Compact Residential Development
Beijing
The Urban Green Isolation Plan of Beijing

- Located in eastern central city of Beijing
- Bounded by the Greenbelt on the south
**Site Area**: 100 Ha

**Land Use**: Residential

**Density**: 50,000 person/sq km

**Transit**: Subway Line 7 (2013)
**Beijing Climate**

**Latitude:** 39°55N  
**Longitude:** 116°25E

- **Summer:** hot and humid  
- **Winter:** cold and dry

- **Average High:** 30°C  
- **Average Low:** -4°C  
- **Highest:** 40°C  
- **Lowest:** -20°C
Energy

- Increased Solar Radiation/Use of photovoltaics
- Reduce car use
- Greywater for greenbelt
- Reduction of water run-off
- Better building envelope
  - Optimizing daylight
  - Vertical transport
- Rainwater harvesting
- Greywater reuse
- Life-cycle design

District Heating

More exercise
- Improved walkability
- High density compact design

Quality of Life

- Better accessibility
- Natural ventilation
- Improved air quality
- Mixed-use neighborhood

Water/Resources

Reduced CO2 emissions

Block

Masterplan

sustainability goals

BEIJING
Designers: THCA Architectural Design & Consulting Institute
<table>
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<tr>
<th>Masterplan</th>
<th>Block</th>
<th>Lifecycle</th>
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<tr>
<td>• Mixed landuse</td>
<td>• human scale</td>
<td>• PV</td>
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<td>• Walkability</td>
<td>• operative energy</td>
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<td>• Water ecology</td>
<td>• thermal comfort</td>
<td>• CO2 emission</td>
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<td></td>
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• Mixed landuse
• Walkability
• Water ecology
our proposal
our proposal
Average block size 120 x 200m
our proposal
BEIJING

our proposal

Subway station
Boulevard
A street
B street
Pedestrian Path
Green Buffer
Public Square
our proposal

BEIJING

- Subway station
- Boulevard
- A street
- B street
- Pedestrian Path
- Green Buffer
- Public Square
- Residential
- Retail
- Offices
- School
Conceptual Sketch of Boulevard

Source: Adapted from Ian Lockwood
**Base Case**

- **Central Road**: 45m
- **Secondary Streets**: 12m
- **Block Streets**: 6.5m

**New Proposal**

- **Boulevard**: 45m
- **Primary Streets**: 25m
- **Secondary Streets**: 12m
Highest Walkscore: 90
Lowest Walkscore: 50
Average Walkscore: 71

Highest Walkscore: 100
Lowest Walkscore: 88
Average Walkscore: 96
Chatting by
Grocery on the way home

Entering and leaving
Looking at displays with

Walking alongside
Looking in and out of

Source: Adapted from Jan Gehl
Rainwater: harvested

Stormwater: infiltration

Grey Water: infiltration then landscaping

Blackwater: treatment
• human scale
• operative energy
• thermal comfort
BEIJING

Gap=25m
H=15m
10m
15m
20m
N

155000
160000
165000
170000
175000
180000
185000
190000
195000
200000

H/G=0.6
0.75
1
1.5

Heating(kWh)

Residential

Roof R=3.52
Exterior Wall R=1.96
WWR=20%
Window Glass U=1.78
SHGC=0.6

distance
©Jan Gehl
Residential Block Prototypes

Base Case

20F

Energy: 47.3kWh/m²

Our Proposal

6F

Energy: 46.4kWh/m²

Parameters: Roof $R=3.52$; Exterior Wall $R=1.96$; WWR=20%; Window Glass $U=1.78$; SHGC=0.6; Natural Ventilation; Lighting control Off

<table>
<thead>
<tr>
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<th>Heating</th>
<th>Total</th>
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<tr>
<td>Basecase</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>New Proposal</td>
<td>25</td>
<td>40</td>
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</table>
Open area: 13600sq m
Central Green: 7000sq m
Roof Area: 10400sq m
Built Area: 43%
Covered Parking: ~300 cars
January

March

June
Mean Radiation = 241.7 kWh/m²  
October-March

Mean Radiation = 563.6 kWh/m²  
April-September

Mean Radiation = 807 kWh/m²  
75.6% area between 0-1000
24.6% area >1250

Annual
3 hours of sun
Office Block Prototypes

Area: 24000 sq m
Energy: 66.2 kWh/m²

Area: 23400 sq m
Energy: 67.2 kWh/m²

Area: 25000 sq m
Energy: 68.9 kWh/m²

Parameters: Roof R=3.52  Exterior Wall R=1.96  WWR=60%  Window Glass U=1.78  SHGC=0.6  Lighting power density=9  Lighting control=On
• PV
• lifecycle
• CO2 emission
• rainwater harvesting
No Photovoltaic Panels

Cell Efficiency: 0.12  Inverter Efficiency: 1.0

Total energy used: 46.14 kWh/m²

With Photovoltaic Panels

Total energy used: 39.29 kWh/m²

Energy Reduced: 6.85 kWh/m²

Energy Produced/sq m: ~420 kWh/m²

Total PV Production for a block: ~260,040 kWh

Total PV Production for residential: ~9,101,400 kWh
What is life-cycle assessment?

Source: What is the LCA of illuminants? Osram.com
From DesignBuilder we know
- High rise building consumes 2.5% more electricity
- Low rise requires 47% more heating energy

Assumptions for the material input and energy calculation
- Ratio of concrete to steel in HR: 40/60
- Ratio of concrete to steel in HR: 60/40
- Energy requirements in HR construction: 987 MJ/m²
- Energy requirements in LR construction: 650 MJ/m²
- Elevator energy consumption 8% HR, 5% LR
Comparing 'Highrise' with 'Lowrise Development'.
Method: IMPACT 2002+ V2.10 / IMPACT 2002+ / Damage assessment
52 million litres of Water per can can be harvested per year.

- ~21 Olympic Swimming Pools per Year
- Enough water to flush 8 million times
Acknowledgement:

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