Climate is sensitive to energy consumption
Consumption is due to demand
Demand is driven by architectural design
So climate is sensitive to design
So what design is sensitive to climate?

Austrian Embassy Jakarta

Fritz OETTL

ECREEE, ECOWAS, Praia Cpo Verde June 2014
Austrian Embassy Jakarta
first „green“ embassy building worldwide

Client: Austrian Foreign Ministry
Lead Architect and Engineering: pos architekten
Local partner: Tim 7, Yogjakarta
Contractor: PT.PP, Indonesia

Competition: Nov 2008
In Operation: June 2011

1.000 m² usable area,
20 workplaces, visa office,
convention hall for conferences,
concerts and events
Sustainable design -
What for?
Building stock
• contributes 49% to energy consumption
• emits 47% of CO2
• uses 45% of resources for structure and equipment

60% increase of building stock in Asia until 2020 (basis 2011)
“Pollution in Jakarta is becoming a bigger issue every single day, and we all have our ways in contributing....
What is…

Jakarta, current state of design vision and building standards, e.g. Mandala Multifinance – Modern Office Building in Jakarta

“…To reduce the greenhouse effect, use the glass facade Super Silver Clear Stopsol type of PT Asahimas Flat Glass Tbk. This type of glass makes the heat absorption effect is not so big, so it has no effect on the consumption of electrical energy to cool office spaces…”


<table>
<thead>
<tr>
<th>Structure</th>
<th>Light properties (EN 410)</th>
<th>Energy Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT%</td>
<td>LR%</td>
<td>EA%</td>
</tr>
<tr>
<td>10</td>
<td>62</td>
<td>33</td>
</tr>
<tr>
<td>4</td>
<td>64</td>
<td>35</td>
</tr>
<tr>
<td>6</td>
<td>63</td>
<td>34</td>
</tr>
</tbody>
</table>
Some technical features of Austrian Embassy

- 96 m² photovoltaic generator
- Sun protection by external screen of local timber
- Air tight and thermally insulated building shell
- Interior good natural daylight conditions
- Green spaces with water seepage & rain water cistern
- Bamboo stands → CO₂ sequester
- Cooling by concrete core temperature control
- Slow speed air ventilation with energy recovery
Possible?

CO₂ Emission (equivalent)
in tons per year for estimate 1000m² rough floor area
Reduction of CO₂ emissions by 84,8% or 72,9 tons. - or
72,9 kg / m² r.f.a.

e.g. Zentral-Jakarta
„Jakarta Pusat“ 48,17 km²
Estimate 2 m² rough floor area per 1 m² district area.
Means approximately 96 mio m² r.f.a.

Potential of reduction
7 mio tons CO₂ p.a.
Sustainable design?

a multiple strategy- some simple guidelines

1. keep in mind aesthetics and the user
keep in mind aesthetics
a beautiful building will persist by the appreciation of the users and owners
Aesthetics refer to a bouquet of topics
Set of space, volume, light, void- appropriate selection of materials-..
keep in mind the user

The floorplan is a diagram of function and the basis of space

Ground floor
A functional design will gain the respect of the user and offers multitude opportunities for future activities. Conference, music, lecture, meeting, reception, exhibition…
a functional design will gain the respect of the user
And offers multitude opportunities for future activities
Conference-music-lecture-meeting-reception-exhibition…
A functional design will gain the respect of the user and offers multitude opportunities for future activities.
Conference - music - lecture - meeting - reception - exhibition...
a functional design will gain the respect of the user
 Offers „Chill out“- and smokers places
keep in mind the user

a floorplan meeting the requirements precisely will gain the respect of the user
Always keep in mind the user

Waiting lounge
Always keep in mind the user

Working place
Sustainable design?
a multiple strategy- some simple guidelines

1. Always keep in mind aesthetics and the user
2. Try to understand local conditions
Try to understand local conditions

Equatorial location, latitude -6.13°: the design has to meet the conditions of hot and humid climate.

Temperature: min max range from 21.4° to 35.2°C  
Annual average: 27.5°

Humidity relative: min max range from 43.0% to 100% 
Annual average 79.7%
Try to understand local conditions
Solar Incidence, Jakarta
650 Watt on horizontal areas
200 W on vertical areas facing north and south
300 W on verticals facing east
550 W on verticals facing west

Solar incident in Watt /local time 6 am-pm
fltr: horizontal, NS, EW areas
__ total; _ _ direct; -- diffuse radiation
Respect sunpower and soothe it
By orientation of building
By shading
By blocking
By insulating
Sustainable design?  
a multiple strategy - some simple guidelines

1. Always keep in mind aesthetics and the user
2. Try to understand local conditions
3. Adopt comfort - terms of references
Adopt comfort terms of references

Proposed design and key **decision of client:**

Target temp. 18° C 😞 or 25° C 😊

Target humid. 40% 😞 or 60% 😊

Result?

1. Significant reduction of cooling and dehumidification loads
2. Change to radiant cooling and downsizing of HVAC System

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**Monitoring data 15.9.2011, 8 a.m.**

<table>
<thead>
<tr>
<th>Room</th>
<th>Temp °C</th>
<th>Humid. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrance locker</td>
<td>23.7</td>
<td>60.1</td>
</tr>
<tr>
<td>Lobby</td>
<td>23.5</td>
<td>61.2</td>
</tr>
<tr>
<td>Confer. R.</td>
<td>23.7</td>
<td>60.1</td>
</tr>
<tr>
<td>Kitchen</td>
<td>23.8</td>
<td>58.2</td>
</tr>
<tr>
<td>Consul</td>
<td>23.8</td>
<td>59.0</td>
</tr>
<tr>
<td>Visa office</td>
<td>23.8</td>
<td>58.2</td>
</tr>
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Sustainable design?
a multiple strategy- some simple guidelines

1. Always keep in mind aesthetics and the user
2. Try to understand local conditions
3. Adopt comfort- terms of references
4. Reduce external loads
Design Basics
(includes simulation!)

Orientation: windows preferably oriented north and south

Shade

Thermal Insulation of Building envelope

Airtight building envelope

Balance of transparent and opac openings
Shade
By exterior timber screen
By recessing openings
Detail work
Building envelope

Adopting passive house knowledge

Insulation airtightness
Exterior wall detail
thermal simulation
Load reducing sequence:
1. Opaque opening ratio
2. Insulated glazing
3. Recessed openings
4. Exterior shading

Austrian Embassy Jakarta: two-pane thermal glazing
U-Value: <1.1W/m2K, g-Value 0.3
Sustainable design?

a multiple strategy- some simple guidelines

1. Always keep in mind aesthetics and the user
2. Try to understand local conditions
3. Adopt comfort- terms of references
4. Reduce external loads
5. Balance Light and loads
Indoor light conditions

Balance energy block and light transmission

Calculation of daylight ratio
Natural daylight comfort
Natural daylight
...from top
Sustainable design?

a multiple strategy - some simple guidelines

1. Always keep in mind aesthetics and the user
2. Try to understand local conditions
3. Adopt comfort - terms of references
4. Reduce external loads
5. Balance Light and loads
6. Make technical services efficient
Technical services serve the user comfort
gentle radiant cooling instead of cold breeze of split units
CCTC - Concrete Core Temperature Control
Covers the cooling load

chiller and HVAC equipments

Concrete Core Temperature Control (CCTC)

More comfort, less energy consumption
Ventilation (with coolness recovery)
Provides dehumidified air with gentle air flow
Adopting passive house knowledge
Sustainable design?

a multiple strategy - some simple guidelines

1. Always keep in mind aesthetics and the user
2. Try to understand local conditions
3. Adopt comfort- terms of references
4. Reduce external loads
5. Balance Light and loads
6. Make technical services efficient
7. Increase renewables
Use Solar electric power
reduce fossile energy demand
22% coverage of total annual electric energy demand
Increases safety by double back-up
Stand alone 24h emergency operation mode

PV-system:
Nominal power 12,6 kWp
Increase use of renewables
energy production “on-house”
96 m² solar photovoltaic generator on top
Evaluate the design
Dynamic building simulation -
Reliable basis for sustainable design decisions

Embassy Jakarta, basis version

- Solar irradiation global horizontal
- Solar irradiation direct horizontal
- Relative humidity chancellor
- Cooling capacity room
- Supply air cooling
- De-humidify
- Outside air temperature
- Operative room temperature chancellor
Evaluate the design
Dynamic building simulation -
Reliable basis for sustainable forecasts

Final take over at march 2012, detail balancing of HVAC until sep 2012, monitoring ongoing set up
Sustainable design?

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4. Reduce external loads
5. Balance Light and loads
6. Make technical services efficient
7. Increase renewables
8. Consider local culture and expertise
On site, concrete casting works, CCTC laying

AEJ, layout of pipes for CCTCI, jun 2010
Know how transfer Blower door test
What do we gain by sustainable design? Besides user friendly architecture—some energy savings for the owner

- **Results of design simulation**
  - Annual total energy demand in kWh per m² usable area:
    - **AEJ building 39.9**
    - Compared to
    - "**Standard building**" 270.0
    - **Energy saving is 85.2%**

- Photovoltaic generator covers 22% of annual total electric energy demand by solar power

- Fully air conditioned office in Jakarta consumes 5 times more energy than that of non air conditioned building

- **AEJ building has same energy demand as a non-air-conditioned office building in Jakarta**
What does the environment gain?

CO₂ Emission (equivalent) in tons per year

AEJ building 13,0
standard building 85,9

73 tons less CO₂ Emission
Minus 85%
Sustainable design?
a multiple strategy- some simple guidelines

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3. Adopt comfort- terms of references
4. Reduce external loads
5. Balance Light and loads
6. Make technical services efficient
7. Increase renewables
8. Consider local culture and expertise
9. talk about and learn
Sustainable design matters

For user
For owner
For society
For environment
Sustainable design happens once users ask for sustainable environments.
Once governments shape sustainable building standards.
Once investors demand sustainable projects.
Sustainable design shows the true colors. What we build today shows how we care about tomorrow.
Sustainable design makes a world difference