IPRO 323
ENERGY-AND ENVIRONMENT-BASED
ARCHITECTURAL RESEARCH & DESIGN

Student Center
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PROJECT BRIEF:

AREA:
200,000 SQ.FT/ FLOOR

PROGRAM:
STUDENT CENTER
2-STORY BUILDING WITH BASEMENT

OBJECTIVE:
INTEGRATION OF BIPV & WIND TURBINE SYSTEM WITH BUILDING ENVELOPE

PROJECT INTRODUCTION
CLIMATIC ELEMENTS

TEMPERATURE

HUMIDITY

EXTRA DATA RANGE
MEAN MONTHLY TEMP
MEAN MONTHLY MAX TEMP
MEAN MONTHLY MIN TEMP

MEAN MONTHLY HUMIDITY (%)
MEAN MONTHLY MAX HUMIDITY (%)
MEAN MONTHLY MIN HUMIDITY (%)
WIND MOVEMENT

AUGUST

SEPTEMBER
LEARNINGS FROM TRADITIONAL ARCHITECTURE
Massing for mutual shading
Blank walls facing West
Smaller opening on W & S side
Solids & Voids

Staggered mass facing courtyard
Covered circulation areas
Solids & Voids
LEARNINGS FROM TRADITIONAL ARCHITECTURE
The traditional vernacular style of architecture in Dubai is the result of a mixture of three dominant factors:

the climate (hot and humid),
the religion and customs of its people, and
the locally available building materials.

To reduce the heat as much as possible, houses were constructed close to each other, with narrow alleys (*sikkas*) running in between from North to South, ending at the creek. For most of the day, these alleys were shaded by the high walls of the houses and allowed the fresh North wind to circulate freely.
LEARNINGS FROM TRADITIONAL ARCHITECTURE
Narrow Shaded Streets opening into courtyard
Tall Structures abutting street
Proportions of openings: Solids & Voids
Projected balconies at upper level reducing gap for direct sunlight
(carved in stone or wood)
Vegetation
Introvert Design
Segregation of spaces
Use of Wind Towers
Thermal buffer: walls, courts, patios

LEARNINGS FROM TRADITIONAL ARCHITECTURE
Study of Building Form

Fig. 3.1. Three different dispositions of built forms

Fig. 3.2. Modified Court, Pavilion and Street forms

Fig. 3.6. Shade and light pattern of a cluster of Courts

Fig. 3.17. Hourly solar views, projected area and solar exposure and total daily solar exposure for a cube for summer and winter (for 29°N latitude.)

Fig. 3.26. Solar efficiency $E_s$ of building forms at different latitudes
Design development: Plan
Design development: Thermal Zones

Thermal buffer around activity areas
Mutual shading
Design development: Roof Plan
Design development: Section 1
Design development: Section 2

SECTION 2-2

- floor offset
- activity area
- courtyard
- activity area
- wind tunnel
Built-form: Study of Shades & Shadows
(Summer Solstice 10:00am)
Built-form: Study of Shades & Shadows (Summer Solstice 12:00pm)
Built-form: Study of Shades & Shadows
(Summer Solstice 2:00pm)
Built-form: Study of Shades & Shadows
(Summer Solstice 4:00pm)
Built-form: Study of Shades & Shadows
(Winter Solstice 10:00am)
Built-form: Study of Shades & Shadows
(Winter Solstice 12:00pm)
Built-form: Study of Shades & Shadows
(Winter Solstice 2:00pm)
Built-form: Study of Shades & Shadows
(Winter Solstice 4:00pm)
Phasing
**POWERGUARD SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Values (USA)</th>
<th>Values (Metric)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tile Weight</td>
<td>5 - 7 lb/ft²</td>
<td>26.6 - 35.2 kg/m²</td>
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<tr>
<td>Tile Dimensions</td>
<td>Range: 25&quot; x 27&quot; - 50&quot; x 69&quot;</td>
<td>Range: 0.64m x 0.69m - 1.27m x 1.78m</td>
</tr>
<tr>
<td>R-Value</td>
<td>R-10 or greater</td>
<td>0.029 watt/m² °C</td>
</tr>
<tr>
<td>Roof Penetration</td>
<td>None, except high-wind areas</td>
<td>None, except high-wind areas</td>
</tr>
<tr>
<td>System Monitoring</td>
<td>Data Acquisition System (DAS)</td>
<td>Data Acquisition System (DAS)</td>
</tr>
<tr>
<td>Typical Output</td>
<td>4.4 - 25 kWh/1,000 sq ft</td>
<td>4,027 - 2.28 kWh/1,000 sq ft</td>
</tr>
</tbody>
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**Built-form: Aerial View**
Built-form: Top of Courtyard
Built-form: View to Courtyard
Built-form: View from Courtyard
Energy Calculations

- Building Floor Area = 34,000 sq.m.
- Annual Electric Demand = 34,000sqm x 2.5kw/ = 85,000 kw
- PV Array Area = 7,734 sq.m.
- Type of PV panel used: Mono-crystalline PV panels
- Annual energy generation
  = 7,734sqm x 0.146kwh/sqm/h/y = 1,129.2 kwh/y
- % of energy generated by PV panels = 7.5%