HUMANISING ARCHITECTURE

Case Study of

ITC BHADRACHALAM TOWNSHIP
TEAM

• CENTRAL PROJECTS ORGANISATION, ITC LTD
• SPACE MATRIX DESIGN CONSULTANTS PVT LTD
• INTEGRATED DESIGN (INDE)
• TERI - BANGALORE
ITC BHADRACHALAM TOWNSHIP

Constant 29 Degrees

External Temperature 2 – 45 degrees

Internal temperature varies by only 1 degree

The equivalent of a 2km high building

Captures natural air flow
The proposed site is located in Sarapakka Village, Khammam Dist., Andhra Pradesh, 4 kms from the town of Bhadrachalam.

The complete Mill Unit at Bhadrachalam is spread over 500 acres of land. National Highway 221 buffers the proposed site from the ITC Paper Mill factory.

**Nearest Railway Station:**
Kottagudam (30kms)

**Nearest Airport:**
Hyderabad (8hrs drive);
Vijaywada (4hrs drive)
Climatic Study and Analysis provided by TERI – Bangalore

ITC BHADRACHALAM TOWNSHIP

Climate Analysis

17°66’, 80°88’
Average Elevation: 63 mts

Temperature and RH analysis for Bhadrachalam

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBT (Max)</td>
<td>33.6</td>
<td>38.4</td>
<td>41.6</td>
<td>43.5</td>
<td>44.9</td>
<td>45.9</td>
<td>35.8</td>
<td>37.1</td>
<td>36.6</td>
<td>37.9</td>
<td>38.4</td>
<td>32.4</td>
<td>38.8</td>
</tr>
<tr>
<td>RH</td>
<td>54.7</td>
<td>52.2</td>
<td>49.2</td>
<td>46.8</td>
<td>44.5</td>
<td>57.4</td>
<td>82.9</td>
<td>76.3</td>
<td>79.4</td>
<td>71.3</td>
<td>52.8</td>
<td>59.6</td>
<td>60.6</td>
</tr>
</tbody>
</table>

Max Temperature = 46 deg
Max Humidity (RH) = 83%

As per the climate zone map of India, provided in National Building Code 2005 and the Energy Conservation Code 2007, Bhadrachalam is categorized as - Warm & Humid Climate.
Program

EXISTING SINGLE STOREY RESIDENTIAL DEVELOPMENT

PROPOSED MULTI STOREYED RESIDENTIAL DEVELOPMENT

1510 FAMILIES

245,000 SQM BUILT UP AREA

LARGE SCALE SUSTAINABLE DEVELOPMENT
The development plan envisions various units types and modules for different workforce sections as well as necessary amenities, play areas, infrastructure and open spaces. The project demonstrates a high-standard, sustainable quality of life among various sections of users.

This large development (~ 1500 dwelling units; approx. 245,000 sq.m built area) is focused on the model of an “Integrated Township” - a place marker for a cost-effective yet sustainable residential development in India.
DESIGN DRIVERS
STAKEHOLDER PARTICIPATION
Methods & Procedures : Participation

Dedicated user workshop involving participation from Stakeholders (~120 people) covering managers, employee union, ladies and younger population in different sessions.

Integrated design approach – active participation, design workshops from different parties including end users, master planners, architects, landscape architects, environmentalist, geologist, engineers, cost consultants and water consultant.
Methods & Procedures: Land

**EXISTING**

- **900 FAMILIES**
- **110 ACRES**
- **11% GROUND COVER**

**PROPOSED**

- **1510 FAMILIES**
- **43 ACRES**
- **19% GROUND COVER**

**Carrying Capacity**

- **900 FAMILIES** on **110 ACRES** with **11% GROUND COVER**
- **1510 FAMILIES** on **43 ACRES** with **19% GROUND COVER**

**Sustainable Sites**

- **Mandate**: Green cover = 9 m²/capita = 67,950 sqm. Project achieves a green cover of 1,250,000 sqm, which is 16.5 m²/capita
- **Intent**: Encourage sites within existing communities.
- **Intent**: Protect and preserve sensitive areas of site and reduce the impact of a development on the environment.
Methods & Procedures: Land

Topography

Site Assessment & Planning

• **Intent**: Preserve & protect the rare and unique geological and geo-morphological features of the site.

• **Intent**: Minimize soil disturbance in design & construction.

• **Intent**: Measures should be taken to store & preserve topsoil.

• **Intent**: Natural and semi-natural plant groupings should be conserved wherever possible and disturbed as little as possible.

Earth Balance

Re-use the excavated earth for foundations to create berms as a noise buffer towards the highway.

SECTION 01: Section of earth berm along highway edge
Methods & Procedures : Land

- Elimination of basement parking system, to retain natural terrain
- Modulated internal Levels of stilt parking, minimising cut and fill.
- Porous built form, allowing pedestrian access and green connect

Site Assessment & Planning

- Intent : Develop design & engineering strategies to minimize cut & fill of slopes
- Intent : Roads & lot layouts should complement the site topography
DESIGN DRIVERS
PASSIVE DESIGN
Methods & Procedures: Passive Right Intent

**VIEW QUALITY**

60% units face outwards looking towards an external space (outside site)

**LIGHT QUALITY**

All units face outwards towards an outdoor space

**CROSS VENTILATION**

100% units have at least two sides of the unit being open edge. Spacing between units to enhance the cross ventilation.

**THERMAL COMFORT**

60% units facing north
40% units facing south
Methods & Procedures : Solar Passive Design

- Buildings are clustered such that they are mutually shaded.
- Reduced the heat gain to buildings.
- Residential Unit – Deep shades and balconies are provided to shade the fenestration.
- Window to Wall ratio is 60% (lower than the maximum permitted by ECBC)
- Appropriate external shading has been recommended to meet the effective SHGC

Solar Passive Design

- **Intent**: Integrate solar passive design strategies at various levels and shall be climate responsive
- **Intent**: The built form shall reflect climate responsiveness of the building.
- **Intent**: Space planning of building shall be worked out in order to create thermal buffer zones
### Methods & Procedures: Daylight

#### Living & Dining

<table>
<thead>
<tr>
<th>Floor</th>
<th>Ground Floor</th>
<th>Fifth Floor</th>
<th>Ninth Floor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average DF</td>
<td>1.14</td>
<td>1.2</td>
<td>1.28</td>
</tr>
</tbody>
</table>

#### Kitchen

<table>
<thead>
<tr>
<th>Floor</th>
<th>Ground Floor</th>
<th>Fifth Floor</th>
<th>Ninth Floor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average DF</td>
<td>2.8</td>
<td>2.95</td>
<td>3.2</td>
</tr>
</tbody>
</table>

#### Bedroom

<table>
<thead>
<tr>
<th>Floor</th>
<th>Ground Floor</th>
<th>Fifth Floor</th>
<th>Ninth Floor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average DF</td>
<td>1.8</td>
<td>2.0</td>
<td>3.8</td>
</tr>
<tr>
<td>Shading Factor</td>
<td>1</td>
<td>0.83</td>
<td>0.56</td>
</tr>
</tbody>
</table>

#### Shading Angles:

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Shading Design Time</th>
<th>Vertical Shading Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>North East</td>
<td>09:00hrs, 15th Apr</td>
<td>56</td>
</tr>
<tr>
<td>North West</td>
<td>16:00hrs, 15th Apr</td>
<td>42.3</td>
</tr>
<tr>
<td>South East</td>
<td>10:00hrs, 15th Feb</td>
<td>43.7</td>
</tr>
<tr>
<td>South West</td>
<td>15:00hrs, 15th Feb</td>
<td>40.3</td>
</tr>
</tbody>
</table>

- All rooms would require VLT greater than 50% and SHGC less than 0.41.
- All Rooms facing the small courtyards would require VLT greater than 70% and SHGC less than 0.41.
- Bedrooms would need external shading as per solar geometry (8th, 9th & 10th Floors). Minimal shading is required for the lower floors.
- All Kitchen would require VLT greater than 70%.
- Single glazed window not available with VLT 70% and SHGC 0.41. Additional solar shading is provided in accordance to GRIHA.
- The total daylight area is estimated to be more than 75% of the total living area.

![Shading Device for typical window](image-url)
Methods & Procedures: Electrical

Design Goals:
- Increase occupant comfort & improved productivity
- Optimize building system performance
- Reduce building life-cycle costs
- Energy efficient design
- Sustain property values
- Maintenance friendly design
- Optimizing of distribution losses

TOTAL DEMAND LOAD

HOUSING & AMENITIES
- 6010 kW

COMMON UTILITIES
- 210 kW

STREET LIGHTING
- 36 kW

LANDSCAPE LIGHTING
- 114 kW
Methods & Procedures: Water

**Water Management**

- Centralized Collection sump of the water source (External)
- Individual Over Head tanks for Fresh water and Flushing water separately
- Solar Hot water of 200 L capacity for each family.
- Approx 15000 kW-hr of energy is saved by Solar water heaters, in terms of electricity required for water heating using Geysers

### Carrying Capacity of Site

<table>
<thead>
<tr>
<th>Source/Item</th>
<th>Quantity (litre/person/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh water source</td>
<td>832000</td>
</tr>
<tr>
<td>Available treated waste water</td>
<td>112000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>944000</strong></td>
</tr>
<tr>
<td>Average water demand per person</td>
<td>110</td>
</tr>
<tr>
<td><strong>Carrying Capacity of site</strong></td>
<td><strong>8582</strong></td>
</tr>
</tbody>
</table>

*Note:*
- Source quantity as per EPA standards
- Source of fresh water is the null unit
- No tapping of water from ground
- Average water demand per person as per UDPFI 70 to 130 lpcd

### Proposed Water Efficiency

<table>
<thead>
<tr>
<th></th>
<th>Baseline-GRIHA</th>
<th>Actual</th>
<th>Baseline-GRIHA</th>
<th>Actual</th>
<th>% of Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flushing demand</td>
<td>54</td>
<td>14</td>
<td>13,79,70,000</td>
<td>3,57,70,000</td>
<td>74.1%</td>
</tr>
<tr>
<td>Domestic demand</td>
<td>165</td>
<td>68</td>
<td>42,15,75,000</td>
<td>17,24,62,500</td>
<td>59.1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>219</td>
<td>81.5</td>
<td>55,95,45,000</td>
<td>20,82,32,500</td>
<td>62.8%</td>
</tr>
<tr>
<td>Irrigation</td>
<td>6</td>
<td>2.4</td>
<td>55,95,45,000</td>
<td>20,82,32,500</td>
<td>60%</td>
</tr>
</tbody>
</table>

**Intent:**
- The carrying capacity of the site is 8500 residents. Proposed no. of residents is 7550.
- Develop and integrate a water strategy at the community level to ensure that the landscape water requirement at the community level is reduced.
- Provision for adequate quality of water for potable and non-potable applications with stringent monitoring plan.
**Methods & Procedures : Water**

**Storm Water Management**

<table>
<thead>
<tr>
<th>Month</th>
<th>Storm water runoff in months (m³)</th>
<th>Rain water harvested from rooftops in months (m³)</th>
<th>Total (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>259</td>
<td>145</td>
<td>404</td>
</tr>
<tr>
<td>Feb</td>
<td>591</td>
<td>330</td>
<td>921</td>
</tr>
<tr>
<td>Mar</td>
<td>1,305</td>
<td>728</td>
<td>2,034</td>
</tr>
<tr>
<td>Apr</td>
<td>932</td>
<td>520</td>
<td>1,452</td>
</tr>
<tr>
<td>May</td>
<td>2,310</td>
<td>1,289</td>
<td>3,599</td>
</tr>
<tr>
<td>Jun</td>
<td>6,554</td>
<td>3,658</td>
<td>10,212</td>
</tr>
<tr>
<td>Jul</td>
<td>14,170</td>
<td>7,908</td>
<td>22,078</td>
</tr>
<tr>
<td>Aug</td>
<td>13,976</td>
<td>7,800</td>
<td>21,776</td>
</tr>
<tr>
<td>Sep</td>
<td>9,320</td>
<td>5,201</td>
<td>14,521</td>
</tr>
<tr>
<td>Oct</td>
<td>3,750</td>
<td>2,093</td>
<td>5,843</td>
</tr>
<tr>
<td>Nov</td>
<td>1,227</td>
<td>685</td>
<td>1,912</td>
</tr>
<tr>
<td>Dec</td>
<td>395</td>
<td>221</td>
<td>616</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>54,790</strong></td>
<td><strong>30,577</strong></td>
<td><strong>85,367</strong></td>
</tr>
</tbody>
</table>

**Storm Water Management & Climate Change Adaptation**

- **Intent**: Reduction of hard paving on site to reduce runoff, increase infiltration and reduce Urban Heat Island effect.

- **Intent**: Ensure that the entire rainwater falling on the site is recharged through adequate measures.

- **Adaptation Measure**: Prepare for urban impact: drought and water shortage by extensive rainwater harvesting.
Methods & Procedures : Water

PERVIOUS SURFACES
Increase ground water recharge by maximizing pervious surfaces
Alternate options to traditional street & parking area paving systems

Storm Water Management

Vegetated Swales
direct and collect storm water.

Percolation Pits
harvest incident rain & reinforce passive drainage.

Permeable Surfaces
maximized to allow infiltration and recharge.

Grading of Land
manage water and control erosion.

SWALES & DETENTION PONDS
Storm water runoff from swales is collected in shallow Detention Ponds, allowing ground water recharge.
Methods & Procedures: Road Section

Section 01: High Traffic Loop Roads (Concrete Roads) with swale
DESIGN DRIVERS
MOBILITY
### Methods & Procedures: Mobility

**SITE CIRCULATION PLAN**

Integration of Landscape Elements

Streetscape designed to facilitate pedestrian movement

- Internal driveways are classified as High Traffic and Low Traffic Roads.
- Internal green courts are pedestrian-only zones.
- Blocks linked through internal pedestrian network.

**ROAD WIDTH CALCULATION**

<table>
<thead>
<tr>
<th>MANAGERS</th>
<th>CARS</th>
<th>2-WHEELER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>573</td>
<td>329</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EMPLOYEES</th>
<th>TOTAL PCU AT PEAK HOUR</th>
<th>902 PCU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TOTAL PCU AT PEAK HOUR</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>151</td>
</tr>
</tbody>
</table>

**Mobility**

- **Intent**: Develop a hierarchical road network
- **Intent**: Follow road classifications and design standards for urban roads - Indian Roads Congress (IRC) codes
- **Intent**: Promote safety, efficiency, community living, environmental and aesthetic quality and cycling & walking

Plan showing the treatment of circulation highlighting the pedestrian entrance to the building.

Integrated planting and swale along the ramp edge.

View of landscape court formed along the circulation.

View of pergola space to define the entrance.
DESIGN DRIVERS
SOCIAL WELL BEING
Create equity and social well being
Re-create similar social fabrics and enhancing the sense of identity among users.
**Methods & Procedures : Social Well Being**

**Promote social cohesion and harmony**

Intermediate public road through site, connects the adjacent villages to the Highway. Porous street edge with commercial activities. Dedicated hawker zone. Community Hall and Play areas abutting the road.

**Intent :** Measures to be undertaken on site and within site design to bring in equity and social well being

**Intent :** Create public and recreational facilities that help build an egalitarian society

**Intent :** Provide housing for all sections of society

**Intent :** Room for informal market like vegetable vendors

Image : View of the frontage offered by commercial block and its interaction with the public road

Typical section showing extension of road to create a hawker’s zone with semi-permanent shaded space for shops.

View of semi-permanent shaded structure in the hawker’s zone.
Methods & Procedures: Social Well Being
Methods & Procedures: Social Well Being

Community Linkage

Pedestrian Connect
Ease of connection, reduced dependency on vertical transportation or mechanical means of transportation. Landscape designed to emphasize block entrance and retain green connect to higher levels.
Methods & Procedures : Social Well Being

Community Linkage

Landscaped Terraces
Alternating landscaped terraces act community break-out spaces
Create varied experiences and promote social interactions and community activities
Methods & Procedures: Social Well Being

Community Linkage

Interlinking Corridors
Extending the streetscape beyond the ground plane to higher levels of building
Bringing the street character into the building
Community Linkage

Personalisation of Spaces
Corridors extend as Transitional spaces – a passage from the public realm to private. Allow for personalisation, bringing quality and identity to spaces.
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DESIGN DRIVERS
MATERIALS
Methods & Procedures : Locally Available Materials

- 100% of the building blocks shall have at least 40% fly ash (by volume).
- Minimum 30% of OPC, used for masonry and plaster mortar, shall be replaced by fly ash.

Fly Ash Bricks

To be produced locally.
Fly Ash to be sourced from the adjacent paper mill
ITC BHADRACHALAM TOWNSHIP

DESIGN DRIVERS
WASTE
Methods & Procedures : Solid Waste Management

**Garbage Chutes**

- **Intent**: Ensure that organic waste and recyclables must be collected and stored separately in multi-coloured containers/bins at both decentralized and centralized level.

- **Intent**: Ensure a facility/system for effective and efficient management of waste

- **Intent**: Arrangements for secondary collection and communal storage for recyclables should be made to be taken up on a frequent basis
Methods & Procedures: Sewage Waste Management

Vortex Treatment

- Elimination of odours and colours
- Natural self purification process
- Low energy consumption (1 to 3Hp)
- Reduced footprint
- No chemicals or additives required
- Scalability for different types and quantities of waste water
- Easy maintenance and operation
- Aesthetic integration within landscape
- Low running cost

Study and Analysis provided by: Auroville Centre for Scientific Research

FOOT PRINT REDUCTION
From ~1m2/user
To ~0.15m2/user
### Summary

<table>
<thead>
<tr>
<th>Sustainable Site</th>
<th>Water Management</th>
<th>Social Wellbeing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>16.5%</strong> GREEN COVER PER CAPITA</td>
<td><strong>62.8%</strong> REDUCTION FROM BASELINE</td>
<td>EQUITY SOCIAL CONNECT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mobility</th>
<th>Energy</th>
<th>Waste Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>PedShed 400M RADIUS</td>
<td><strong>PASSIVE RIGHT</strong></td>
<td>vortex de-wats</td>
</tr>
</tbody>
</table>
“In the coming decades, the survival of humanity will depend on our ecological literacy - our ability to understand the basic principles of ecology and to live accordingly...”

(Fritjof Capra – Founder - Centre for Ecolitracy, Berkeley, California)

THANK YOU