information, digital and telecommunication technologies, to improve its operations for the benefit of its inhabitants.
- In other words, in a smart city, the digital technologies translate into better public services for inhabitants, and for better use of resources while impacting the environment less.
- A city “connecting the physical infrastructure, the information-technology infrastructure, the social infrastructure, and the business infrastructure to support the collective intelligence of the city”.

AN OVERVIEW OF SMART CITY COMPONENTS



COMPONENTS AND CHARACTERISTICS OF SMART CITY



SMART INFRASTRUCTURE

- It includes rapid transit system, waste management system, road network, railway network, communication system, traffic light system, street light system, office space, water supply system, gas supply system, power supply system, firefighting system, hospital system, bridges, apartment homes, hotels, digital library, law enforcement, economy system, etc.
- The backend of the smart infrastructure is the ICT infrastructure which make the physical infrastructure “smart”.
- The ICT infrastructure includes communication infrastructure such as fiber optics, Wi-Fi networks, wireless hotspots as well as service-oriented information systems.
- The smart infrastructure may have physical infrastructure, sensors, firmware, software, and middleware as its overall components.
- Smart infrastructure is more efficient, safe, secure, and fault-tolerant as compared to classic infrastructure.

SMART BUILDINGS

- Smart buildings can be considered as part of the smart infrastructure or they can be considered as independent components of smart cities. A smart building can have different hardware, software, sensors, and smart appliances, for different automated operations including data network, voice-over-IP (VoIP), video distribution, video surveillance, access control, power management, and lighting control.
- Smart buildings can easily connect to other buildings, people and technology, the global environment, and smart power grids.
- The use of the Internet of Things (IoT) provides integrated solutions that can process and analyse large amounts of data that will maximize the operational and energy efficiency of smart buildings.

SMART TRANSPORT SYSTEM

- Smart transportation also known as the Intelligent Transport Systems (ITS) includes various types of communication and navigation systems in vehicles, between vehicles (e.g. car-to-car), and between vehicles and fixed locations (e.g. car-to-infrastructure).
- ITS also covers the rail, water, and air transport systems, and even their interactions.
- The use of ICT and real-time data processing has made the smart transportation system possible.
- The smart transportation system maximizes the utilization of the vehicles used in the system.
- The smart transportation system allows passengers to easily select different transportation options for low-cost, shortest distance, or fastest routes.

SMART ENERGY

- The smart energy system consists of the intelligent integration of sustainable energy sources, efficient distribution, and optimized power consumption.
- Low-carbon generation, also known as a green energy, photo-voltaic, solar thermal, bio-gas, and wind energy can be an important part of a smart energy system.
- Efficient distribution in the smart energy system is made possible by the use of smart infrastructure, smart grid, smart meters as well as an appropriate level of utilization of the information and communication technology (ICT).

SMART HEALTHCARE

- Smart healthcare can be conceptualized as a combination of various entities including traditional healthcare, smart biosensors, wearable devices, information and communication technology (ICTs), and smart ambulance systems.
- The various components of smart healthcare include emerging on-body sensors, smart hospitals, and smart emergency response.
- In smart hospitals, various mechanisms including ICTs, cloud computing, smart phone apps, and advanced data analysis techniques, are used for their operation.

SMART TECHNOLOGY

- Smart technology is key for the design, implementation, and operation of smart cities.
- Smart technology includes Green and Renewable Energy Resource, Sustainable Transport System, Sustainable Resource Management, Communication Infrastructure, Global ICT Infrastructure, Social Network and Cyber Physical System and State-of-Art Technology

CHALLENGES AND OPPORTUNITIES OF SMART CITY DESIGN

- The challenges for building smart cities are quite diverse and complex.
- Few of the challenges are cost, efficiency, sustainability, communication, safety, and security
- These challenges are governed by various factors like natural environment, government policy, social communities, and economy.
- Cost is the most important factor of the smart city design.
- Operation efficiency of the smart cities is an important challenge: higher efficiency can reduce the operational cost and improve sustainability of the smart city.
- Cutting down carbon emissions and city waste to enhance sustainability and efficiency.
- Smart cities need to cope up with population growth while ensuring long-term sustainability with optimized operation cost.
- Smart cities need to be resilient to disasters and failures.

- Security of the information and infrastructure is an important design challenge.
- Above all, public safety is a critical design challenge for smart cities as the safety of the inhabitants is of paramount importance, which can also increase design and operation budgets.

CLEAN CITY CONCEPT

CLEAN CITY CONCEPT

- Environmental awareness and plantations
- Every educational institution must educate the society about the importance of the environment in today’s world.
- Everyone should be taught how to keep their environment clean and maintain proper hygiene.
- Deforestation is one of the major reasons of pollution today and therefore, more tree plantations should be encouraged

Sorting your garbage

- We think that the sorting different types of garbage are a tedious task.
- On the contrary, it actually is the most effective way of garbage discarding.
- All we essential to do is sort our dustbins into two categories, biodegradable and non-biodegradable and dump the waste accordingly.
- We can help others around to contrivance this too.
- By doing this we can reuse certain non-biodegradable waste or dispose of it safely to prevent soil pollution

Hygiene

- The spreading of diseases can be reduced if we maintain hygiene both indoors and outdoors it, in turn, helps in destroying the breeding spots for mosquitoes, rats, and many other pathogen carriers.
- Dirty hands are one of the main reasons for the spread of diseases and everyone should clean their hands properly especially before eating.

Reusing and Recycling

- Reusing and recycling are two huge leaps towards a clean environment.
- We need to find alternative uses for old and redundant objects.
- We also need to recycle objects which cannot be disposed of so that it does not affect the surroundings in any way

No to plastic

- Plastic is poisonous for our environment.
- Being non-biodegradable it does not break down in the soil and hence, needs to be disposed of properly.
- If ingested, it can kill animals and also poisons our food if not disposed of properly.
- Therefore, we need to cut down the usage of plastic bags and always dispose of them in dustbins.

Consume

- What you need Things we need and we want are different.
- The question is not how much can you pay for what you consume but how much is left over on this planet for an individual and how much can be consumed.
- Extreme exploitation of resources will lead to their depletion. Hence, we need to consider the planet’s future and make our decisions.

Water care

- Water is the most valuable resource on this planet and sustains all life on Earth. The per capita availability has been on the decline in India.
- The rise in the population and the depletion of potable water due to pollution are the biggest reasons for the decline.
- Rainwater harvesting is the best way of making water available in the surroundings as water is the driving force of life, agriculture and many industries.
- Another option to reduce water consumption and wastage are to recycle using appropriate water treatment.

Reduce carbon footprints

- Carbon Footprint is the total amount of greenhouse gasses released into the atmosphere as a result of the actions of an individual, organization or community.
- We need to use energy efficient products and limit the usage of air conditioners, water heaters, dishwashers or thermostats.
- We need to keep our carbon footprints in control to control the greenhouse effect

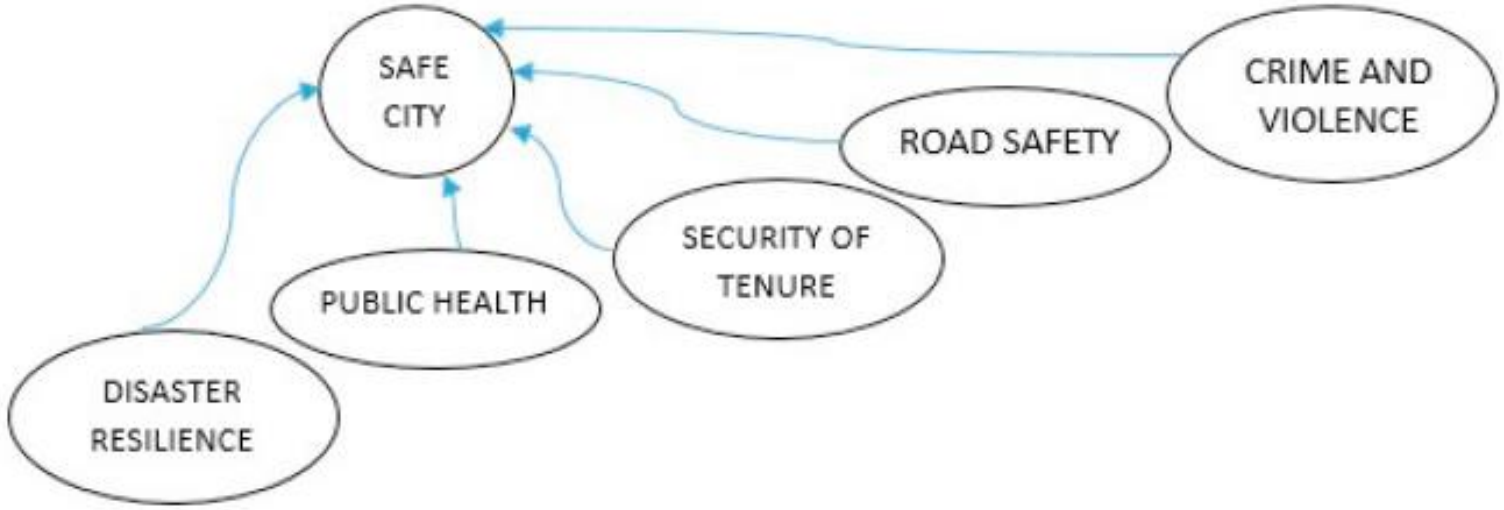
Air pollution

- Burning garbage might seem like an easy way to dispose garbage but we fail to realize that we release a lot of toxins into the air surrounding us.
- Some vehicles which have not been serviced regularly and properly also burns a lot of fuel and results in air pollution.
- Using public transport reduces the number of vehicles on the roads and hence, decreases air pollution.
- We need to implement this in our daily life and make it a part of our routine. Only by doing so we will be able to keep our country clean otherwise, we will be leading to an environmental dystopia.

SAFE CITY CONCEPT

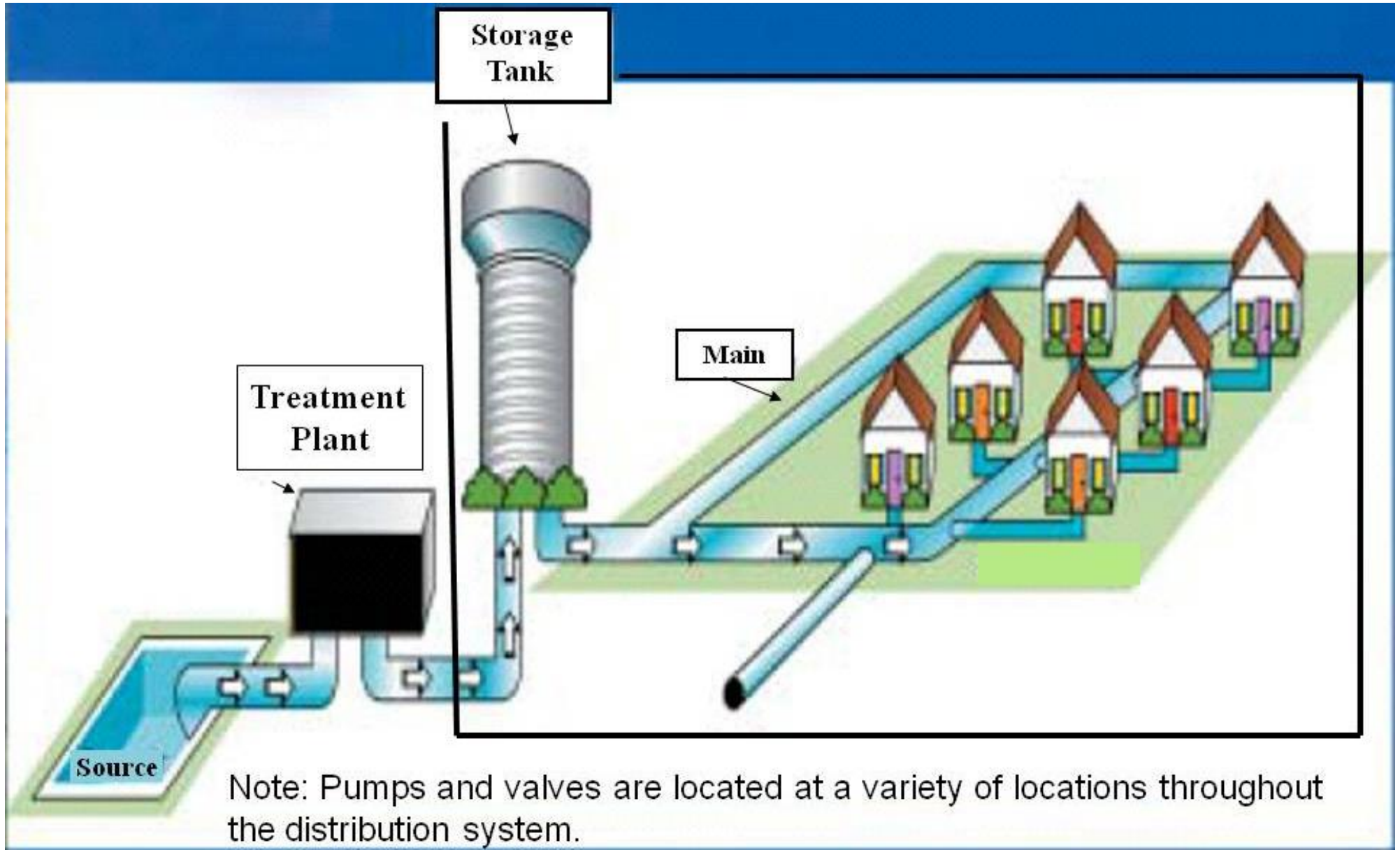
SAFE CITY

- Safe City is a city, the integration of technology and natural environment increases the effectiveness of processes in the field of safety, in order to reduce crime and terror threats, to allow its citizens life in a healthy environment and simple access to healthcare, and to achieve a readiness and quick response to threatening or arose emergencies
- The indicators planned to implement Safe City are divided into 5 main aspects, namely: (1) crime & violence, (2) road safety, (3) ownership security, (4) disaster resilience, (5) public health.



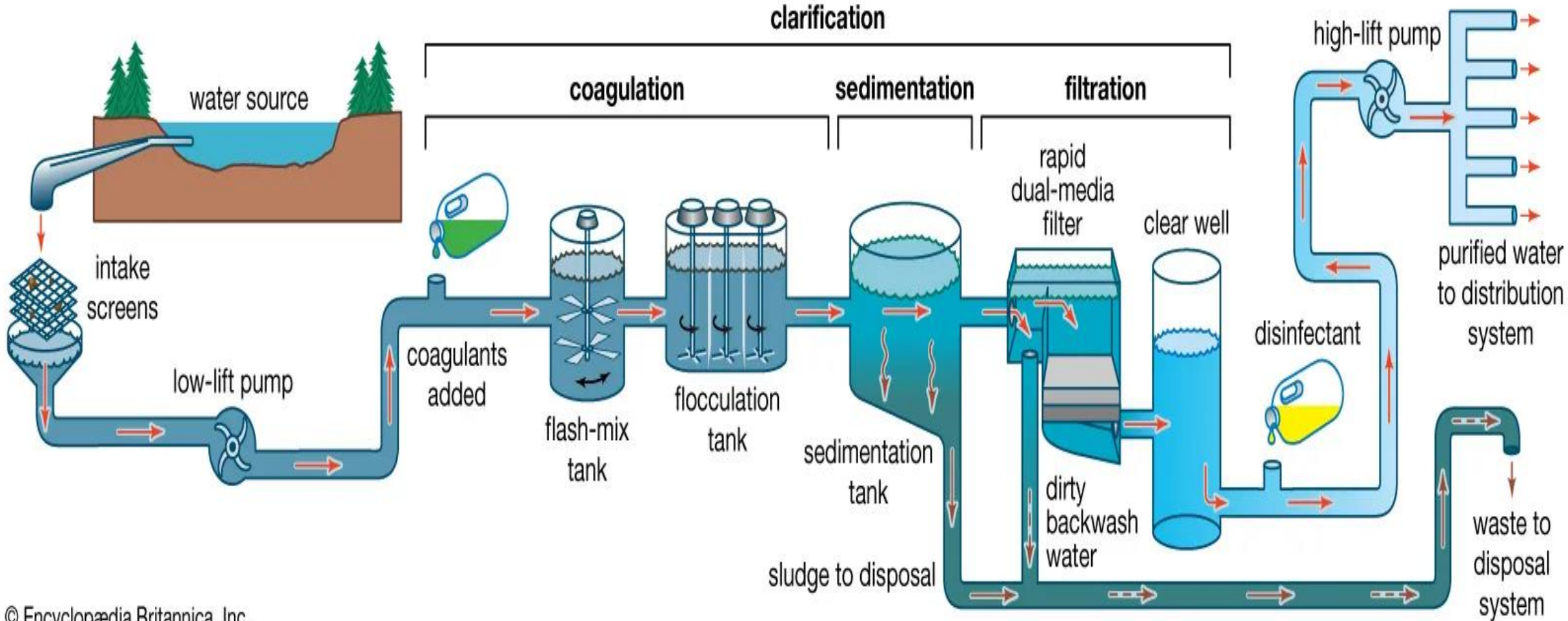
WATER SUPPLY AND SANITORY SYSTEMS

WATER SUPPLY SYSTEM



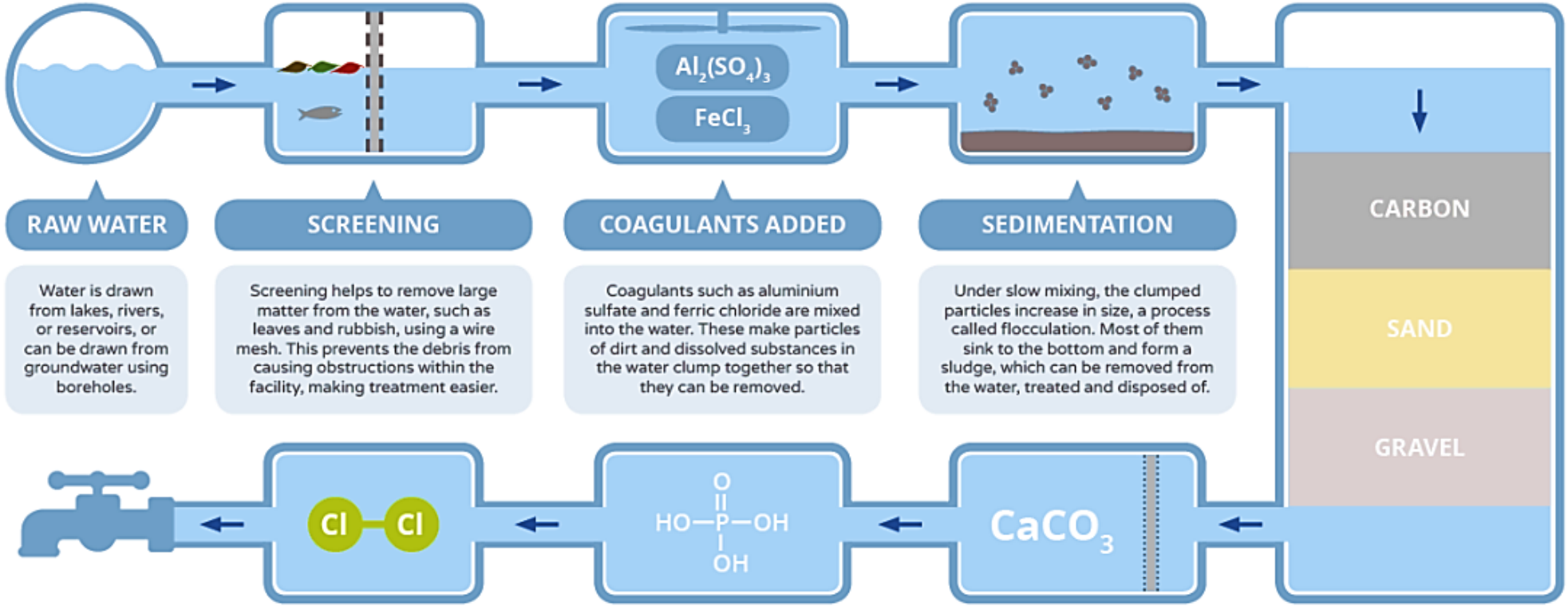
PROCESS

- Water is collected from various sources like rivers, lakes, reservoirs and also from underground sources through digging bore wells.
- The collected water is then treated in a water treatment plant.
- The treatment process involves screening, coagulation, sedimentation, filtration and disinfection.
- The treated water is then stored in large overhead tanks.
- From the tanks, water is then supplied to homes via main water supply pipe and distribution water supply pipe.
- Water meter is installed in every house to record the utilization of clean drinking water.
- We have to see to it that usage of pumps is limited in the water supply system and take the help of gravity for the entire process.



WATER TREATMENT – FROM RESERVOIR TO HOME

We take the water coming from our taps for granted – but what happens to it before it gets there? Here's how chemistry helps!



RAW WATER

Water is drawn from lakes, rivers, or reservoirs, or can be drawn from groundwater using boreholes.

SCREENING

Screening helps to remove large matter from the water, such as leaves and rubbish, using a wire mesh. This prevents the debris from causing obstructions within the facility, making treatment easier.

COAGULANTS ADDED

Coagulants such as aluminium sulfate and ferric chloride are mixed into the water. These make particles of dirt and dissolved substances in the water clump together so that they can be removed.

SEDIMENTATION

Under slow mixing, the clumped particles increase in size, a process called flocculation. Most of them sink to the bottom and form a sludge, which can be removed from the water, treated and disposed of.

FILTRATION

Some particles remain in the water after sedimentation; these are removed by filtration through coal, sand, and gravel beds. They are cleaned by pumping air and water backwards through them.

pH CORRECTION

Water that is too acidic can lead to water pipe corrosion. It can be passed through a filter containing crushed limestone (mainly calcium carbonate) to raise pH. Acids can be added if the pH is too high.

ANTI-CORROSION AGENTS

Agents such as orthophosphates can be added to the water, particularly in areas with lead pipes. These agents form lead-phosphate complexes on the inside of the pipes, stopping lead getting into the water.

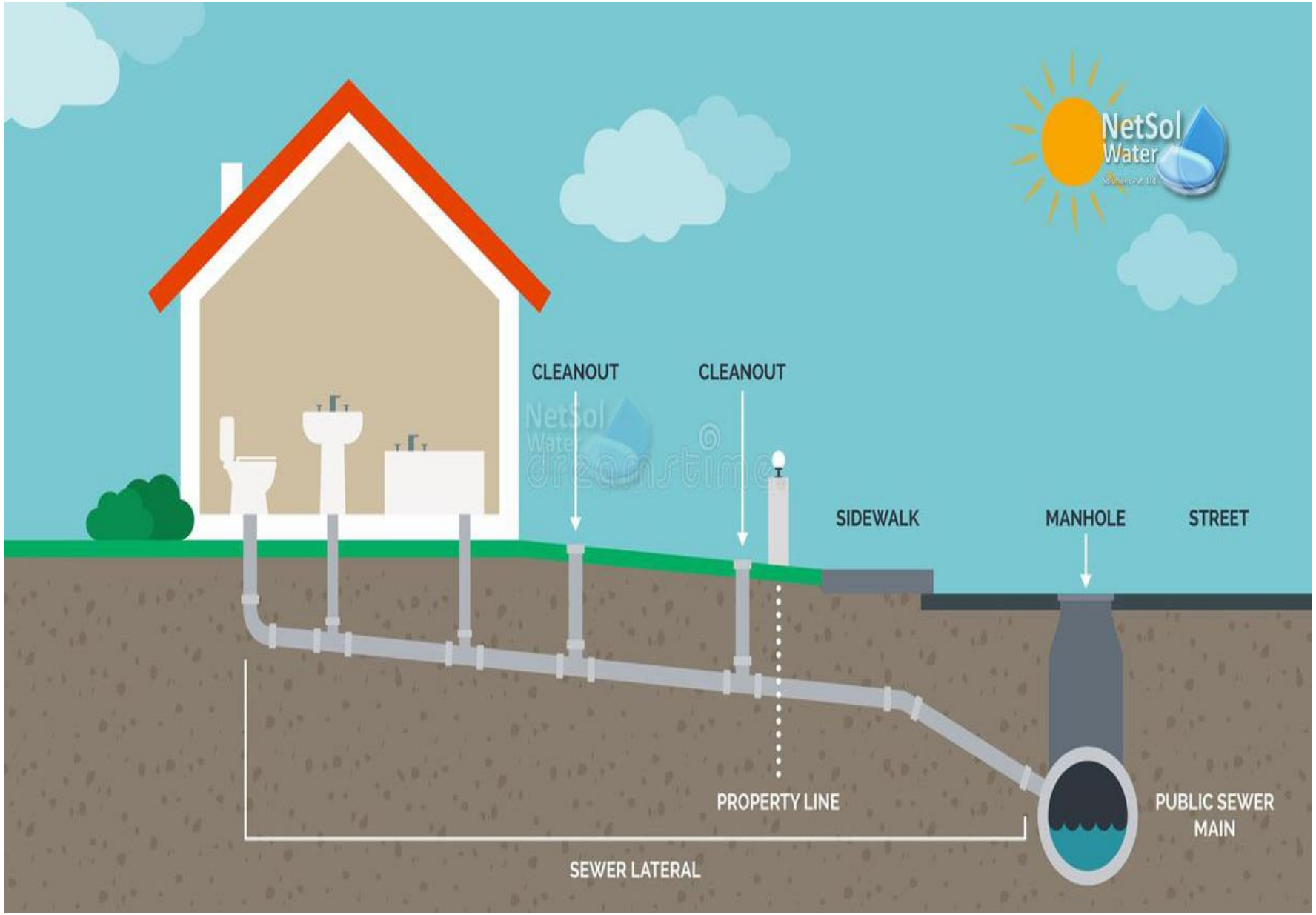
CHLORINATION

Chlorine is added to water to kill bacteria and viruses, preventing water-borne diseases like cholera and typhoid. Ozone can be used instead of chlorine, and avoids disinfection byproducts.

TO HOMES

Residual chlorine in the water safeguards against pathogens. Fluoride can be added after chlorination to help to prevent tooth decay.

SANITORY SYSTEM



- Sewage System or more commonly known as Sewerage is the infrastructure that uses sewers to transport sewage or surface runoff (storm water, meltwater, rainwater).
- It is a network of pipes, chambers, manholes, and other structures used to transport sewage or storm water.
- Receiving drains, manholes, pumping stations, storm overflows, and screening chambers are all included in the combined sewer or sanitary sewer.
- When sewage enters a sewage treatment plant or is discharged into the environment, it is considered to be terminated.
- There are three types of a sewage system,
  - Sanitary sewers
  - Storm sewers
  - Combined sewers

URBAN AIR POLLUTION MANAGEMENT

AIR POLLUTION

- Air pollution is a mix of hazardous substances from both human-made and natural sources.
- Vehicle emissions, fuel oils and natural gas to heat homes, by-products of manufacturing and power generation, particularly coal-fueled power plants, and fumes from chemical production are the primary sources of human-made air pollution.
- Nature releases hazardous substances into the air, such as smoke from wildfires, which are often caused by people; ash and gases from volcanic eruptions; and gases, like methane, which are emitted from decomposing organic matter in soils.

- Reduce the need for car travel
  - Reducing the vehicular emission by promoting use of alternative modes of transport and managing the travel demands
  - Improving the urban amenities and community accessibility to local activities via walking and cycling pathway facilities.
  - Improving the public transport facility by increasing the coverage and quality of service
- Reduce emissions from the vehicles in use
  - Promoting the use of cleaner fuels
  - Improving the vehicle maintenance
  - Preventing over loading the vehicles
- Improving the industry performance
  - Use of better technologies to help them reduce emissions
  - Switching over to cleaner production and best manufacturing/process or practices

- Research and Development for Air Quality Management
  - Finding projects to develop standards of amenity, conservation, energy, health and safety
  - Funding for research on development of air quality indicators for different urban areas
- Improve air quality through planning
  - Encourage and reward industries to use opportunities to reduce emissions.
  - Launch awareness programmes

SOLID WASTE MANAGEMENT

SOLID WASTE

- Solid Waste is defined as “Non-liquid, non-soluble materials ranging from municipal garbage to industrial wastes that contain complex and sometimes hazardous substances”.
- Solid waste includes garbage, rubbish, demolition products, sewage treatment residue, dead animals, manure and other discarded materials.

- Steps included in SWM are,
  - Storage
  - Collection
  - Transport and Handling
  - Recycling
  - Disposal and Monitoring of waste materials

SOLID WASTE MANAGEMENT

COLLECTION

TRANSPORTATION

RECOVERY

PROCESSING

DISPOSAL

ANAEROBIC DIGESTER

COMPOST

INCINERATION

SANITARY LANDFILL

- Waste Management Concept – 3 R’s
- The 3 R’s to be followed for waste management are Reduce, Recycle and Reuse.
- Reduce
  - Reduce disposable goods such as paper plate, paper bowl, Styrofoam cups, plastic spoon
  - Use durable goods such as ceramic/metal plates, spoons, cloth napkins etc.
- Reuse
  - Instead of buying new containers form the market, use the ones that are already at home.
  - Don’t throw away the soft drink can or bottle, use them as an alternate for pencil stand or flower vases.
- Recycle
  - Stop before throwing any waste in the bin and think if the waste can be recycled
  - Try to recycle the waste as much as possible.

CATEGORY OF WASTE

- ✓**Organic waste:**
  - Kitchen waste, waste from food preparation, vegetables, flowers, leaves, fruits, and market places.
- ✓**Combustibles:**
  - Paper, wood, dried leaves, packaging for relief items etc. that are highly organic and having low moisture content.
- ✓**Non-combustibles:**
  - Metal, Tins, Cans, bottles, stones, etc.
- ✓**Toxic waste:**
  - Old medicines, paints, chemicals, bulbs, spray cans, fertilizer and pesticide containers, batteries, shoe polish.
- ✓**Recyclables:**
  - Paper, glass, metals, plastics.
- ✓**Ashes or Dust:**
  - Residue from fires that are used for cooking.

CATEGORY OF WASTE

- ✓**Construction waste:**
  - Rubble, roofing, broken concrete etc.
- ✓**Hazardous waste:**
  - Oil, battery acid, medical waste, industrial waste, hospital waste.
- ✓**Dead animals:**
  - Carcasses of dead livestock or other animals.
- ✓**Bulky waste:**
  - Tree branches, tires etc.
- ✓**Soiled waste:**
  - Hospital waste such as cloth soiled with blood and other body fluids.

SOURCES OF SOLID WASTE

- **Residential**
  - Residences and homes where people live are some of the major sources of solid waste.
  - The garbage from these places includes food wastes, plastics, paper, glass, leather, cardboard, metals, yard wastes, ashes and special wastes like bulky household items such as electronics, tires, batteries, old mattresses and used oil.
  - Most homes have garbage bins where they can throw away their solid wastes in and later, the bin is emptied by a garbage collecting firm or person for treatment.

- **Industrial**
  - Industries are known to be one of the biggest contributors to solid waste.
  - They include light and heavy manufacturing industries, construction sites, fabrication plants, canning plants, power and chemical plants.
  - These industries produce solid waste in the form of housekeeping wastes, food wastes, packaging wastes, ashes, construction and demolition materials, special wastes, medical wastes as well as other hazardous wastes.

- **Commercial**
  - Commercial facilities and buildings are yet another source of solid waste today.
  - Commercial buildings and facilities, in this case, refer to hotels, markets, restaurants, godowns, stores and office buildings.
  - Some of the solid wastes generated from these places include plastics, food wastes, metals, paper, glass, wood, cardboard materials, special wastes and other hazardous wastes.

- **Institutional**
  - The institutional centers like schools, colleges, prisons, military barracks and other government centers also produce solid waste.
  - Some of the common solid wastes obtained from these places include glass, rubber waste, plastics, food wastes, wood, paper, metals, cardboard materials, electronics as well as various hazardous wastes.

- **Treatment Plants and Sites**
  - Heavy and light manufacturing plants also produce solid waste.
  - They include refineries, power plants, processing plants, mineral extraction plants and chemical plants.
  - Among the wastes produced by these plants, there are industrial process wastes, unwanted specification products, plastics, metal parts, just to mention a few.

- **Construction and Demolition Areas**
  - Construction and demolition sites also contribute to the solid waste problem.
  - Construction sites include new construction sites for buildings and roads, road repair sites, building renovation sites and building demolition sites.
  - Some of the solid wastes produced in these places include steel materials, concrete, wood, plastics, rubber, copper wires, dirt and glass.

- **Municipal Services**
  - The urban centers also contribute immensely to the solid waste crisis in most countries today.
  - Some of the solid waste brought about by the municipal services include street cleaning, wastes from parks and beaches, wastewater treatment plants, landscaping wastes and wastes from recreational areas, including sludge.

- **Agriculture**
  - Crop farms, orchards, dairies, vineyards and feedlots are also sources of solid wastes.
  - Among the wastes they produce are agricultural wastes, spoiled food, pesticide containers and other hazardous materials.

- **Biomedical**
  - This refers to hospitals and biomedical equipment and chemical manufacturing firms. In hospitals, there are different types of solid wastes produced.
  - Some of these solid wastes include syringes, bandages, used gloves, drugs, paper, plastics, food wastes and chemicals.
  - All these require proper disposal or else they will cause a huge problem for the environment and the people in these facilities.

EFFECTS OF POOR SOLID WASTE MANAGEMENT

- **Litter Surroundings**
  - Due to improper waste disposal systems, particularly by municipal waste management teams, wastes heap up and become a menace.
  - While people clean their homes and places of work, they litter their surroundings, which affect the environment and the community.

- **Impact on Human Health**
  - Improper waste disposal can affect the health of the population living nearby the polluted area or landfills.
  - The health of waste disposal workers and other employees involved with these landfill facilities are also at a greater risk.
  - Exposure to wastes that handled improperly can cause skin irritations, respiratory problems, blood infections, growth problems, and even reproductive issues.

- **Disease-causing Pests**
  - This type of dumping of waste materials forces biodegradable materials to rot and decompose under improper, unhygienic and uncontrolled conditions.
  - After a few days of decomposition, a foul smell is produced, and it becomes a breeding ground for different types of disease-causing insects as well as infectious organisms. On top of that, it also spoils the aesthetic value of the area.

- **Environmental Problems**
  - Solid wastes from industries are a source of toxic metals, hazardous wastes, and chemicals. When released to the environment, the solid wastes can cause biological and physicochemical problems to the environment that may affect or alter the productivity of the soils in that particular area.

- **Soil and Groundwater Pollution**
  - Toxic materials and chemicals may seep into the soil and pollute the groundwater. During the process of collecting solid waste, hazardous wastes usually mix with ordinary garbage and other flammable wastes making the disposal process even harder and risky.

- **Emission of Toxic Gases**
  - When hazardous wastes like pesticides, batteries containing lead, mercury or zinc, cleaning solvents, radioactive materials, e-waste and plastics mixed up with paper and other non-toxic scraps are burned they produce dioxins, furans, polychlorinated biphenyls, and other gases.
  - These toxic gases have the potential of causing various diseases, including cancer.

- **Impact on Land and Aquatic Animals**
  - Our carelessness with our waste and garbage also affects animals, and they suffer the effects of pollution caused by improperly disposed of wastes and rubbish.
  - Consuming styrofoam and cigarette butts have been known to cause deaths in marine animals.
  - Animals are also at risk of poisoning while consuming grasses near contaminated areas or landfills as the toxins seep into the soil.

METHODS OF SOLID WASTE MANAGEMENT

- **Sanitary Landfill**
  - This is the most popular solid waste disposal method used today.
  - Garbage is basically spread out in thin layers, compressed and covered with soil or plastic foam.
  - Modern landfills are designed in such a way that the bottom of the landfill is covered with an impervious liner, which is usually made of several layers of thick plastic and sand.
  - This liner protects the groundwater from being contaminated because of leaching or percolation.
  - When the landfill is full, it is covered with layers of sand, clay, topsoil and gravel to prevent seepage of water.

- **Advantage:**
  - If landfills are managed efficiently, it is an ensured sanitary waste disposal method.

- **Constraint:**
  - It requires a reasonably large area.

- **Incineration**
  - This method involves the burning of solid wastes at high temperatures until the wastes are turned into ashes.
  - Incinerators are made in such a way that they do not give off extreme amounts of heat when burning solid wastes.
  - Incinerators that recycle heat energy through furnace and boiler are called waste-to-energy plants.
  - These waste-to-energy systems are more expensive to set up and operate compared to plain incinerators because they require special equipment and controls, highly skilled technical personnel, and auxiliary fuel systems.
  - This method of solid waste management can be done by individuals, municipalities and even institutions.
  - The good thing about this method is the fact that it reduces the volume of waste up to 20 or 30% of the original volume.

- **Advantage:**
  - The volume of combustible waste is reduced considerably by burning waste. In the case of off-site pits, it is an appropriate method to minimize scavenging.

- **Constraint:**
  - It can cause smoke or fire hazard and also emits gaseous pollutants.

- **Recovery and Recycling**
  - Recycling or recovery of resources is the process of taking useful but discarded items for the next use. Plastic bags, tins, glass and containers are often recycled automatically since, in many situations, they are likely to be scarce commodities.
  - Traditionally, these items are processed and cleaned before they are recycled.
  - The process aims at reducing energy loss, consumption of new material and reduction of landfills.
  - The most developed countries follow a strong tradition of recycling to lower volumes of waste.

- **Advantage:**
  - Recycling is environmentally friendly.

- **Constraint:**
  - It is expensive to set up, and in most emergencies, there is limited potential.

- **Composting**
  - Due to a lack of adequate space for landfills, biodegradable yard waste is allowed to decompose in a medium designed for the purpose.
  - Only biodegradable waste materials are used in composting.
  - It is a biological process in which micro-organisms, specifically fungi and bacteria, convert degradable organic waste into substances like humus.
  - This finished product, which looks like soil, is high in carbon and nitrogen. Good quality environmentally friendly manure is formed from the compost that is an excellent medium for growing plants and can be used for agricultural purposes.

- **Advantage:**
  - Composting is environmentally friendly as well as beneficial for crops.

- **Constraint:**
  - It requires intensive management and experienced personnel for large scale operation.

- **Pyrolysis**
  - This is a method of solid waste management whereby solid wastes are chemically decomposed by heat without the presence of oxygen.
  - It usually occurs under pressure and at temperatures of up to 430 degrees Celsius.
  - The solid wastes are changed into gasses, solid residue of carbon and ash and small quantities of liquid.

- **Advantage:**
  - This will keep the environment clean and reduce health and settlement problems.

- **Constraint:**
  - The systems that destroy chlorinated organic molecules by heat may create incomplete combustion products, including dioxins and furans.
  - These compounds are highly toxic in the parts per trillion ranges.
  - The residue it generates may be hazardous wastes, requiring proper treatment, storage, and disposal.

IDENTIFICATION OF LANDFILL SITES

CRITERIA FOR SELECTION OF LANDFILL

➢ Geology

- A landfill should be located in areas with a low risk of groundwater contamination

➢ Land use

- In the site selection process; forests, vineyards and gardens, as well as agricultural areas should not be included. On the other hand, stony and rocky areas are considering as one of the most suitable areas for the solid waste landfill site.

➢ Distance from surface waters

- While selecting a landfill site, it should be noted that the distance of the site from the surface water is as far away as possible in order to avoid the contamination

➢ Erosion

- Areas having no risk of soil erosion must be considered as a landfill site, while areas having high and severe risk are considered as restricted.

➢ Distance from fault zones

- Areas closer to the fault zones are considered as higher risk areas as it can contaminate the groundwater.

➢ Distance from cities

- Solid waste landfill sites should not be located close to the people, since they might cause different types of pollution. For this reason, landfill constructions should be implemented far away from the cities.

➢ Distance from highways

- The distance from the highways is significant in the sense of transport costs. The transport costs of the solid wastes are increasing, while moving away from the highways. However, being located on nearby the highways might cause odour and the other related pollutions. For this reason, the moderate distances from the highways should be considered.

➢ Slope

- Slope is the basic criterion for landfill site selection. High slope areas are not suitable for landfill site due to construction cost and probable mass movement hazards. For this reason, areas having lower slope degrees should be considered.

URBAN FLOOD CONTROL

URBAN FLOOD

- Urban flooding describes the flooding of land or property within a constructed environment, especially in locations that are more densely inhabited like cities, as a result of excessive rainfall that exceeds the capacity of drainage systems.
- Urban flooding is significantly different from rural flooding as urbanization leads to developed catchments, which increases the flood peaks from 1.8 to 8 times and flood volumes by up to 6 times.
- Consequently, urban flooding occurs very quickly due to faster flow times which is in a matter of minutes.
- Urban areas are densely populated and people living in vulnerable areas suffer due to flooding, sometimes resulting in loss of life.
- It is not only the event of flooding but the secondary effect of exposure to infection also has its toll in terms of human suffering, loss of livelihood, and, in extreme cases, loss of life.

CAUSES OF URBAN FLOOD

- Higher rainfall
- Storm surges and frequent depressions in open waters
- Depleting groundwater tables
- Heavy melting of snow causes flash floods in lower catchment areas
- Rising sea levels due to global warming
- Encroachments on drainage areas like lakes, wetlands, and riverbeds close off ways for the excess water to flow thus causing floods
- Climate change has disrupted the rainfall pattern
- Urban heat lands have increased rainfall over urban areas resulting in flooding
- Pollution of water bodies is choking up the pathways for excess water to flow
- Illegal mining activities in rivers deplete the natural bed causing soil erosion and reducing the water retention capacity of the water body
- Unplanned and uninformed release of water from dams causes devastation as the public does not get enough time to respond
- The importance of Flood governance is also not taken seriously by the administrators

CONTROLLING METHODS

- Build away from floodplains and flood-prone areas- this is the best way to ensure less loss of life and property.
- The development of blue-green infrastructure will be effective in providing sustainable solutions to urban climate challenges.
- Better water management should be ensured, like including rainwater harvesting in all infrastructure developments.
- Geospatial technology should be utilized for flood vulnerability mapping which will aid in better planning for development.
- The natural water bodies should be strictly desilted and maintained to ensure the free flow of excess water.
- Water bodies should be made clear of pollution and encroachment and drainage systems should be regularly maintained.
- More awareness and education of residents are needed to make them known of the risks and responsibilities of dwelling in flood-prone areas.

ENERGY EFFICIENT BUILDINGS

- The value of reducing energy consumption in buildings has increased worldwide.
- This is because the consumption of fossil fuels for the full-fledged operations of a building is as high as it is in other industries.
- Therefore, the adoption of energy efficiency techniques during the construction and operation of buildings would play a crucial role in the creation of sustainable cities in the future.
- Energy efficiency is the use of less energy in a building to perform the same operation as buildings that consume energy inefficiently.
- It should be considered during the design stage, selection of construction materials, construction process, and operation of the building.
- Adopting passive solar house design strategies at the design stage is the first step toward an energy-efficient structure.
- Low-energy building materials and less energy-consuming construction equipment must be used during the construction process.
- As far as building operation is concerned, utilities for renewable energy systems have to be integrated into the building for water heating, photovoltaic electrification, etc.

STEPS TO BE FOLLOWED TO CREATE ENERGY EFFICIENT BUILDING

- **Nearly Zero-Energy Passive Building Design**
  - The design of a nearly zero-energy passive building involves adopting all solar passive strategies at the design stage before actual construction begins like passive solar heating/cooling, building daylighting, and provision for rainwater harvesting.
  - The design of passive building requires knowledge of solar geometry, local climate and window technology.

- **Utilization of Low Embodied Energy Building Materials**
  - The usage of low embodied energy materials for building construction reduces the impact of global warming and makes the building energy-efficient.
  - Examples of low embodied energy construction materials are fly ash bricks, fiber-reinforced bricks, woods, stabilized adobe blocks, cement-replacement materials such as silica fume, slag, and fly ash which is mostly by-products in factories.

- **Usage of Energy-Efficient Equipment**
  - This involves using energy-efficient equipment in a building that requires the lowest possible energy, such as LED lights, fans, air-conditioners, and refrigerators.
  - Energy star-approved fluorescent bulbs are highly desirable because they are more durable, and their maintenance cost is 75% less than conventional bulbs.
  - Using a lighting control mechanism improves energy efficiency because it automatically turns off lights and eliminates waste of energy.
  - Use of thermoset regulates heating water and room temperature.

- **Integration of Renewable Energy Technologies in Different Applications**
  - Integrating renewable energy technologies in the building is another way to reduce energy consumption and reduce carbon footprint.
  - Solar water heaters, small wind turbines to generate electricity, solar photovoltaic electricity generation are examples of renewable energy technologies installed in a building to reduce operational energy consumption.
  - Other renewable energy sources like hydroelectricity, biomass, and biofuels can also be used.
  - Roofs and facades of buildings are suitable for the placement of solar thermal collectors and photovoltaic panels.

SOUND CONTROL IN BUILDINGS

The methods employed for noise control in buildings

- **Increasing the mass and thickness of walls**
  - The massiveness of a material is an efficient parameter that resists noise. Hence concrete walls are more insulating than wooden walls.
  - Another way of increasing the insulating property is to add more thickness for the walls.
  - The increase of thickness of walls would result in more mass which in turn increase insulation.

- **Use of Cavity Partition in Buildings for Noise Control**
  - The sound transmission can be resisted by the usage of airspace between the two partition walls.

- **Increase Airspace Width of Walls**
  - The increase in airspace will obviously increase the noise insulation property.

- **Increasing the Stud Spacing**
  - It is found that the spacing between the studs would increase the sound transmission capacity of the room.

- **Usage of Studs in a Staggered Manner**
  - The arrangement of studs in a staggered manner would help in noise absorption, thus reducing noise intensity.

- **Studs and Panels held together by Resilient Materials**
  - Making use of inexpensive resilient layers like glass or fiber board, or semi-resilient attachments which are inert in nature, will help in reducing the

- **Panels Used are Dissimilar**
  - Using different thickness and materials for panels would help in reduction of noise, thus increasing the sound insulating quality of walls.

- **Sound Absorbing Blankets Used in the Airspace**
  - The sound absorbing blankets are also called as isolation blankets which are placed in the airspace arrangement, that are provided between the panels.
  - This blanket enables an increase in sound attenuation.
  - Mineral or rock wool, wood fibers or fiberglass are some the materials used to make these blankets.

- **Windows can be Closed**
  - Permanent sealing or closing of the windows are the best measures to reduce the direct effect of noise.
- **Windows Size can be Reduced**
- **Glass Thickness can be Increased**
- **Construction of Doors for Acoustic Control in Buildings**
- **Construction of Floors for Acoustic Control in Buildings**
- **Noise Control in Buildings by use of Masking**

TEMPERATURE CONTROL IN BUILDINGS

THERMAL CONTROL IN BUILDING

- Thermal control helps keep the occupants of a building more comfortable by moderating the temperatures of the interior surfaces of the building and reducing drafts.
- Additionally, it reduces the energy consumption of a building for heating and cooling to a fraction of what it would otherwise be.
- Thermal insulation helps keep a building cooler in summer and warmer in winter by decreasing the passage of heat through the exterior surfaces of a building.
- A wide variety of materials are used today as thermal insulation.
- These include wood, plastics, and metal products.
- There are three ways that heat is transmitted: through conduction, convection, or radiation.
- Conduction occurs when materials are in direct contact.
- Convection takes place in a fluid medium, such as air or a liquid.
- Radiation occurs between two objects, not in contact and not shielded from each other.

Location and Placement

- Additionally, location and placement play a significant role in the type of insulation.
- For example, roof insulation can be placed above the roofing membrane, between the membrane and the roof deck, and below the roof deck.
- Each location requires a different type of insulation, and each has its advantages and disadvantages.
- Buildings gain or lose heat through these processes.
- The purpose of thermal control is to slow down heat gain or loss in order to maintain comfortable interior temperatures while conserving energy.
- Choice of Insulation
- The choice of insulation material depends on its physical characteristics, resistance to the flow of heat, and cost. When choosing a specific type, R-Value is usually the most important consideration.
- However, the application is important as well as some materials are better suited for certain parts of the building. Installations on walls differ from installations on roofs or from floors for example.

Choice of Insulation

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- Installations on walls differ from installations on roofs or from floors for example.
- There are two advantages to placing the insulation above the membrane:
- the membrane is protected from temperature extremes and
- the membrane, being on the warm side of the insulation, acts as a vapour barrier.
- Each element of a building that experiences heat gain or loss needs to be addressed in a manner specific to the condition.
- For example, cracks and openings can be addressed by the use of caulking and weather-stripping, while windows can be treated with tinted, reflective, or insulated glass.
- Walls and roof assemblies are typically treated using thermal insulation.

Thermal Insulation

- Thermal insulation is composed of materials that have a high thermal resistance (R) or high reflectivity, such as aluminum foil.
- Enclosed air has excellent insulation properties, therefore insulation materials are typically made of air enclosed cells in foamed glass or plastic.
- Some common types of insulation include loose fill, batt or blanket, board or sheet, reflective, and foam.
- Each has advantages depending on the use and placement.
- Insulation is measured using R-Value, the inverse of thermal conductivity ($R=1/k$) where R is resistance and k is thermal conductivity.

Loose Fill Insulation

- Loose fill is composed of glass or mineral wool, vermiculite, and perlite.
- It is typically 4 inches thick with an R-Value of 3.90 and it is used in wall cavities and flat air spaces such as attics.
- Loose fill insulation is blown into building cavities using special equipment.
- It is well suited for places where it is difficult to install other types of insulation, such as irregularly shaped areas, around obstructions, and in hard-to-reach places.

Batt or Blanket Insulation

- Batt or blanket insulation is made from glass or mineral wool enclosed by paper or aluminum.
- Thickness is typically 3.5 inches and R values are about 11.00.
- It is used in air spaces in framed walls, floors, and ceilings.
- Batt insulation and blankets are available unfaced, faced on one side with moisture resistant craft paper forming a vapor barrier, and faced with aluminum foil forming a fire-resistant facing.
- Some types have a facing on both sides and are used for vertical applications on walls, and horizontal applications on floors and ceilings.

Board or Sheet Insulation

- Board or sheet insulation is comprised of cork, glass, or mineral fibers, or paper pulp.
- It is typically 1 inch thick with an R-value of 2.75.
- It is typically used for wall sheathing and as rigid roof insulation.
- Also known as rigid insulation, board or sheet insulation is used in all parts of a building.
- Wood and cane fiberboard are commonly used for exterior sheathing and shingle backer boards and are asphalt impregnated.
- Granulated cork rigid insulation is used for roof, wall, and floor insulation.

Reflective Insulation

- Reflective insulation is made up of aluminum foil in combination with layers of paper and a f-inch air space.
- The R-value for two reflective surfaces with a 1-inch air space is 1.39.
- It is typically used on roofs, walls, and floor insulation with a vapor barrier.
- It is available in single thickness layers or in a multi-layer batt that has dead air spaces between the layers.
- The reflective foil uses the reflective properties to reject the passage of heat plus the effectiveness of the dead air spaces.

Foam Insulation

- Foam can be either the spray type or rigid panels usually 1 inch in thickness.
- It has an R-Value of 6.00 and is commonly used as sheathing or in the case of spray foam in irregular spaces.
- Foamed-in-place insulations are generally polyurethane or phenol-based compounds that provide excellent insulation.
- When mixed they are pumped through hoses into cavities, such as wall cavities, and sprayed in layers on flat and sloping surfaces such as roof and decks.

Vapor Barriers

- Vapor barriers are often combined with insulation, and since condensation tends to form on the cool side of insulating materials, aluminum foil-backed insulation should always be installed with the foil facing the warm side.
- A vapor barrier is used to keep water vapor generated inside a building, such as by cooking, from penetrating the wall and condensing as moisture on the building insulation.
- It can also be used to reduce the penetration of moisture from outside sources into the building.

SMART BUILDINGS

INTRODUCTION

- An Intelligent building is the one which provides a productive and cost-effective environment through optimization of four basic elements: structure, systems, services and management, and the interrelationship between them.
- It is a type of building that uses both technology and process to create an environment that is safe, healthy, and comfortable to everyone.

NEED OF INTELLIGENT BUILDING

- Technology is changing how we design and construct buildings and the building fabrics themselves
- Intelligent buildings are the new Era in the field of construction throughout the world.
- It is Environment Friendly.
- It is cost Effective.
- It has many social benefits.

DIFFERENCE BETWEEN ORDINARY AND INTELLIGENT BUILDING

- Intelligent building: Intelligent building adjusts the inside functional aspects such as lighting, ventilation, fire-fighting, air-conditioning, etc. automatically with the changes in environmental conditions controlled by computer.
- The security system , communication system, etc. are coordinated and automatically controlled by computer work station.
- Ordinary building: Ordinary building there will be different room conditions depending on the changes in the environmental conditions.
- The security system , communication system, etc. are not coordinated and automatically controlled by computer work station.

COST EFFECTIVE CONSTRUCTION

- Fly ash Based concrete walls should be used.
- Intelligent buildings are more energy efficient.
- These buildings use less water
- Materials efficiency.
- Intelligent building should be constructed so that it can take advantages of renewable resources.
- Reduces operating cost.
- Solar cells should be used.

COMPONENTS OF ENERGY EFFICIENT BUILDING

- Provide good Landscaping
- Ratio of built form to open spacing
- Location of water bodies should be at proper place
- There should be proper orientation of the building
- Use of materials with low embodied energy
- Environment Friendly
- • An intelligent building starts with an environmentally friendly design . • They maintains a comfortable, safe and secure environment . • The uses of carbon is minimum which reduces pollution. • Enhance and protect biodiversity and ecosystems. • Improve air and water quality. • Reduce waste streams. • Optimum Use of Day Light.

ENVIRONMENT FRIENDLY

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ACCESS CONTROL

- Access control restricts how and when people enter and exit an area.
- It can be done by many methods.
  1) Finger Print Lock
  2) Voice and Video Intercom
  3) Code Based Access System
  4) Swipe Card Access System
  5) Biometric Access System
  6) Surveillance through CCTVs.

SAFETY

- Life safety systems, often called “fire systems”, are typically driven by code considerations.
- Early warning systems like smoke detection systems, detects the fire at a very early stage and pinpoint to the care taker where exactly it is occurring, so that the fire is extinguished locally through manual fire extinguishers.
- Fire protection system pumps water to the areas where the fire occurs, so as to do use it automatically through sprinkler bulbs and also manually through the fire brigade.

MANAGEMENT SYSTEMS

- Energy Management
- HVAC systems
- Lighting systems
- Lift and Escalator systems
- Alarm Monitoring
- Water Management systems

WATER MANAGEMENT SYSTEM

- Rain Water Harvesting should be done
- Water Efficient Plumbing and Fixtures should be used
- Water Treatment, Recycling & Minimal Disposal
- Grey Water Handling
- Solid Waste Control Strategies
- Proper water drainage system should be provided.

HVAC SYSTEMS

- HVAC is an important part of residential structures such as High rise buildings and intelligent buildings.
- It refers to Heating, Ventilation and Air conditioning of the buildings.
- Heaters can be used to generate heat if required.
- Ventilation includes both the exchange of air to the outside as well as circulation of air within the building.
- Unpleasant smells and excessive moisture are reduced.

ADVANTAGES OF INTELLIGENT BUILDINGS

- Provides Air quality control
- Higher level of security and safety
- Reduced administration costs
- Provides good comfort
- Environment friendly
- Proper control over the entire structure
- focus on eliminating CO2 emissions

DISADVANTAGES OF INTELLIGENT BUILDING

- The initial cost of an installed system is high.
- Repairing problems.
- Requires special super vision over all configuration.
- Small life of the electronic equipment.
- Serviceability would be an issue unless users have a trained technician on the staff.
- Technological limitations.