**Prefabricated Bathroom and Kitchen**

These bathroom and Kitchen pods are prefabricated in a factory environment. These units take care of sound attenuation, fire properties, local water bylaws, accessibility, future refurbishment, and are ready to install.

Can be completely tailored to any particular development. Can offer a wide range of finishes to ensure variety and practicality and low maintenance worries.

Each unit is designed by a trained professional to ensure aesthetic quality and functionality,

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**Building Type / Structure : Materials**

Partial Unit, Prefab Bathroom and Kitchen
Source: http://www.pod-modules.co.uk/
Shared Walls and Foundations

The cooling and heating Energy requirements of smaller housing Typologies such as villas, increases as the amount of exterior wall area is increased. Row houses which share walls save operational energy, materials, and land area. Hybrid house/row house typologies have a feeling of the detached home, while allowing for the combination of ground floor access and site work.

Sharing foundation and site work conserves site green space, facilitates the distribution of site utilities.

Building Type / Structure : Energy

Source: MIT Building energy calculator
Higher Not Necessarily More Efficient

Cooling and heating energy requirements of housing typologies are a function of solar exposure, exterior wall exposure.

Heating and cooling energy required
Given building shape in Kwh per year per square meter
Per annum

<table>
<thead>
<tr>
<th>Building Type / Structure: Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 story</td>
</tr>
<tr>
<td>6 story</td>
</tr>
<tr>
<td>12 story</td>
</tr>
<tr>
<td>16 story</td>
</tr>
<tr>
<td>-Elevators</td>
</tr>
<tr>
<td>-Water pumps</td>
</tr>
<tr>
<td>-Exhaust fans</td>
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<tr>
<td>-Fire command center</td>
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</tbody>
</table>
**Natural Ventilation**

An envelope that allows effective natural ventilation. Orienting fenestration on the southeast for wind ventilation in summer and shelter in winter. Integration with green facades and circulation is ideal. Allowing operable windows and exhaust fans are operated by building management at common areas can reduce cooling energy use.

Window systems can allow stack driven ventilation while decreasing cooling loads through double leaf enclosures. In addition to wind driven

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**Envelope: Flexibility**

Shanghai wind rose data: MIT Sustainable development in China website
Green Facades and roofs

Plants and buildings are ideally combined. Plants can cool, via transpiration and produce oxygen via photosynthesis. Plant friendly facades create defensible green spaces for residents. Plants provide natural shading in the summer and residents enjoy maintaining gardens.

A Green roof systems lowers amount of storm water, provides recreational space, and extra insulation from summer heat gain. Paint and stucco degrades quickly in a wet climate. Ventilated facades, help to extend the lifetimes of cladding materials, prevent the penetration of water, and excessive solar gains. Ideal vented facades materials are wood, terra cotta, cast stone, or metal panels.

Solar thermal and photovoltaic installation should be encouraged on South facing roof tops with steeper slopes or into facades themselves.

Envelope: Energy
**Insulation and Air barrier**

Cellulose insulation is made from recycled newspaper and treated with fire retardants and insect protection. Agricultural fiber insulation is available in the form of cotton insulation made with mill waste, low grade, and recycled cotton. CFC and HCFC insulation refers to the blowing agents that contain chlorofluorocarbons used in making many rigid insulating sheathing products. Extruded polystyrene and polyisocyanurate foam insulation boards are currently made with CFC or HCFC blowing agents.

Cementitious foam insulation is made from magnesium from sea water and blown in place with air. Perlite insulation is made from a natural occurring volcanic mineral and is often used as loose fill insulation in concrete block cavities.

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Heating and cooling

Energy required in typical 10x60 meter 6-story Building with no natural ventilation.

KWh/ m²/ year:

- 90+ (Poor quality construction)
- 50-60 (Add insulation)
- 20-30 (Add tight construction and insulation)

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Sources: The HOK guidebook to sustainable design

**Envelope: Materials**

' 2005 Xella International GmbH
Aerated autoclaved insulating concrete

Wall materials
**Heating and Cooling**

Apartments with individual, through wall, units is not efficient, and typically are not carefully installed. Energy inefficiency is compounded by air infiltration through unsealed condensate and electric lines. Air leakage may present a long-term energy loss, and cause maintenance issue near these interruptions in the facade. And aesthetics.

Peak demand for electricity usually occurs in the hot summer temperatures.

**Building Services: Flexibility**
**Heating and Cooling Alternatives**

Alternative systems allow various fuel sources. High efficiency water source systems allow individual units to take responsibility for power usage (tenant metering) while avoiding facade penetrations, allowing user-selected capacity. Building plant could be centralized and geothermal or ice slurry stores could be centralized load shifting strategies for development. Cooling towers could be substituted for cooling ponds, solar thermal could assist boilers.

**Building Services: Flexibility**
Water conservation

Shanghai is currently experiencing a shortage of potable drinking water. Toilet flushing is the largest opportunity for savings. A grey water toilet flushing system is most advantageous in a large development due to the volume of grey water production and range of building types to work with. It is also very possible to treat grey water within building systems, green roofs or settling ponds. In all cases stagnation is best avoided with grey water.

Building Services: Flexibility

Rainwater collection zones (provides Potable water)

Grey water Treatment (reduces outflow)

Domestic consumption breakdown: Source: Ecohouse: Sue Roaf

Grey water Pressure tanks situated in high volume

Speculative roof zoning
**Vertical movement**

Elevators must be used for buildings higher than 10 stories for good power efficiency. If possible, combined freight and residential lifts if possible. A cab-based magnet can save up to 40% on a mid rise and requires no equipment rooms and can be installed in lighter construction. Avoiding hydraulic elevators will help save energy.

**Past:**

- High speed traction
- 6 and above

**Future:**

- Magnetic lift
  - No overrun/machine rooms
  - Quieter
  - 40% power savings
  - Lighter hoistway framing

**Building Services: Energy**

Otto Steilde, Documenta Urbana, Kassel

Bike to storage unit
Housing, Delft NL Photo: ER
Design Approach

An integrated design approach considers building energy early. A design team should identify key local issues and integrate technical input early in the design process. Experts who understand priorities in Shanghai (i.e., fresh water supply, electrical power shortages) should evaluate the environmental impacts, resource efficiency, and performance of proposed building materials over the full life cycle of the building.