Establishing a framework for Sustainable Open Space Design

Understanding sustainable landscapes
GREEN BUILDING AND ARCHITECTURE AS AN ESTABLISHED PROCESS

GRIHA CONFERENCE 2012
Mohan S Rao INDÉ
BANGALORE, INDIA
OPEN SPACES AND LANDSCAPES REMAIN UNDEVALUED

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LAND

WATER

ECOLOGY

PRINCIPLES AND APPROACH TOWARDS SUSTAINABLE LANDSCAPE

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BANGALORE, INDIA
To preserve and protect the existing natural geomorphologic features on site.

To design and work with existing land topography so as to avoid excessive cut and fill of soil/slopes.

To design and promote techniques to avoid erosion of top soil.

To design open space land-use based on hydro-geological conditions as well geomorphologic conditions of the existing site.

To develop specific and contextual site erosion control plan and suggests passive and natural methods for soil conservation and avoid adverse engineering techniques for the same.

To ensure that land not used for construction or as open spaces is utilized for productive purposes including growing food and managing waste.
5. **Kitchen Garden**

Water availability is limited. We can't cultivate vegetables which require too much water. Conversely, the sun gives much light and we don't have to fear frost. Most suitable species are:

- **Artichoke** (common in Sardinia)
- **Broad bean**
- **Beetroot**
- **Topinambour**
- **Garlic**
- **Onion**
- **Carrot**
- **Potatoes**

Species require more water but appreciate full sun:

- **Tomatoes**
- **Melon**
- **Courge**
- **Aromatic herbs** (Thyme, Estragon, Basil, Parsley, Verveine, Minth)

**Harvesting Date**

- July-September
- June-July
- July-November
- October-April
- July
- July
- October
- July-September

**Rotation**

Rotation, each year, avoid disease development. Vegetables will supply the inn. For periods when any vegetables can be collected, it will be tinned and stocked.

**Water Management**

Cultivated surface: 1290 m²

**Seasonal Collected Water for the Kitchen Garden:**

- Spring: 3.2 m³
- Summer: 1.4 m³
- Autumn: 3.5 m³
- Winter: 3.8 m³

Water tanks will conserve it for the dry season: summer, when vegetables need humidity. There are not on the scheme, but water tank have to be covered to avoid evaporation and waterweed development or other organism which need light to grow.

However, we think that the water collected quantity is too tight. Water requirement have to be completed with another source.
COURTYARD  
GARDEN  
BUILDING  
STREET  
PUBLIC  
PASSIVE  
SYSTEMS  
INFRA  

Construction period

Ditch to protect construction site against erosion and running water

NOT TO BE TOUCHED!  
SAVED SOIL!
To provide strategies to treat storm water in a passive manner by reducing and minimizing use of drains to transport water out of the site.

To maintain, harvest and retain all incident water on site.

To provide enough pervious spaces within the development that would allow recharge of shallow aquifers within the region.

To develop measures and controls for site drainage that does not allow disturbance of the regional drainage pattern.

To develop a water cycle to meet the development's needs by reduced fresh water demand and by integrated rain water harvesting, management, recycling and reuse of waste water.
COURTYARD
GARDEN
BUILDING
STREET
PUBLIC
PASSIVE
INFRA

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Traditional settlements and their interdependency on Landscape systems - an integrated morphology derived through local contextual associations with livelihood patterns, natural systems, urban orders, and agricultural techniques.
This compound situated on the southern bank of the Tungabhadra river towards the north-east of the Hampi Plaza. The Tungabhadra River is one of the major rivers that flow through this area. The river is divided into two branches: the left branch flows through the town, while the right branch flows through the surrounding areas.

The Hampi Plaza is a major pilgrimage center in the eastern region of the Indian subcontinent. It is located near the Tungabhadra River and was once the capital of the Vijayanagara Empire. The plaza is known for its impressive architecture, with several temples and monuments that date back to the 14th and 15th centuries. The area is surrounded by a series of rock-cut structures, including the famous Vittala Temple, which is located at the heart of the plaza.

This complex is located about two kilometers southeast of the Hampi Plaza near the mouth of the Tungabhadra River, towards the north-east of the Hampi Plaza. The river flows through the town and divides it into two branches: the left branch flows through the town, while the right branch flows through the surrounding areas.

In Vijayanagara times the deltaic terrain surrounding the temple was referred to as pur, while there was a concept of a town or settlement surrounding the temple. A typical layout for drainage system was adopted. The Vittala Temple is located about 100 meters west of the Tungabhadra river, and the surrounding area is known as the Vittala Temple Group, which includes a number of smaller temples and shrines.

I believe that this temple has been functioning continuously ever since its inception in the 7th century. It is located near the Tungabhadra River and is surrounded by a series of rock-cut structures, including the famous Vittala Temple, which is located at the heart of the plaza.

A striking visual aspect of the urban structure of Vijayanagara is the nearly vectorless nature of the built component within the landscape. A key driver of such a development is the integration of productive landscapes within the network of urban systems. In fact, it would be more correct to say the opposite – that the urban system is almost exclusively comprised of non-urban landscapes, or what can be considered as natural or lessproductive spaces. This is done through a network of irrigation canals fed from the river Tungabhadra. It is only in the next lower level of prioritization that the urban systems including buildings, housing and other social structures are embedded within the ‘remaining lands’, deemed as less productive spaces.
Digital Terrain Model of Topographic character
Achuyatupura Precinct

Digital Terrain Model of the site, its watershed and drainage lines
Vitthala Precinct

Digital Terrain Model of the site, its watershed and drainage lines
Pushkarni as seen from the Mantapa

Small depressions

Detention pond behind the Western Bazaar Street at the foothills

Identification of detention ponds to be upgraded and cleared off vegetation to increase percolation rate to improve water performance

Small depressions are identified as detention ponds to feed the water bodies and reactivate the ancient water network
To preserve existing vegetation on site after careful analysis of ecological values and condition of existing trees.

To preserve all endangered vegetation, if existing on site.

To propose and encourage the growth of indigenous species on site that contributes towards development of a sustainable site ecology.

To avoid use of purely decorative plants or shrubs, but encourage planting of dense ground covers to protect the top soil of the land.

To propose a vegetation palette with a significantly reduced water demand.

To encourage maintenance of variety of local habitats and introduce them wherever appropriate and possible.

To develop a strategy aimed at mitigating urban heat island effect and to recreate a benign micro climate through reduced radiation and airborne dust and increased evapo-transpiration.

Aim for progressive improvement of land health and increased resilience of the site ecosystem over time.
Section – Light shelves for reflection and dispersion of summer sun.

Section – Light shelves and penetration of winter sunlight.

Section – Extension of terraces to provide protection from summer sun.

Section – Extension of terraces to allow penetration of winter sun.

Section – Maximum width of building maintained at 23 m to ensure penetration of daylight into the interiors.
Section – Direct heat gain from exposed roof slab

Section – Thermal buffer using vegetated roof slab

Section – SPV array over vegetated roof for increased efficiency

Section – Deep planters as radiation blankets and positive aesthetics
EXTENDING LANDSCAPE AS A PLANNING AND DESIGN TOOL
Scales of Sustainability

- **Built Capital**
  - Grey Infrastructure, Man-made materials (roads, sewers, buildings, etc.)

- **Human and Social Capital**
  - People, places and connections (family, neighbourhood, communities, education, health)

- **Natural Capital**
  - Air, water, energy systems, raw materials, and conditions of nature

- **Ecosystem**
  - Biodiversity, natural processes, water cycle, food chain, transpiration
Understanding Sustainability as an ECOLOGICAL matrix
UNDERSTANDING CITY AS A LANDSCAPE MEDIUM
POSITIONING NATURE AS THE PRIMARY ORDER
CAPTURING INTANGIBLE NOTIONS OF WATER
ESTABLISHING AN ECOLOGICAL MATRIX

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GEOCLIMATIC CONSIDERATIONS
SOCIO – CULTURAL CONTEXT AND INFLUENCES
Creating an ecology for Icchapor Site

**Surface City**
- Trade and industry-driven city
- Textile and diamonds industries (small and medium scale)
- Large presence of institutions and public facilities within the city (e.g., Diamond Institute)

**Industrial Diversification at Regional Level**
- Attracting large scale industries specialized in chemicals and petrochemicals
- Specialization of peripheral industrial areas

**Urban-Peripheral Relationship**
- Concentration of public facilities in Surat City
- Densification of the inner city
- Lack of linkage between residential and industrial areas

**Socio-Urban Implications**
- Rural-Urban migration for employment opportunities
- Development of private layouts in the immediate vicinity of industrial areas

**Opportunities for Icchapor TPS**
- Development of public facilities, integrated development with industries
- Creation of an amenity cluster to house incubation, vocational training, and skills upgradation center

**Non-Integrated Development**
- Lack of shared services/amenities in the Surat region
- Lack of integrated environmental services acknowledging the flood-prone nature of Surat region

**Introvert Development**
- No inter-dependent services to other housing schemes
- Local services

**Residential Development as per TPS**
- Proposals as per TPS developed as introverted establishments without any provision for larger institutional facilities

**Industrial Development**
- Industrial developments established with no response to larger environmental concerns or provision for shared facilities for adjacent developments

**Outrovert Development**
- Local services

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To conceive the site to be within an ecological loop allows it to be connected not just environmentally but also socially and politically with the larger context, allowing a feedback loop to operate with the proposed development. It offers an approach an regional approach that is more integral in nature, rather than one which is isolated within the larger context.

The diagram illustrates both the tangible and intangible forces working on the site that would eventually govern the development of the site as Industrial-Institutional hub to close the ecological loop.
Water Management Strategy

Section A
Natural Ground Cover

25%

Section B
10-20% impervious surface

21%

Section C
35-50% impervious surface

20%

Section D
75-100% impervious surface

21%

Section E

40%

10%

Evaporation

Scrub on off

Shallow infiltration

Deep infiltration

25% - 35%

38%

20%

20%

40%

55%

Recessed landscape for infiltration

Vegetation Bed

Permeable Parking surface

Infiltration system

Non-embanked river (normal)

Non-embanked river (during flood)

Embanked River (during flood)

Overflow through vegetation

OverFlow to street drainage system

Overflow to street drainage system

Low fertility

Rise in River Bed

Figure A

Infiltration system

Figure B

Sedimentation Trap

Figure C

Infiltration system

Figure D

Infiltration system

Figure E

Infiltration system
Application of TP scheme in Icchapor

Original Plots

- Located West of Surat City,
- 164 Ha
- Immediate vicinity of industrial complexes
- 155 original plots.

Demonstration Plots

- Laying out the roads,
- Reconstitution of final plots,
- Every owner of the original plot gets a final plot after deduction of a percentage of land varying between 10 to 20,
- Reservation for Housing for S.E.W.S. (10%), for open-spaces (5%), social infrastructure (5%) and for sale by public authority (15%).
Application of TP scheme in Icchapor

Zone with High Natural and Industrial Hazard Risk

- Large portion of parcels affected by a high degree of exposure to natural and industrial hazard risk,
- Disparity between owners exacerbated by future development,
- Risk to compromise the economic and social balance

Land Valuation Evolution

72 plots of 155 affected by a high degree of risk from industrial and natural hazards.

46 % of the owners with a decreased value of their land after 5 years compared to others.

- 23 % after 5 years for land with risk
+ 61 % after 5 years for land without risk.
Water System restructuring
Schematic Plan
## Ecological Matrix

<table>
<thead>
<tr>
<th>Design</th>
<th>Principles</th>
<th>Objectives</th>
<th>Implementation Index (100)</th>
<th>Mobility</th>
<th>Water Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft rainwater management</td>
<td>- Bio-swale, Permeable parking surface, Infiltration System</td>
<td>- Collect rainwater in drains</td>
<td>78</td>
<td>Soft</td>
<td>Rainwater Management</td>
</tr>
<tr>
<td>Drained rainwater management</td>
<td>Storm-water drainage system</td>
<td>- Leave natural space to allow water spread</td>
<td>56</td>
<td>Motorized</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Flood plain with streamside wetland, Gabion placement, Joint Planting</td>
<td>- Raise an artificial bank to contain / redirect water</td>
<td>89</td>
<td>Decentralized</td>
<td></td>
</tr>
<tr>
<td>Soft River Edge</td>
<td>- Embankment of the river edge, Built canal</td>
<td>- Plant open spaces, grow food + animal husbandry</td>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard River Edge</td>
<td></td>
<td>- Create non-built space for social and collective usage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open-Space</td>
<td>- Urban Farming</td>
<td>- Create non-built space for social and collective usage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Un-Productive&quot;</td>
<td>- Community sharing open-space</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>River Edge</td>
<td>- Park and Playground (natural or impervious ground)</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobility</td>
<td>- Dedicate space for pedestrian and cyclist</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft</td>
<td>- Increase performance of motorized transport</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motorized</td>
<td>- Treat and recycle water closest to its usage</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decentralized</td>
<td>- Phyto remediation and treatment plant, Artificial wetland</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Time of implementation

| (1=long, 2 = medium, 3=short) | 2 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 2 |

### Cost of implementation

| (1=high, 2 = medium, 3=low) | 3 | 1 | 3 | 1 | 2 | 3 | 3 | 2 | 3 |

### Skills Required

| (1=high, 2 = medium, 3=low) | 2 | 1 | 2 | 1 | 3 | 1 | 2 | 2 | 2 |

### Frequency of maintenance

| (1=high, 2 = medium, 3=low) | 3 | 1 | 2 | 3 | 1 | 2 | 2 | 2 | 2 |

### Cost of maintenance

| (1=high, 2 = medium, 3=low) | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 2 |

### Skills/Materials

| (1=high, 2 = medium, 3=low) | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 |

### Maintenance Index (100)

| 78 | 56 | 67 | 78 | 56 | 56 | 78 | 78 | 67 |

### Run-Off volume

| (1=High, 2=medium, 3=low) | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 |

### Resilience

| (1=High, 2=medium, 3=low) | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 |

### Velocity

| (1=High, 2=medium, 3=low) | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 |

### Flexibility of the system

| (1=Low, 2=medium, 3=high) | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 |

### Downstream Impacts

| (1=High, 2=medium, 3=low) | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 3 |

### Flood Mitigation Index (100)

| 93 | 33 | 93 | 33 | 93 | 33 | 80 | 33 | 93 |

### Increased biodiversity

| (1=low, 2=medium, 3=high) | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 |

### Erosion Prevention

| (1=low, 2=medium, 3=high) | 3 | 1 | 3 | 1 | 3 | 1 | - | - | 3 |

### Water Recycling

| (1=low, 2=medium, 3=high) | 2 | 1 | 2 | 1 | 3 | 2 | - | - | 3 |

### Waste Recycling

| (1=low, 2=medium, 3=high) | 2 | 1 | 2 | 1 | 3 | 1 | - | - | 2 |

### Absorption/Reduction of Pollution

| (1=low, 2=medium, 3=high) | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 |

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Establishing an equitable model for development

Distinct from a regular ownership right, the Development Right encompasses the productive performance of the land, either built and non-built. Its value is hence defined accordingly to its inclusive development potential.

**Productive Landscape Index**

As demonstrated earlier in the ecological matrix, the productive landscape obtains a sustainability index of 87/100 while the non-productive landscape obtains a sustainability index of 49/100. (for the details of the sustainability index, please refer to the ecological matrix presented on page 9).

Hence, Productive Landscape has an added value of 77% compared to Non-Productive Landscape.

<table>
<thead>
<tr>
<th>Development Right Valuation and its sharing</th>
<th>Productive Landscape</th>
<th>Non-Productive Landscape</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st Step</strong></td>
<td><strong>Global Development Right Value at Site Level</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Built Value</strong></td>
<td><strong>Un-built Value</strong></td>
<td></td>
</tr>
<tr>
<td>Buildable Land Value (₹)</td>
<td>Productive Landscape Value (₹)</td>
<td></td>
</tr>
<tr>
<td>Definition of an Average Buildable Land Rate per sq.m. at Site Level = Cost of land + Cost of Infrastructure Development + Built-up Cost + Overhead /Taxes/Profits (40%)</td>
<td>Definition of an Average Productive Landscape Rate per sq.m. at Site Level = Cost of land + Cost of Infrastructure Development + Productive landscape index + Overhead /Taxes/Profits (40%)</td>
<td></td>
</tr>
<tr>
<td><strong>2nd Step</strong></td>
<td><strong>Individual Development Right Value</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Individual Built Right (sq.m.) x Buildable Land Rate (₹/sq.m.)</td>
<td>Individual Built Right (sq.m.) x Productive Landscape Rate (₹/sq.m.)</td>
</tr>
<tr>
<td><strong>Total Individual Development Value</strong></td>
<td></td>
<td>Built Value + Un-Built Value (₹)</td>
</tr>
</tbody>
</table>

Hence, Productive Landscape has an added value of 77% compared to Non-Productive Landscape.
INFRASTRUCTURE INTEGRATION

**Section A - 17m Secondary Road**

**Section B - 24m wide Primary Road**
CHAPTER 4: CASE STUDY

BABZAERS, MOROCCO

GREEN INFRASTRUCTURE AS AN URBAN STRUCTURING PARADIGM