Chapter -4
Sustainable Sites

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Learning Objectives

- Construction activity pollution prevention
- Site assessment
- Site development-protect or restore habitat
- Open Space
- Rainwater management
- Heat island reduction
- Light pollution reduction

Overview

- Rewards decisions about the environment surrounding the building
- Emphasize on restoring project site elements, integrating the site with local and regional ecosystems, and preserving the biodiversity that natural systems rely on
Construction Activity Pollution Prevention

Prerequisite

Intent

• To reduce pollution from construction activities, addresses mainly
  ▪ Erosion
  ▪ Sedimentation
  ▪ Air borne dust generation
**Erosion: Loss of top soil**

- Top soil supports vegetation
- Increased fertilizer requirement for the landscape and hence increased environmental damage

**Reasons of Erosion:** Storm water runoff, wind, construction vehicle traffic, steep slopes etc.

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**Sedimentation: Water Pollution**

**Sedimentation:** Addition of solid particles in water bodies.
- Sediments from construction site are rich in contaminates and pollutes the water bodies

**Air Pollution**

**Air borne dust generation:**
- Erosion due to wind pollutes the air with particulate matter and suspended particles
Strategies & Implementation

Erosion & Sedimentation Control Plan

• Projects should develop and implement Erosion and Sedimentation Control (ESC) Plan which complies with EPA 2012 Construction General Permit or local standards
Protecting & restoring top soil:

**Stock Piling**: Topsoil is removed from the site and piled in safe place, replaced by free drain gravel and finally restored after the construction.

Stabilization Strategies:

- **Temporary Seeding**: Plant fast growing grasses to temporarily stabilize the soil.
- **Permanent Seeding**: Plant grass, trees and shrubs to permanently stabilize the soil.
Stabilization Strategies contd:

- **Mulching**: Spreading material like sawdust, straw, hay, grass, wood chips or gravel over the topsoil to stabilize it.

Structural Strategies:

- **Silt fencing**: Construction post with fabric filter media to remove sediments from storm water runoff.
**Structural Strategies contd:**

**Sediment Traps:** A cavity where sediments from storm water are allowed to settled down.

**Sediment basin:** same as sediment trap but of larger size

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**Structural Strategies contd:**

**Earth Dikes:** mound of stabilized soil to divert the run off through the desired direction (ideally through sediment traps and basins)
Site assessment

Intent

• To assess site conditions before design to evaluate sustainable options.
Strategies & Implementation

Conduct a site survey prior to design to assess
- Topography
- Hydrology
- Climate
- Vegetation
- Soils
- Human use
- Human health effects
Significance

• Assets such as favorable climate conditions, good solar access, and healthy plant populations

• And liabilities, such as unhealthy soils, blighted structures, pollution sources, steep slopes, and extreme climate patterns.

Site development - Protect or Restore Habitat
Intent

- To conserve existing natural areas
- Restore damaged areas
- To promote habitat and promote biodiversity.

Strategies & Implementation
Site development - Protect or Restore Habitat

Applicable for greenfield sites
- Preserve a part of site area
- Restore all disturbed or compacted soils to its original condition

Applicable for previously developed sites
- Restore a part of site area by planting native or adaptive plants
- Provide financial support to a nationally or locally recognized land-trust or conservation organization

Open Space
Intent

• To create exterior open space that encourages interaction with the environment, social interaction, passive recreation, and physical activities.

Strategies & Implementation
Open Space:

- Open space is a vegetated or 50% pervious surface which may include following:
  - Pedestrian– oriented paving
  - Recreation– oriented paving
  - Garden spaces
  - Habitats

Maximize Open Space:

- Reduce hardscape, Increase open space
- Achieve the required area by increasing height not width
- Cluster developments together
- Maximizing open space reduces storm water runoff and heat island effect
Rainwater management

Intent

• To reduce runoff volume
• Improve water quality by replicating the natural hydrology and water balance
Significance

- Reduce load on sewage treatment plant
- Reduce Erosion, sedimentation, eutrophication and related environmental impacts
- Reducing storm water runoff helps maintain the natural aquifer recharge cycle.

Eutrophication:

Eutrophication is the enrichment of inorganic plant nutrients (e.g. nitrate, phosphate) in fresh water bodies. It may occur naturally but can also be the result of human activity (cultural eutrophication from fertilizer runoff and sewage discharge)
Strategies & Implementation

Green infrastructure / Low impact developments

• Rain water management approach which replicates the natural hydrology of the ground cover is called as Low Impact Development. LID applied to urban planning / township development or neighborhood development is called as Green Infrastructure
Non-Structural strategies

• Promotes natural infiltration of storm water into soil.
• Best suited for sites which has sufficient open space
• Example rain gardens, vegetated swales, reducing impervious areas and pervious pavement

Structural strategies

• Collect, hold and treat storm water
• Best suited for urban sites with space constraint
• Example: rainwater cisterns, sediment traps and ponds

Impervious pavement

• Reduce Impervious surfaces and promote natural infiltration

• Use open grid pavement, pervious paving instead of conventional hardscape surfaces
**Rain Gardens:**

Planted depression that allows rainwater runoff from impervious urban areas like roofs, driveways, walkways, parking lots, to be absorbed.

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**Vegetated Filter Strips:**

Filter strips function by slowing runoff velocities and filtering out sediment and other pollutants, and by providing infiltration into underlying soils.
Vegetated Swales:

Constructed open-channel drainage ways used to convey storm water

Bioswales:

Landscape elements designed to remove silt and pollution from surface runoff water. They consist of a swaled drainage course with gently sloped sides (less than six percent) and filled with vegetation, compost and/or riprap.
Vegetated roof

Storm water cistern:

Collect, treat and reuse storm water for non potable application
Heat island reduction

Heat Island effect:

- Thermal gradient between urban and rural areas
Intent

- Reduce heat island effect to minimize effects on microclimates, human and wildlife habitats

Strategies & Implementation
Consider using **vegetated roof** instead of conventional roof

Use High SRI coating on roof surfaces

- Flat roof/low slope surfaces shall have
  - Initial SRI of 82
  - 3 years aged SRI of 64

- Sloped roof surfaces shall have
  - Initial SRI of 39
  - 3 years aged SRI of 32
SRI (Solar Reflective Index) refers to the ability of a surface to reject heat.

- For a surface to have higher SRI it should have higher emittance and reflectance or Albedo.

Generally construction materials have higher emittance and poor reflectance. But to have high SRI both reflectance and emittance should be higher.

<table>
<thead>
<tr>
<th>SRI values for Solar Infrared Temperatures</th>
<th>Solar Reflectance</th>
<th>Infrared Emittance</th>
<th>SRI</th>
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<tr>
<td>Gray EPDM</td>
<td>0.23</td>
<td>0.87</td>
<td>21</td>
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<tr>
<td>Gray Asphalt Shingle</td>
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<td>0.91</td>
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<tr>
<td>PVC White</td>
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<td>0.92</td>
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<tr>
<td>White coating, 2 coats, 2 mils</td>
<td>0.85</td>
<td>0.91</td>
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</table>
Non-roof

• Increase vegetated pervious surfaces.

• Use open grid pavement/pervious paving

• SRI value non roof surfaces shall be 29 or higher

Non-roof

• Shade surfaces by structures, trees, solar panels
• Consider using under ground parking, shaded parking
Light Pollution Reduction

Intent

- To increase night sky access, improve nighttime visibility, and reduce the consequences of development for wildlife and people.
Strategies & Implementation

Uplight

- Use full cutoff fixtures (shield) in external lighting
Trespass

• Reduce light trespass beyond the property boundary.
• Comply with the light trespass requirements of Illuminating Engineering Society and International Dark Sky Association (IES/IDA)

Interior lightings

• Use timers and occupancy sensors to switch off unnecessary lights after occupancy hrs
• Control Light trespass through transparent surfaces by proper positioning and selection of lighting fixture or automatically closing the transparent openings after specified time
Summary

• Construction activity pollution prevention
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• Open Space
• Rainwater management
• Heat island reduction
• Light pollution reduction

YouTube video references

• Eutrophication Animation: http://youtu.be/6LAT1gLMPu4
• Heat Island Effect & Cool Roofs: http://youtube/urbpBy_Z5lE
• Vegetated Roof/Green Roof: http://youtu.be/pp79mGpomf4
• Light Pollution: http://youtu.be/UDIGJNVumE
Questions?
Ask your questions in the forum section