CHAPTER

1 Site Selection and Planning

INTRODUCTION

Sites have considerable impact on architectural design, planning and construction. Every site is unique and has elements that include climate, topography, flora & fauna and social aspects. These elements largely influence the design process and development.

Many a time, the designer may not have a choice in site selection. The given site needs to be analysed in terms of various challenges that it may pose during construction. In such cases, it is important to carefully look for solutions, so as to construct with minimum disturbances to the site.

The orientation of the building and zoning of built forms within the site need to be considered so as to reduce heat ingress and ensure adequate ventilation. To enhance the microclimate, adequate open spaces and vegetation need to be part of design and site planning. The flora & fauna of the site also need to be preserved right from the design process.

Therefore, design and planning play a key role in restoration & preservation of the site. A good approach is to consider the following factors:

1. Site selection
2. Site ecology and ecological survey
3. Site planning
   (a) Analysis
   (b) Minimising disturbances to the site
   (c) Microclimate
   (d) Heat island effect
   (e) Erosion and sedimentation control
   (f) Exterior lighting
   (g) Facilities for differently abled

1.1 SITE SELECTION

Site selection is about being sensitive to relationships between built environment and ecosystems.

It is best to avoid environmentally sensitive areas that make many areas so special, like reeks, lakes, tree-covered hills, wildlife, native flowers and plants. The objective of site selection and planning is to minimise ecological disturbances. Effective measures like preservation of top soil, protection of water bodies, trees & local habitats need to be part of the design process.

Selecting sites that have already been impacted or choosing brownfield sites and taking remedial steps to restore such sites can save green fields and farmlands being used for development purposes.

1.1.1 LOCATION

Availability of power, water, sewerage, storm water drains, roads and communication network, are vital for habitation. Ideally, one should select a site where these infrastructures are already available.

In locations where infrastructure is unavailable, it can have a negative impact on environment in building new infrastructural facilities. This can also increase the number of motorised vehicles, resulting in use of fossil fuels for transit and associated emissions. Vehicular emissions give rise to air pollution and greenhouse gas emissions. Increase in the number of motorised vehicles is impacting the health of its population.

Besides physical infrastructures, availability of social infrastructure like community housing, schools, hospitals, parks, etc. in close vicinity is also important.

1.1.2 BASIC AMENITIES

Basic amenities are essential for occupants to reduce environmental impacts from automobile use.

People would like to have access to basic amenities like pharmacy, health centre, grocery, creche, bank, restaurant and others. If these facilities are available within walking distances, occupants could walk and reduce the use of automobiles and associated environmental impacts. In such a scenario, pedestrian walkways need to be provided for safety and convenience.

The strategy would be to select a site which has such amenities in close proximity (or) provide as many amenities as possible within the campus of a building.

Fig. 1.1 Example – A project site with basic amenities in proximity

1.1.3 ACCESS TO PUBLIC TRANSPORTATION

For large distance commuting, public transportation would be more sustainable. The emissions per passenger is considerably lower when people use public transport. The following table shows relative emission values:

Mode of Transport	Emission value (g Co2 / km / passenger)
Passenger car	67
Autorickshaw (Petrol)	35
Bus (CNG)	27
2-wheeler (petrol)	26
Metro	20

India's National Action Plan for Climate Change (NAPCC) recognises that GHG emissions from transport can be reduced by adopting a sustainability approach through a combination of measures, such as increased use of public transport, higher penetration of biofuels and enhanced energy efficiency of transport vehicles.

Some of the measures to encourage people to use public transportation are as follows:

(a) **Access to public transport during site selection:** Ensure that at least one mode of public transport is at a walkable distance (800m) to the building occupants. If public transport is not accessible, provision of shuttle vehicles from & to the nearest mode of public transport can be made available. Carpooling can also be encouraged by providing incentives to the occupants, besides mass transit use.

(b) **Encourage alternative modes of transport:** To encourage the use of bicycles and alternative fuel vehicles, associated infrastructure like bicycle racks, e-charging facilities, and reserved parking for e-vehicles can be encouraged.

1.2 SITE ECOLOGY AND SURVEYS

An ecological site is a distinct land with specific soil and physical characteristics with an ability to respond to natural disturbances.

Most of the developments impact the habitat and the local biodiversity of the place. Such impacts include loss of habitats or the ability of the habitat to support the species that depend on them.

Early identification of ecological constraints ensures incorporation of mitigation measures into the design phase.

Ecological surveys are carried out to identify species or habitats that exist on a particular site. They identify potential constraints to the development with an intent to protect certain habitats or species.

The purpose of carrying out ecological surveys is to:

- Evaluate ecological constraints, if any, at an early stage
- Assess the biodiversity of the site. Identify endangered or protected species and avoid any impact on them, caused due to development
- Appropriately design mitigation measures

1.3 SITE PLANNING

1.3.1 SITE AND CLIMATE ANALYSIS

Site analysis is performed prior to the commencement of design, to evaluate site characteristics and ensure minimum disturbances to the site. This helps in establishing a good relationship between the building and the site, to seamlessly merge the two.

Site analysis involves study of the climate by analysing the sun path and wind patterns to locate the building with an ideal orientation on the site. The analysis further includes study of existing soil, topography, underground water levels and vegetation.

The general strategy for each of the climatic regions are:

- Cold – warming effect of solar radiation should be maximised and impact of winter wind minimised.
- Temperate – The warming effect of solar radiation should be maximised in winter and circulation of winter wind minimised. Shades should be provided in summer, while allowing air circulation.
- Hot-Arid – The design should focus on maximising shade and minimising the hot, dust-laden winds.
- Hot-Humid – The design should focus on maximising shade and allowing for wind circulation

1.3.2 SUN PATH

The sun path diagram helps determine the position of the sun at different times of the day.

It helps to understand the co-ordinates of the sun during its course around the Earth, throughout the year. Further, each latitude has its own sun-path diagram. The sun path combined with shading mask diagrams help in understanding the shading provided by sunshades, existing trees or buildings around the site on the project building.

Elements of Sun Path Diagram

The sun path diagram shows the path of the sun in the sky-dome as projected onto a horizontal surface.

- The lines running from east to west represent the path of the sun on 21st day of each month of the year.
- Lines running perpendicular to the sun path lines indicate hours of the day.
- The lines radiating from the centre indicate the sun's azimuth, i.e., the direction/angle of the sun.
- The concentric lines indicate the sun's altitude. For example, at sunrise and sunset the sun's altitude is zero, while it is maximum at 12 noon.

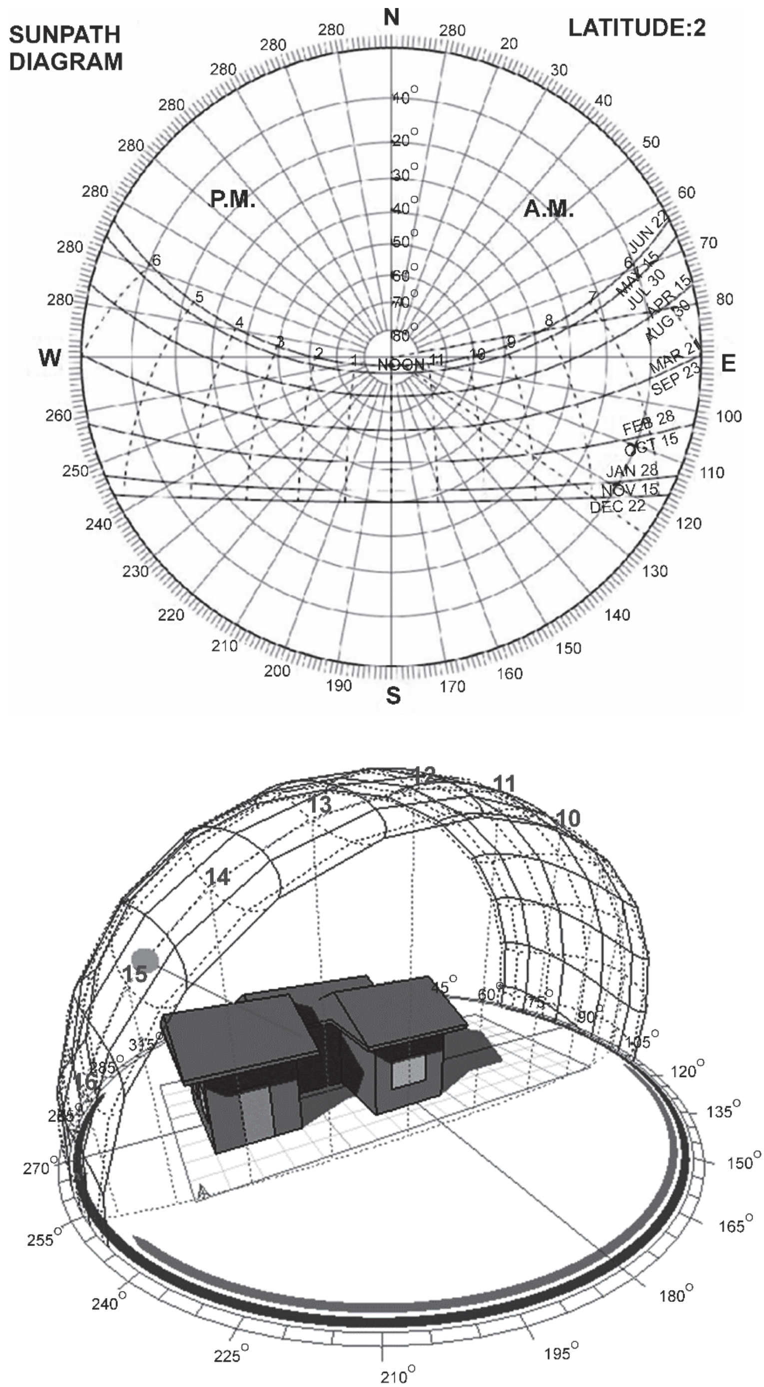

Fig. 1.2 Sun Path Diagram – Latitude 28^{o}

How to read sun path diagram

To determine the sun's position at 28°N latitude at 3pm in April,

1. Identify the month and time – Find the intersection of 3pm line and April line.
2. Find the azimuth – Follow the radial line that runs through the intersection and read azimuth of 260° west of south
3. Find the altitude – Finally, follow the concentric ring that runs through the intersection and read the sun altitude of 45°.

1.3.3 WIND ROSE

Wind rose diagrams graphically represents the wind condition, direction, and speed, at a given time and location. It shows the frequency of winds blowing from a particular direction.

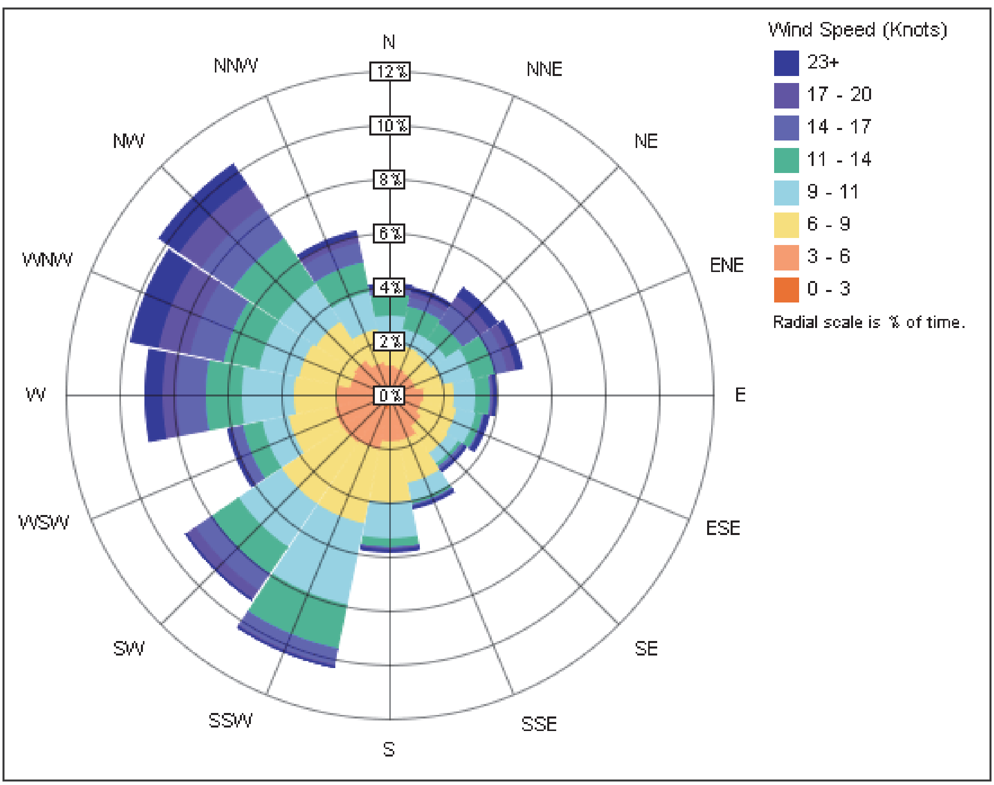

Fig. 1.3 Wind rose plot of Chennai 1 January 2020 – 31 January 2020

- The wind rose diagram normally comprises 8 or 16 radiating spokes that represent the cardinal wind directions (north, east, south, west) and their intermediate directions.
- The concentric circles and thickness of the lines represent the frequency of the wind.

How to read wind rose diagram

1. **Location –** The location of the wind rose is mentioned at the top of the diagram along with time duration.
2. **Legend –** The coloured boxes represent the wind speeds listed next to it. These colours correspond to the colours on the spokes and tell the wind speed. Check the unit to see if it's given in m/s, km/s, m/h, knots, etc.
3. **Concentric circles –** The concentric circles represent the duration for which the wind blows at certain speeds. Most often, the numbers are presented as percentages of the overall time, however, sometimes they are presented as hours or days.

1.4 MINIMISE DISTURBANCES TO SITE

Development activities would impact the biodiversity and topography of the place. Developments would often disturb the existing vegetation. This can lead to loss of native species and lead to associated impacts.

Invariably soil gets disturbed. It takes decades to enhance fertility of the soil. The top soil (top 4” to 6”) is the most fertile soil which needs to be preserved and reused. The type of soil would influence where buildings need to be located. A comprehensive soil profile must be performed for the entire site.

To address these aspects, buildings need to be developed with minimum footprint so as to reduce site disruptions.

Some of the measures to reduce site disturbances include:

- Preserve natural features like rocks and lakes
- Work with the site contours rather than mass grading, which creates air pollution and soil erosion and ecosystem loss
- Maintain existing topography and vegetation which helps in preserving biodiversity on the campus
- Design landscapes with multi-culture plant species to promote adaptive vegetation
- Take up measures to have vegetated spaces on built structures, walkways, roads, medians and pavers. Also, consider vertical landscaping on external walls
- Improve site air quality with water spraying

Preservation of existing trees and transplantation

Tree felling for the sake of development can have adverse impacts on environment. This often leads to the loss of native species and biodiversity. Trees are carbon sinks and CO_2 levels could increase due to deforestation. Every fully grown tree can absorb 15 kg of CO_2 annually, besides the high carbon that it captures during its growth.

Preservation of existing tress during construction and protecting them from damage can go a long way in retaining the green cover

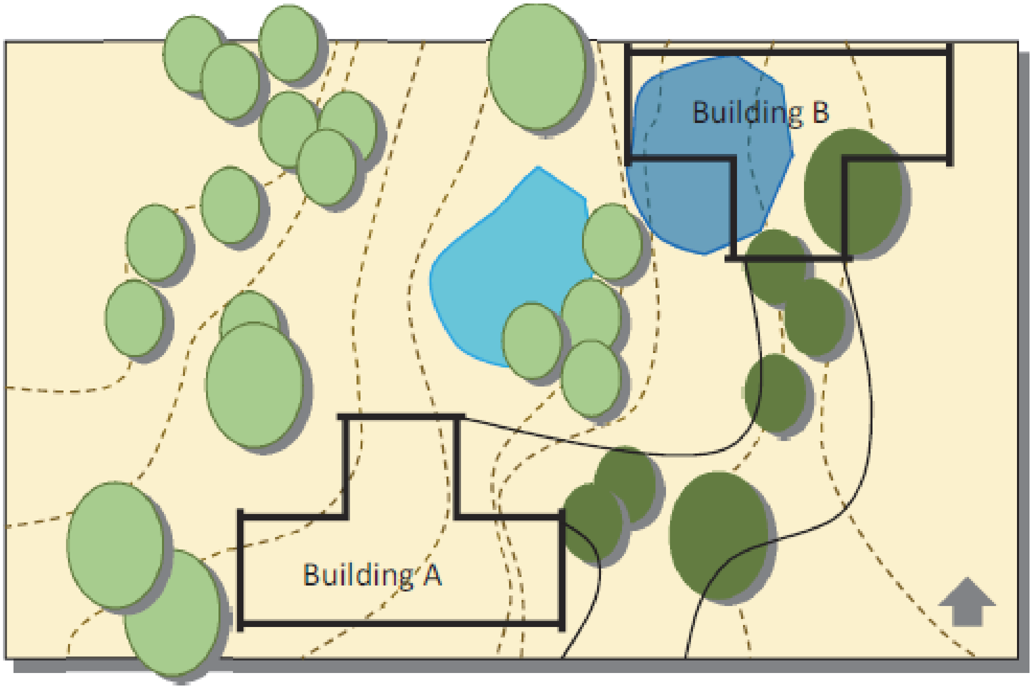

Fig. 1.4 Example – Site planning with existing trees

Site planning with existing trees

If trees are present onsite, the design team should ensure that the building is constructed around the trees rather than felling them down. Existing vegetation can be marked on the site survey plan. Design must embrace trees with the new development to preserve the maximum number of existing trees.

In the example below, 7 trees out of the 25 are impacted by the proposed development. Pathway can be altered to save trees. Alternatively, footprint of the building can be modified to preserve the existing trees. After marking the location of the existing trees, the project team can start planning for utilities, roads, design of the buildings around the existing trees, thereby protecting the local habitat and biodiversity.

Trees must be retained on the project site and protected by taking the following measures:

Tree survey should be carried out, capturing all possible details of the species, so as to record and take corrective steps. The landscape plan should show trees that have been preserved, and those which have to be removed or transplanted

Table 1.1 Tree survey schedule format

Tree Survey Schedule Format						
Tree No.	Botanical Name	Common Name	Girth	Height	Spread	Condition

Transplantation of existing trees

If the project cannot preserve the existing trees, tree transplantation must be carried out. Transplantation is the latest method to conserve trees without felling of trees.

Any healthy tree can be transplanted in any season. The survival rate of trees while transplanting is about 80%. Transplantation can be done up to a distance of about 1500km. Transplantation is a proven technique.

Transplantation process

Following is a step-by-step approach to transplant a tree from one location to another:

- **Planning:** The first step is to collect the details of the tree species to be transplanted. The team should evaluate whether the tree is healthy enough to transplant. Details of the tree should include the sun light requirement, water needs, type of soil, height, girth and root ball diameter. Assessment of the site of relocation should be done with details like soil condition, water availability, spacing of existing trees etc.,

Botanical name: Couroupitaguianensis

Common name: Cannon ball tree

Approxht.: 7ft

Sun requirement: Full Sun

Water requirement: Moderate

Fig. 1.5 Example – Transplantation process

- **Pit Preparation:** The pit should be dug in advance and its size be at least 1.5 times the root ball diameter. The depth of pit should be approximately the same as the root ball.

Fig. 1.6 Preparation of pit

Fig. 1.7 Preparation of tree

- **Preparation of tree:** The area of the root ball should be marked, branches pruned and excavation done outside the demarcated line.
- **Root ball excavation:** The circular shape should be maintained while excavating the root ball and cutting should be done without damaging the roots. By using a rooting hormone ensure that the plant grows fast and strong while being protected from fungus and disease. Root hormone is a mixture of plant hormones that stimulate the growth of a plant and should be sprayed on fresh cuts.

Fig. 1.8 Root ball excavation

- **Burlap/packing of root ball:** While packing the root ball, wrap the root ball with gunny sacks, which help retain moisture, protects the root ball and ensures easy installation.
- **Lifting and packing:** The tree and root ball must be firmly secured and leaves of the tree removed to reduce evaporation loss. Few leaves can be retained to understand the growth pattern of the tree after transplantation. The lifting should not take place from the trunk. It should be done from an inch above the root ball.

Fig. 1.9 Root Ball excavation, Burlap and lifting to move

- **Post-plantation care:** The tree support systems need to be provided post the transplantation. After placing the tree, the pit should be filled with topsoil followed by excavated soil. The plant/tree must be irrigated depending upon the season and the root/shoot hormones be applied periodically.

Fig. 1.10 Post-plantation care

Some key aspects related to operation and maintenance during and post transplantation are:

- With proper support, trees can be left without plantation for 4–5 days.
- Trees can be stored in tree banks for 2–4 years.
- Trees can be transported and translocated from 40 km to 1500 km distance.
- Tree survival after transplantation depends on proper trimming of roots, sunlight, watering of plants and support for adaptation. Water logging must be avoided and care be taken to ensure roots do not rot.
- Time required for the process to establish the tree is 6–8 months, depending on the height and girth of the tree.

1.5 TOPOGRAPHIC MICROCLIMATE

Every site has its own atmospheric variations. The site conditions that differ from those in the surrounding areas is called microclimate.

Buildings can be located with the use of these microclimates. Microclimate makes a location on the site more desirable than the other locations. Microclimate can get affected by buildings and landscapings around the site too. For example, the tree in the figure below is acting as a windbreak that protects the house against the winter winds and changes the microclimate of the site significantly.

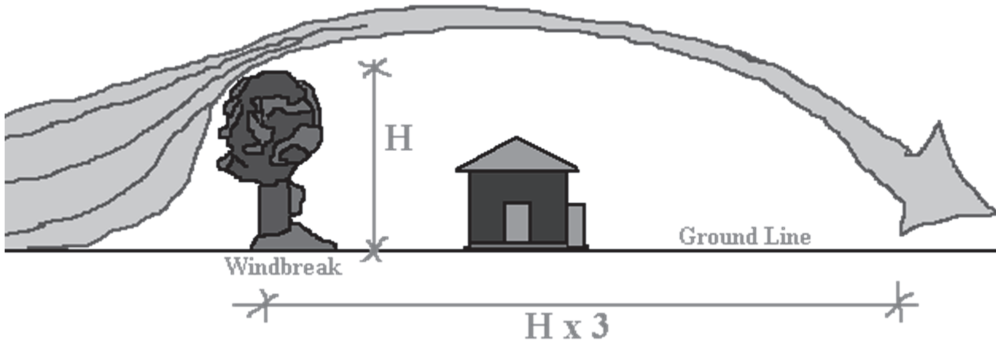

Fig. 1.11 Topographic microclimate

According to the Indian Meteorological Department, the critical months of each season are January, May, August, and November, representing winter, summer, monsoon, and post monsoon respectively.

Several principles to predict the microclimate whike design a building are:

- **Air movement is driven by density:** In valleys, the less dense warm wind moves uphill during the day and the denser cool air flows downhill. At night, when temperatures are cool, the area near the ground forms a cool layer by collecting the cool air, while a warm layer of air collects in the higher elevation landforms. Thus, in such areas designing the buildings at higher landforms is suitable for the microclimate created in the valleys.

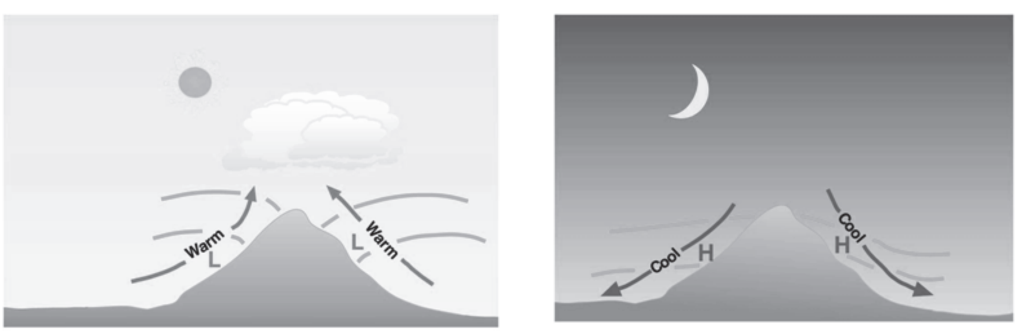

Fig. 1.12 Air movement driven by density

- **Solar radiation varies with the terrain:** In tropical climatic conditions, the sun moves from east to west via the south and faces south for the maximum time of the day. South-facing slopes/ flat surfaces receive more radiation of the sun than other orientations. Designing buffer spaces in the south reduces air-conditioning energy. Locating solar panels facing the south direction result in maximum generation.

  In cold climates, designing regularly occupied spaces towards the southern direction result in heating the space naturally. The east orientated spaces receive the morning sun and west oriented areas receive more of the afternoon sun. The projects can choose to locate regularly occupied spaces in these orientations. North orientated spaces receive diffused daylight.

- **Air flows from high-pressure to low-pressure areas:** Natural ventilation is caused by the pressure difference created naturally because of the temperature difference between outside and inside of the building. The windward side of the building creates a positive/ high pressure, whereas the leeward side of the building has a negative pressure, thus creating a suction region. This results in a large flow of wind from the high pressure areas to the low pressure areas through the building openings/windows and is commonly termed cross ventilation.

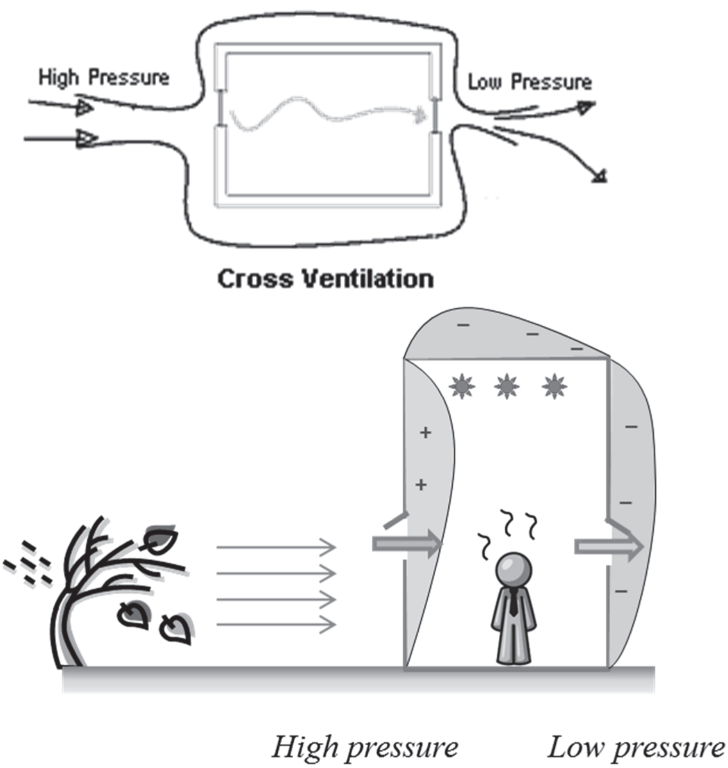

Fig. 1.13 Air flow from high-pressure to low-pressure areas

- **Venturi effect:** When the air flow is channelled and restricted, it creates a pressure drop, and its velocity increases. This phenomenon is termed as venturi effect. Venturi effect is utilised in buildings for passive cooling and natural ventilation. Buildings can be designed with higher positive and lower negative air pressure zones, thus creating increased air flow in the buildings. The venturi effect can be utilised while designing the street networking to increase airflow on the streets.

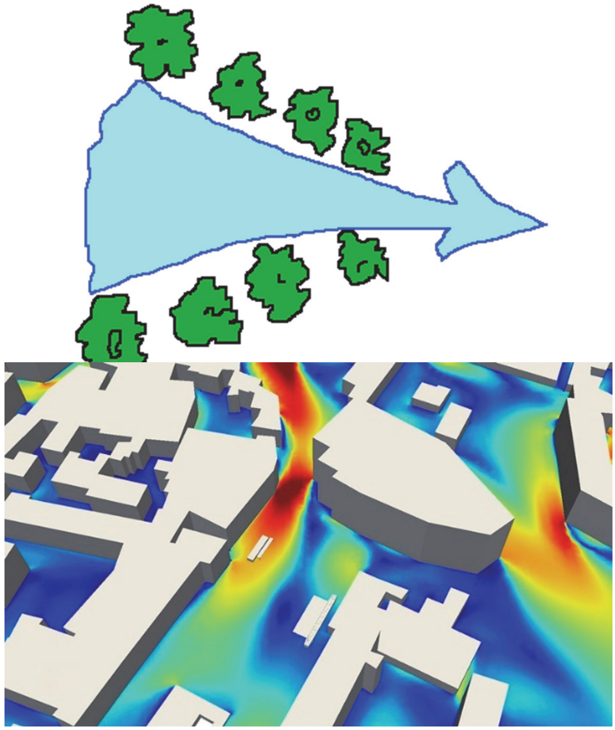

Fig. 1.14 Venturi effect

1.6 HEAT ISLAND EFFECT

Heat island effect occurs when urban landscapes experience warmer temperatures, as compared to the adjacent rural areas, because of solar energy retention on constructed surfaces. Artificial urban surfaces, such as concrete and asphalt, act as a reservoir of heat, absorbing it in the day and releasing it at night.

Research shows that cities would be warmer by 5–7°C than the surrounding rural areas on summer nights. The two important strategies to mitigate this problem are high emissive coatings and vegetated roofs.

Dark, non-reflective surfaces used for parking, roads, roofs, walkways, and other hardscapes absorb the sun's warmth and radiate heat, creating heat islands. Urban areas can be 1–3ºC warmer than the surrounding suburban & undeveloped areas and as much as 4-5 ºC warmer in the evenings. These heat islands may contribute to increasing global temperatures.

Urban heat island effects have numerous negative consequences. Plants and animals sensitive to temperature fluctuations may find habitat affected by heat islands inhospitable. Human health may suffer because exposure to ground-level pollution is often worse in places affected by heat islands. Additionally, heat islands increase cooling loads in summers, necessitating higher air-conditioning loads, that use more electricity. This in turn emits greenhouse gases and causes pollution.

A few strategies to reduce the negative impact of heat island effect are:

- Limit the hardscape areas on the site. Use open grid pavement systems for parking lots, roads, and walkways, which stay cooler due to reduction of impervious surface area and increased evaporation from the vegetation.
- Use light coloured paving surfaces, and shade paved areas with trees. Darker paving materials have low SRI values. Grey or white concrete has a higher reflectance and a higher SRI. For asphalt pavement, coatings can be used to attain the required SRI value.

Solar Reflectance: the fraction of solar energy that is reflected by the roof

Thermal Emittance: The relative ability of the roof surface to radiate heat

Solar Reflectance Index (SRI) – Is a calculated value that combines solar reflectance and thermal emittance into one number. It is defined such that the SRI of a standard black material with an SR value of 0.05 & TE of 0.9 is 'Zero', while the SRI of a standard white material with an SR value of 0.8 & TE value of 0.9 is 100.

Some of the typical solar reflective index of paving and roofing materials are given in Table 1 and 2.

- Vegetation can be used to shade buildings and pavements from solar radiation. This can be achieved by having shade-providing trees, large plants and shrubs of native or adaptive species.
- Parking under cover can also help reduce heat island effect. Parking can be multi-storied, or have subterranean structure, or be a shade providing structure. Roof of structured parking can also be covered with high SRI paints

Elevated temperatures from urban heat islands, particularly during the summers, can affect the microclimate of a site. Reduction in urban heat island leads to the following benefits:

- **Energy consumption –** Higher summertime temperatures in cities increase energy demand for cooling and adds pressure to the electricity grid during peak periods of demand. A reduction in heat island helps control energy demand.
- **Air quality and greenhouse gases –** Higher temperatures increase energy demand for cooling, which causes higher levels of air pollution and greenhouse gas emissions in power generating stations

Table 1.2 Solar Reflectance Index (SRI) for Standard paving materials

Material	Emissivity	Reflectance	SRI
Typical new grey concrete	0.9	0.35	35
Typical weathered* grey concrete	0.9	0.20	19
Typical new white concrete	0.9	0.7	86
Typical weathered* white concrete	0.9	0.4	45
New asphalt	0.9	.05	0
Weathered asphalt	0.9	.10	6
*Reflectance of surfaces can be maintained with cleaning. Typical pressure washing of cementitious materials can restore reflectance close to original value. Weathered values are based on no cleaning.			

Table 1.3 Solar Reflectance Index (SRI) for typical roofing materials

Example of SRI Values for Generic Roofing Materials	Solar Reflectance	Infrared Emittance	Temperature Rise	Solar Reflectance Index (SRI)
Gray EPDM	0.23	0.87	68°F	21
Gray asphalt shingle	0.22	0.91	67°F	22
Unpainted cement tile	0.25	0.90	65°F	25
White granular surface bitumen	0.26	0.92	63°F	28
Red clay tile	0.33	0.90	58°F	36
Light gravel on built-up roof	0.34	0.90	57°F	37
Aluminium	0.61	0.25	48°F	56
White–coated gravel on built-up roof	0.65	0.90	28°F	79
White coating on metal roof	0.67	0.85	28°F	82
White EPDM	0.69	0.87	25°F	84
White cement tile	0.73	0.90	21°F	90
White Coating – 1 coat, 8mils	0.8	0.91	14°F	100
PVC White	0.83	0.92	11°F	104
White Coating – 2 coats, 20mils	0.85	0.91	9°F	107

Source: LBNL Cool Roofing Materials Database. These values are for reference only and are not for use as substitute for actual manufacturer data.

Case Study

Building information –

Typology : Factory building

Structure : Ground + Mezzanine

Conditioned area : 20,000 sq. ft

WWR : 32%

Solar Reflectance Index –

Conventional roofing sheet : 45

GreenPro certified roofing sheet : 85

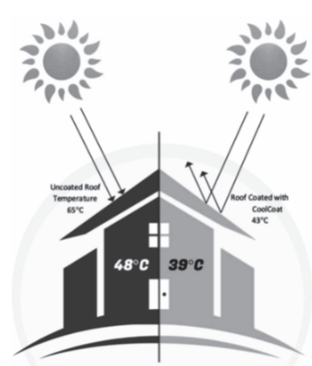

Table 1.4 Energy saving as per conventional roof and roof with GreenPro certified roofing sheet

S. No.	Parameter	Conventional Roof	Roof with GreenPro Certified Roofing Sheet	Savings
1	Cooling load	91 TR	84 TR	**8.1%**
2	Annual building energy consumption	249070 kWh	238360 kWh	**4.3%**

1.7 SOIL EROSION CONTROL

Soil erosion refers to the carrying away of topsoil by the natural forces of water or wind. The Soil can also be disturbed by construction activities. Erosion, whether by water, wind or tillage, involves three distinct actions—soil detachment, movement and deposition.

It is reported that the global population depends on 11% of the world's land for growing all of its food needs and only 3% of the planet's soils are fertile. This reiterates the importance of erosion control.

The topsoil is very fertile and needs to be handled responsibly. The topsoil, high in organic matter, if allowed to be carried away by flowing storm water, may get into drains which is a wastage of the rich resource. If the top soil is mixed with other soil during construction activities, we lose the rich nutrient soil. Many a time, this can even go to landfills where they do not have any use. Fertile soil reaching watercourses and lakes would eventually reduces cropland productivity.

Soil erosion can be a slow process that continues relatively unnoticed, or can occur at a rapid rate, causing serious loss of topsoil.

The erosion possibilities of a surface are determined by factors like soil characteristics, climate, topography and vegetative cover.

Types of Soil Erosion

(a) **Splash Erosion –** During rainfall, soil particles dislodge and splash into the air. The dislodged soil gets suspended in the water and transported to great distances by surface water runoff.

(b) **Sheet erosion:** Impermeable surfaces and compacted soil lets water run across it, washing away disturbed surface particles

(c) **Rill erosion:** Sheet erosion wears down soil to establish a definite path, forming rivulets in the soil referred to as rills. Rill erosion is much more visible than splash or sheet erosion.

(d) **Gully erosion**: Over time, rills widen and deepen into a gully, accelerating the effects of erosion by creating more and more surface area susceptible to disturbance.

(e) **Streambed erosion** – Streambed is a long, narrow, sloping depression on land that is shaped by flowing water. Streambeds can range in width from a few feet to several hundred feet for large rivers. Streambank and streambed erosion result in sediment loads to surface water resources.

(f) **Wind erosion** – Wind erosion occurs when strong winds blow over light-textured soil

Strategies to mitigate soil erosion

Before working on the soil erosion control measures, the following information of the site are required:

- Soil analysis
- Existing topographic features of the project site and the immediate surrounding area
- Storm water runoff from the project site, post the development
- Location of surface water bodies, which may receive runoff within or from the project site
- Wind patterns

Reducing the storm water runoff and hardening of soil are two key aspects involved in mitigating soil erosion. Commonly used methods to prevent soil erosion in building sites are the following:

- **Grading:** Grading of land to minimise the disturbed area exposed is an effective way to reduce erosion. Developments can be designed to fit the existing landscape so as to minimise the disturbed areas.
    - Phased grading divides areas into distinct parts. Grading of each phase is started, completed and stabilised in sequence. Phasing minimises the extent of disturbed land at any given time and helps maintain vegetative cover
    - It is best to start grading activities at the highest point of a site and gradually move down the gradient. To reduce soil compaction, deep tillage should be done as the final step of grading activity at each phase. This helps increased infiltration, decreases runoff, and improves rooting depth.
- **Mulching:** Is done to protect the soil around vegetation. Straw, fibre or wood chips are generally used for mulching. These materials hold the moisture for longer durations. Mulching limits soil erosion and lessens the need to contain sediments.
- **Temporary and Permanent Seeding:** To reduce runoff and erosion during construction, temporary seeding methods can be used. Seeding of fast-growing plants and shrubs can hold the soil and help in soil erosion. Permanent seeding can be done post the building plans so that they continue to grow, stabilize the soil and help in soil conservation.
- **Dust Control:** Dust control is a temporary control measure to protect top soil. The following measures can be considered:
    - Sprinkle water to moist the surface and allow the settling of dust.
    - Provide barricades to control air currents.
    - Utilise coarse gravel to in areas where high speed winds result in soil erosion
- **Compost Blanket:** A compost blanket is a layer of compost applied on the soil as mulch, typically at a depth of 50 mm. This protects the soil from wind and water erosion. These blankets have necessary nutrients for improving the health of the soil and allow native grass seeds to germinate, thereby hardening the soil

1.8 FACILITIES FOR DIFFERENTLY ABLED

Today, accessibility for all is recognised as a basic necessity, all over the world. Barrier-free features are now being integrated at the design stage. Universal design or barrier free environment is a design that makes any space accessible to everyone, irrespective of age, disability, or other factors.

The ‘Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1996’ was enacted by the Government of India to ensure a barrier free environment and smooth, free & safe movement for people regardless of age or disability of any kind.

The main intent of barrier free environment is to design spaces such that every person can function independently without external assistance during their everyday activities like procurement of everyday essentials, communal living, employment, leisure and relaxation. The building facility should be able to attend to his/her needs.

Design aspects according to human abilities

People with disabilities may include, but are not be limited to inability or difficulty to walk, reliance on walking/mobility aids, visual impairments, speech and hearing impairments, lacking in coordination of motor movements & reaching, lack of stamina, difficulty in interpreting & reacting to sensory information.

Key considerations

A well-designed environment that is safe, convenient, comfortable, and readily accessible benefits everyone. Some of key considerations while designing such spaces are the following:

- Pedestrian and vehicular access to the site
- Reserved parking close to the entrance of the building
- Ramps, wherever required, to be designed with adequate gradients, width and proper landings
- Adequate external and internal lighting
- Detailed information signage at the entrance
- Smooth level differences providing adequate support – Raised thresholds to be avoided, but where this is not possible, their height should not exceed 25mm
- Spacious elevators that allow traffic by wheelchairs. Audio and braille assistance in lifts for visually impaired people
- To enable wheelchair users to pass through doors, the minimum clear door width must be 900 mm
- To enable wheelchair users to approach doors, manoeuvring space is needed and so the corridor must have a width of at least 1200mm to allow a 90° turn to be made through a door.
- Sanitary facilities should be made accessible and usable by the physically challenged.

- Non slippery walking surfaces and tactile pathways need to be provided.
- Important information should be communicated via two senses or more (tactile, audible and visual)

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