Built to deliver a better world
Five overarching principals set the direction of the Design Guideline and what National Housing is seeking to achieve:

1. **Cultural Sensitivity**
   National Housing will be developed in respect to, and with emphasis on, values of cultural sensitivity including a strong National identity demonstrated by a clear hierarchy of space that respects privacy.

2. **Sustainability**
   Sustainable National Housing communities will be developed in resilient manners to adapt and evolve with future generations. This will include the protection of precious resources such as water, the efficient management of wastewater, and the conservation of energy. This will include appropriate long-term responses to climate and environment.

3. **Community and Family**
   National Houses and communities will be designed to respond to different family size and structures found across the three regions of Abu Dhabi to create culturally responsive designs that accommodate current and future families throughout the Emirate.

4. **Accessibility**
   National Housing communities will be accessible and integrated for all ages and abilities.

5. **Flexibility**
   National Housing will be developed in a resilient manner of a villa that will allow to adapt and evolve with future generations. This includes vertical and horizontal expansion of a villa.
### List of Factors

<table>
<thead>
<tr>
<th></th>
<th>1 ORIENTATION</th>
<th>2 KIND OF WALL</th>
<th>3 ROOF</th>
<th>4 SOLID VS GLAZING</th>
<th>5 WINDOWS</th>
<th>6 MATERIALS</th>
<th>7 COLORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
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<td></td>
<td>Bio Brick</td>
<td>Light colors</td>
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<td>S</td>
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<td>B</td>
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<td>Terracota</td>
<td>San colors</td>
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<td>E</td>
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<td>W</td>
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<td></td>
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<tr>
<td>C</td>
<td></td>
<td>Green Wall</td>
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<td></td>
<td></td>
<td>GRC Panels</td>
<td>Dark colors</td>
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<td>D</td>
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<td>Graphic Concrete</td>
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<td>E</td>
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<td>Doble Glazing</td>
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</table>
Modularity Walls

Modular Panels Option 1

- Option 1A
  - South facade
  - Opaque

- Option 1B
  - North facade
  - Single Openings

- Option 1C
  - East, West facades
  - Single Protections

Modular Panels Option 2

- Option 2A
  - South facade
  - Opaque

- Option 2B
  - North facade
  - Double Openings

- Option 2C
  - East, West facades
  - Double Protections
### Modularity Walls

<table>
<thead>
<tr>
<th>Modular Panel</th>
<th>M.Panel + Window</th>
<th>M.Panel + Window + Sun protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>external wall</td>
<td>insolation</td>
<td></td>
</tr>
<tr>
<td>internal wall</td>
<td>window</td>
<td></td>
</tr>
<tr>
<td>window</td>
<td>sun protection</td>
<td></td>
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</tbody>
</table>

Intended for exterior cladding quickly, easily and with significant savings, in addition to providing thermal insulation. Easy assembly makes the work time decreases significantly. The junction between panels is male-female screw seen or can join without screw. Indicated mainly in their appropriate thicknesses: the modular enclosure or internal divisions.
The ROOFS are inclined to south orientation to place solar panels for use and maximize the energy of the sun.

Some space on the roof is designed for MEP SYSTEMS, 25m² are required for a water tank.

The Windows facing south, east and west require SOLAR PROTECTION SYSTEMS. In the north facing, mashrabia can be placed as a decoration because is not required.

The ENERGY SAVINGS are independent of orientation, in all cases we will have 60% savings

*Space Between Panels to allow for access and maintenance*
Modularity Roofs

Flat Roof

Inclined Roof Variation

* In both types of modular roofs, the slab is in flat position for easier colocaction and operation. The solar panels are placed on the slab and inclined depending the orientation of the plot.
3D View_Eintrance
3D View_Outdoor Area
3D Sketches
Sustainable Elements

- MASHRABIA
- LIGHT COLORS
- IN-SET GLASS
- SMALLER OPENINGS
- ORIENTABLE SOLAR PANELS
- THICK WALLS
- GREEN PROTECTION
- MODULAR PANELS
Heat Gain % Difference Vs. Baseline

Increased heat gain when compared to baseline.

Decreased heat gain when compared to baseline.
Passive Design Strategies

- Cool roof with high SRI
- Air tightness
- Thermal bridge free
- High performance glass and shading
- Thermally broken frames and balconies & wall
- Fully insulated envelope
- Robust Thermal insulation and high thermal mass
ANNUAL HEAT GAIN BREAKDOWN | PROPOSED Vs. BASELINE (kWh)

52% REDUCTION IN TOTAL EXTERNAL HEATGAIN.
Effects of Orientation

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Baseline kWh</th>
<th>Proposed kWh</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0° Orientation</td>
<td>147,368 kW</td>
<td>53,009 kW</td>
<td>60.5% reduction</td>
</tr>
<tr>
<td>90° Orientation</td>
<td>149,628 kW</td>
<td>53,059 kW</td>
<td>60.0% reduction</td>
</tr>
<tr>
<td>180° Orientation</td>
<td>149,395 kW</td>
<td>53,024 kW</td>
<td>60.3% reduction</td>
</tr>
<tr>
<td>270° Orientation</td>
<td>148,019 kW</td>
<td>53,098 kW</td>
<td>60.0% reduction</td>
</tr>
</tbody>
</table>

* Most favourable result
* Least favourable result
### BASELINE Vs. PROPOSED RESULTS

<table>
<thead>
<tr>
<th>Baseline</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2 W/m²K &amp; 0.4 SHGC</td>
<td>1.20 W/m²K &amp; 0.2 SHGC</td>
</tr>
<tr>
<td>15% of conditioned floor area</td>
<td>15% of conditioned floor area</td>
</tr>
<tr>
<td>0.14 W/m²K</td>
<td>0.1 W/m²K</td>
</tr>
<tr>
<td>0.32 W/m²K</td>
<td>0.35 W/m²K</td>
</tr>
<tr>
<td>1.263 W/m²K</td>
<td>0.3 W/m²K</td>
</tr>
<tr>
<td>0.35 ACH</td>
<td>0.18 ACH</td>
</tr>
<tr>
<td>3.4 (excluding heat rejection)</td>
<td>5.7 (including heat rejection)</td>
</tr>
<tr>
<td>2.8 W/s</td>
<td>FCU - 0.5 W/s</td>
</tr>
<tr>
<td>ASHRAE 90.1 - LPD's</td>
<td>20% less than baseline</td>
</tr>
<tr>
<td>None</td>
<td>Mashrabiya &amp; Shading structures</td>
</tr>
<tr>
<td>50% of total load</td>
<td>80% of total load</td>
</tr>
</tbody>
</table>

### Energy Comparison

- **Baseline:**
  - 148,600 kWh/year
  - 259 kWh/m²/year
- **Proposed:**
  - 53,000 kWh/year
  - 92 kWh/m²/year

**60% Energy Reduction**
Baseline Vs Proposed Results

148,600 kWh/year
259 kWh/m²/year

60% ENERGY REDUCTION

53,000 kWh/year
92 kWh/m²/year

* A 5% BUFFER HAS BEEN INCLUDED TO THE ENERGY REDUCTION PERCENTAGE TO ACCOUNT FOR END USER BEHAVIOR.

ABU DHABI MUNICIPALITY (EXISTING RESIDENTIAL BUILDINGS)
250 - 350

AECOM BASELINE VILLA
259

AECOM VILLA
92

ENERGY BENCHMARKS
(kWh/m²/year)
Baseline Vs Proposed Results

The proposed energy conservation measures significantly reduced the electricity demand allowing the villa to fully offset the energy consumption with renewable energy. However, we recommend connecting the villas to the grid as a back up solution in case of increased demand, and to avoid dependence on expensive batteries.

Due to the strict passive design strategies, different orientations hardly affected the energy consumption.
THANK YOU