Mainstreaming Solar Energy in Urban Building

by
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Practicing Architect, Sustainable Design Consultant

Case Study
Indira Paryavaran Bhawan
This is an initiative to mainstream Solar energy in urban areas as against coal and other non-renewables.
Use of Solar Energy has focused on:

- Usage for part lighting solutions in buildings
- Stand alone Outdoor Lighting
- Large scale usage in mega solar farms away from urban areas.

- Can it be a Complete Solution for buildings?
- Can it occur with severe Site Area constraints?
Executing the Design Brief

Site on Jorbagh Road
The building is being designed as the first "Energy-Positive" - Urban - govt. - building
Architectural Concept
Developing the Plan

Plot Area – 9565 sqm
Wider Front Setback (22m) to protect front tree line
Preserve the integrity of the green street

Emphasis on the North & South for Optimal Solar Light but cutting Solar Heat, Bringing the Greens in
Plan developed for direct pedestrian axis to East, North and West Entrance without crisscrossing vehicles
Developing the Plan – Ground Floor

The Courtyard also helps in air movement besides being a shaded interaction space.

Ground Floor populated by Common and Public facilities which are Ok with limited natural light.
- Zero tolerance to surface parking to reduce heat island
- First Basement Parking with Automated parking Below. Helps reduce volume of parking / excavation / embodied energy of structure
- Automated Parking with 19sqm/car instead of 35sqm/car in manual parking
Developing the Plan – First Floor

Keeping Service Areas, Staircases on low light areas. Efficient Usage of the perimeter to maximize sunlit areas and views for the users.
Developing the Plan – Third Floor

OFFICE
RECREATION
CIRCULATION
SERVICES

CROSSOVER BRIDGE
Toward an Energy Positive Approach

Provision of Solar Photovoltaics for Net Zero requirement also Shades the Roof
Towards an Energy Positive Approach

Photovoltaics Stepping towards the south side creating a strong agenda for the future for urban buildings on limited site areas

Photovoltaics Stepping towards the south side creating a strong agenda for the future for urban buildings on limited site areas
Elevations - North

Superstructure = 19,088 sqm
Basement Area = 11,826 sqm
Total Area = 30,914 sqm
Environmental Response of the MoEF Office Bldg.
- Maximum Ground Coverage Used (30%) to keep building height comparable to the surroundings
- Respecting the Eco-logic of the site. Building Punctures & jalis to Aid Cross Ventilation and maximizing non-conditioned spaces like lobbies, passages, service areas.
Site and Water Mgmt Strategies

Appropriate Shading from Summer Sun, while allowing in winter sun

60% reduction in water usage
Energy Conservation Measures

- Energy efficient lighting with LPD = 5W/SQM
- Reduction of artificial lighting load
- Remaining lighting load supplied by building integrated photovoltaics
- Daylighting design with perimeter & inner courtyard fenestration
- Building envelope design to minimize heat ingress
- Functional zoning to minimize AC load
- RCC lightsheLF with reflective surface
- Photovoltaics on space frame over courtyard
- Further cooling air in cooling towers
- Heat exchanger in A.H.U.
- Chilled beam system for air distribution
- Rooftop rainwater
- Surface runoff
Zero Energy
Changing Expectations in Thermal Comfort

Basic level of comfort levels many of us are used to in climate appropriate clothing

Executive Decision for the Setpoint temperature for summers set to 26 degC & Winters at 19 degC

Highly controlled temperatures which can reduce to the extremely cold.
Clothing - Heavy Business wear
Energy Consumption on Site

(MWh)

Area Lighting
Task Lighting
Misc. Equipment
Exterior Usage
Pumps & Aux.
Ventilation Fans
Water Heating
Ht Pump Supp.
Space Heating
Refrigeration
Heat Rejection
Space Cooling

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Energy Positive Building

• Extra Efficient (imported) Solar photo voltaic (SPV) Proposed (Terrace & Projections) : 930 kWp

• Energy produced by above : 14,91,000 kWh SPV Panels per year

• Energy consumption for bldg / year : 14,21,000 kWh
Solar…..but also a shade
## Performance Parameters

<table>
<thead>
<tr>
<th>S.No</th>
<th>Description</th>
<th>Conventional</th>
<th>IPB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air-conditioning Load</td>
<td>150 Sqft/TR</td>
<td>450 Sqft/TR</td>
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<tr>
<td>2</td>
<td>Lighting Power Density</td>
<td>1.1 W/Sqft (ECBC)</td>
<td>0.5 W/Sqft</td>
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<tr>
<td>3</td>
<td>Electrical Load</td>
<td>10 W/sqft</td>
<td>4.3 W/sqft</td>
</tr>
</tbody>
</table>
Geothermal Cooling

- Condenser water heat shall be rejected to earth by boring at suitable depth & sending hot water at 100°F (37.8°C) & back at 90°F (32.2°C).
- Enormous water saving since no make up water is required.
- Make up water pumping & treatment cost get eliminated.
- Saves cooling tower fan energy.
Active Chilled Beams

Working Principle
Supply air flows through nozzles in small air jets which induce room air to flow around the coil & air gets cooled.

Design / Constructional / operational advantages
- Reduces power consumption
- Easy Installation
- No noise as no moving parts
- Easy Air balancing activity
- No filters maintenance
- Save architectural space height
IPB reduces energy requirement by 67% overall vis-à-vis conventional

- **N-S Orientation** – Limiting WWR – Insulation on wall & roof – Extensive Greenery to reduce heat load

- Maximizing **Day lighting** to reduce lighting loads

- Extremely Low **Lighting Power Density** – 5w/sqm

- Planning to **Minimize AC loads** (Keeping open atrium for cross ventilation, Non conditioned lobbies)

- **Efficient HVAC** with Screw Chillers, VFD’s, Chilled Beams

- **Ground based heat exchange** for Condenser Water

- **Remote Computing** - thin client servers

- **Energy efficient appliances** (5 star BEE)

- **…. SPV’s** for the remaining load

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**Net Zero Design**
INDIRA PARYAVARAN BHAWAN
NEW DELHI
has been provisionally certified with a
‘Five Star’
rating under
GRIHA
(Green Rating for Integrated Habitat Assessment)
The Indigenous Rating System for green buildings in India

An initiative of
The Ministry of New and Renewable Energy
Government of India
and
The Energy and Resources Institute
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Thank You
## Projected Cost

<table>
<thead>
<tr>
<th>Cost Item</th>
<th>Rs. In Crores</th>
</tr>
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<tbody>
<tr>
<td><strong>A A &amp; E S</strong></td>
<td>128.63</td>
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<tr>
<td>Civil Incl WS SI</td>
<td>67.96</td>
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<tr>
<td>Electrical</td>
<td>22.08</td>
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<tr>
<td>Solar</td>
<td>8.50</td>
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<tr>
<td>Furniture</td>
<td>8.35</td>
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<tr>
<td>Mechanised Parking</td>
<td>14.00</td>
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<tr>
<td>Local Bodies Charges</td>
<td>1.15</td>
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<tr>
<td>Consultancy Services</td>
<td>0.70</td>
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<tr>
<td>Misc incl Contigencies &amp; labour Cess</td>
<td>5.89</td>
</tr>
</tbody>
</table>

**Unit cost Rs 41,610 / sqm. Rs 34,380/sqm. excluding parking & furniture.**