Vanke Vision: Sustainable Residential Development in Shanghai
Urban Planning and Design Handbook
Vol. 1. Research Seminar and Field Survey | February 2006

Massachusetts Institute of Technology
Department of Urban Studies and Planning
City Design and Development Group
INTRODUCTION
From September 2005 to June 2006, with the generous support of the Vanke Real Estate Group (Shanghai Office), three graduate courses were offered by the Department of Urban Studies and Planning at MIT: Research Seminar in Fall, 2005; Field Survey during Independent Activities Period (IAP) in January 2006; and Planning and Design Workshop in Spring 2006. Vanke’s goal is to continue to improve the design of their housing communities as issues of sustainability become national priorities. All three courses take as their organizing principle that sustainability is not just concerned with environmental issues but equally with economics and equity. Our purpose is to find solutions that are environmentally sound, economically viable and accessible to all residents.

This Urban Planning and Design Handbook is the work of the Research Seminar and the Field Survey. To provide a concrete case study and to highlight the most relevant issues, Vanke has identified Holiday Town, one of their sites in the Shanghai urban fringe that is currently under development. In the fall semester, students first articulated the issues for the handbook and then conducted research in the following aspects.

1. Projected trends in demography, life-style, energy use and environmental factors in Shanghai.
2. Identified key issues to be covered in four broad categories: Community Facilities; Open Space; Site Systems; and Building Systems. The issues include building and population density, public open space, sense of community, transportation, site and landscaping, building typology, climate.
3. Organized work groups to explore the issues – parameters, comparative mapping, case studies from China and elsewhere.
4. Analyzed the Holiday Town site regarding issues above.
5. Prepared for January Field Survey: organized survey – questionnaire, visual mapping of activities etc.

Using the draft handbook incorporating above as a guide, the students conducted a survey and evaluation of Holiday Town in January, 2006. With the aid of Vanke’s staff, students used social survey and visual mapping methods to investigate and collect information necessary to make evaluations of the Holiday Town project. A design/planning charrette was held to generate preliminary ideas for the Spring Studio.

The accumulated research and design explorations will be used as the basis for the following Spring Planning and Design Studio which will focus on designs on two new Vanke sites: Baima and Qibao. The studio will formulate scenarios emphasizing an important future trend that will affect the design, planning and management, e.g.

1. Demographic and Life Style: Aging population, rising incomes, increased leisure, automobile ownership and need for community cohesion?
2. Higher Densities: what are the implications for open space, accessibility, building typologies, energy use, etc?
3. Much Higher Energy Prices and Scarce Resources: Effects on building layouts and orientations, facade treatments, alternative energy?

The product of the Spring Planning and Design Studio will come in a second volume of the Handbook.
From September 2005 to June 2006, with the generous support of the Vanke Real Estate Group, the issues for the handbook were articulated and research was conducted in the following aspects.
SITE VISIT
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PROGRAMMING
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DESIGN
Lorercidui bla facil it lor incipisissim verat. Ut vullam velessis exer sim zzriure dion ulput irit at lum euip endreet lorer susto dipisl ex enim acil ip ea feugue tat wisim quam, con utpatis
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Thanks to Vanke staff for their invaluable help
Haitao Zhang
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SHANGHAI TRENDS
Although the overall population is not expected to increase significantly, demographic changes and increasing incomes will increase housing demand in particular sub-markets.

- The mobile population may create a market for small, easily salable units.
- Aging population will drive market towards new typologies and amenities for seniors.
- Increasing childbearing age and life expectancy will result in larger units or diversified configurations.

The maturation of the private housing market and the overall economy will make branding strategies crucially important to residential development.
Nearly a quarter of Shanghai’s population is “mobile.” Less than 5% of this population currently owns a home, but this group might comprise a market for small units in flexible markets.

The Aging Population

Age distribution in Shanghai 2003

- Huge increase in life expectancy
- China has the fastest-aging population in the world.

Opportunities:
-- new housing products for the elderly
-- adjacencies between smaller and larger units allow adults to care for aging parents.
-- senior homes
-- ground floor development
-- handicapped access
-- medical care facilities
Low birthrate and delayed childbearing age

- Small increase in women of child bearing age
- Decrease in propensity to have children
- Child households predicted to decrease from 51% in 2001 to 38% by 2011

Countertrends?
- End of One Child Policy
- Decreasing female labor participation

Sources: Economist Intelligence Unit Asian Insights Marketing Ltd.
The combination of the aging population and increasing childbearing age may increase the number of families caring for both children and parents at the same time.

Over 40% of American women will be the primary caregiver for BOTH a child and a parent at some point in their lives.

Although there were many predictions that modernization would lead to a breakdown in Asian family structure, the portion of elderly living with their children has stabilized at about **54% in Japan** and **67% in Korea**.

Source: The RAND Corporation, "Aging in America"
The government goal for living space per person is 32 m² by 2020, tripling unit size from 2000.

Sources: People’s Daily 04/25/2001 (China)
People’s Daily 04/13/2004 (China)
Asian Insights Marketing Ltd.
• As the secondary market for housing competes with new development, new development must differentiate itself.

• Maturity in the economy and the housing market have led US developers to focus on branding.
Water and Waste

- To ensure better water quality and protect the local ecology, large scale developments will be seeking available alternatives to local ground water.

- Continued rise in domestic sanitary and storm waste has outpaced the treatment capacity. Large new developments may be encouraged to take on more of this responsibility on site.
Shanghai ground water resources are low, & surface water from river systems is often low quality.

Per capita fresh water resources (cubic meters)

Woe of Shanghai's water sources
Shanghai Star. 2005-06-09
Shanghai Fresh Water Supply

- **Surface water**
  - Industrial wastes

- **Ground water**
  - Subsidence

**SOURCE:** Source: (Zhou and He, 1998)
- New development may need to seek alternative sources and protect surrounding surface water:
  - Exploit rainfall Shanghai has high rain fall which coincides with peak demand
  - Desalinization
  - Protect local existing surface water
  - Buffer zones at waterways
  - Split sources from two water systems

Source: (Zhou and Ho, 1998)
Municipal Waste

- Shanghai expanded municipal waste treatment rates dramatically but untreated domestic waste output growth still higher due overall growth

Source: Shanghai environmental bulletin 1991 and 2001
- Communities may increase responsibility for their own waste
  - Local reduction of effluent output
  - Local treatment / reuse of grey-water component
  - Local retention of storm component

Source: Shanghai environmental bulletin 1991 and 2001
Energy

- In order to avoid power shortages and allow growth, new development districts may consider developing diversified energy strategies.

- New infrastructure will enable cleaner fossil fuels may enable decentralized power generation at the district level.

- Large developments may consider reducing their demand by developing local sources and load shifting methods.
Increasing Electrical Demand

Per capita energy consumption and emission of CO2 comparing cities and provinces in China

- Use of residential air conditioning increase
- Growth in other residential appliances
- Longer appliance usage trends

SOURCE: A Tale of Five Cities: The China Residential Energy Consumption Survey; Debbie Brockett, LBNL; David Fridley, LBNL; Jieming Lin, LBNL; Jiang Lin, LBNL
Energy Sources Over Time

- Nuclear
- Hydro
- NG
- Oil
- Coal

4.3% Growth Through 2025

Wind/Solar/Geo
Nuclear
Hydro Increase
Liquid Natural Gas Increase

1985 2005 2020

• As infrastructure improves, natural gas will allow localized co-generation and alleviate peak load and transmission problems
• Developers to team up with utility providers in face of shortages in Shanghai area

Source:
“Expanding Natural Gas Use in China”
Dong Xiucheng
University of Petroleum, Beijing
Pacific Northwest National Laboratory
Jeffrey.logan@pnl.gov
- Load Shifting and Demand Side Management already beginning in Shanghai and Jiangsu provinces, next step will be at district scale.

- Districts may pursue local generation supplement:
  - Solar Thermal/ Photovoltaic
  - Geothermal heating and cooling

SOURCE: "China-US energy alliance report" by Bryant Tong & Bob Epstein
Transportation

Implications of growth:

1. Innovative parking solutions: underground parking, tandem parking.

2. Adopt road infrastructure for increasing use: Wide roads, clear points of access.

Implications of Alternative Strategies:

1. Locate housing near and with access to public transit: establish private shuttle system or public/private partnerships, create bicycle and pedestrian friendly routes.

2. Consider alternatives to typical private ownership: Zipcar model, small cars, new technology.

Source: Statistics Bureau of China
China’s vehicle ownership is on an upward trend and has far to go before catching up with smaller, less populated countries.

Private Vehicle Ownership

Sources: Department for Transport, Great Britain; Taiwan Institute of Transportation; Singapore Department of Statistics; National Bureau of Statistics, China; and Japanese Ministry of Internal Affairs and Information, Statistics Bureau
China still has a strikingly low percentage of vehicle ownership.

Sources: Department for Transport, Great Britain; Taiwan Institute of Transportation; Singapore Department of Statistics; National Bureau of Statistics, China; and Japanese Ministry of Internal Affairs and Information, Statistics Bureau
The Question: Will Chinese car ownership quadruple by 2020 as predicted? (to 56 mill cars)

- Vehicles as status symbols
- Increasing GDP leads to increased ability to purchase cars
- Improved road infrastructure can accommodate more vehicles
- Two-child allowance will increase younger population
- Government promoting expansion of auto industry
- Privatization of housing led to longer home to work commutes

- Impending fuel tax/car tax
- Registration auction and cap reduces overall number of cars
- Cost of car ownership still very high for average income
- Limited parking in China results in high prices
- Congestion – inadequate road infrastructure

Source: Solutions: Transportation in Developing Countries
The cost of owning a car in Shanghai will limit the growth of vehicle ownership.

Driving school: $500  
Small, domestically sedan: 10,000  
10% Tax and registration fee: 3,500  
**Total (due in cash, up front): $14,000** vs. **USA yearly cost:** $8,431**

Shanghai average income: **$2,148** (2004) vs. **USA avg. income:** $60,070

*Does not include fuel, impending vehicle tax, parking costs
**Includes fuel, average parking costs, and an average $741 in financing costs

<table>
<thead>
<tr>
<th></th>
<th>Yearly cost (1st year)</th>
<th>Mean Income (per household)</th>
<th>% income required to purchase car</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shanghai</td>
<td>$14,000</td>
<td>$2,148</td>
<td>186%</td>
</tr>
<tr>
<td>USA</td>
<td>$8,431</td>
<td>$60,070</td>
<td>14%</td>
</tr>
</tbody>
</table>

**SHANGHAI:**

Current shortage: **60,000** spots  
Estimated shortage 2010: **120,000** spots

Sources: Solutions: Transportation in Developing Countries, National Bureau of Statistics, Park24 Co. Ltd., China Internet Information Center
The expansion of the Shanghai subway system will support alternative commuting strategies.

Shanghai bus system is largest in China.
2020 Prediction: Ridership will double

Sources: UrbanRail.net, Subway’s Future, Solutions: Transportation in Developing Countries, Greenhouse Gas Scenarios for Shanghai, China
COMMUNITY FACILITIES
Good community space:

Is Social
Promotes neighborly interaction among residents
Promotes interaction with the larger community
  o Physically connects to larger community with public streets, pathways, etc.
  o Has some services/facilities that are available to outsiders, e.g. school, park space

Is comfortable to community residents
Adequate garbage facilities
  o Trash pick-up
Regular facilities/landscape maintenance/cleaning
  Contributes to a feeling of safety/actually is safe
  Contributes to the convenience of living in the development

Is adaptable to residents and over time
Allows for different uses without being prescriptive
  Accommodates children and the elderly

Creates cohesion and an identity
Promotes a sense of ownership—Promotes a sense of place
  o Feels like a place that is my place, or our place
Promotes the arts with spaces with visual arts, music, dance, etc.
Addresses history
Promotes a physically active lifestyle or otherwise promotes community health

Sustainable community space:

Is financially sustainable
Contributes to a thriving economy
  Allows for entrepreneurship (small commercial spaces)
Has job creation potential
  Has a financial plan to accommodate maintenance over time

Is environmentally responsible
Minimizes energy use
Promotes access by mass transit, bicycles, and on foot
  Manages storm-water on site as much as possible
Uses water, land, efficiently

Is equitable
Is accessible to a broad range of people across ages and interests, socio-economic levels e
Contributes to the well-being of the community at large
  Allows for residents of surrounding community have access to facilities and services
Contributes to the health of the community

Is adaptable
Can be adapted to accommodate changing demographics of the community it serves

Three Considerations of Sustainability

Community Space in China
Source: http://www.china.org.cn/e-china/images/u10.jpg
Community Facilities:

Community is a vague concept, able to be perceived at many levels, taking on many different forms and functions. To generate a comprehensive list of community facilities, we found it useful to brainstorm around three different categories, these categories being:

1. COMMERCIAL
   - retail
   - entertainment
   - prepared food
   - grocery/convenience
   - services
   - transit

2. INDOOR COMMUNITY
   - civic
   - cultural
   - community space
   - physical recreation

3. OUTDOOR COMMUNITY
   - green space
   - plaza/hardscape
   - physical recreation

Photo Source: 1. (informal kiosks): Rem Koolhaas, Mutations, 2 & 3: MIT Gaoming Studio (05)
Photo Source: www.locationworks.com
Photo Source: (images 1, 2 & 3: MIT Gaoming studio. 4: Andreas Gursky, MOMA, Harry N. Abrams, Inc., NY, 2001)
Holiday Town, Shanghai, China

The adjacent diagram depicts the existing relationship of surrounding amenities to the Holiday Town development. Amenities within the smallest 0.5 km ring are considered to be within a comfortable walking distance from the site. The largest 3 km radius represents the distance that a resident would feel comfortable bicycling from the site. The red dots indicate frequent use facilities, and this diagram reveals that these daily amenities are primarily located 2 to 3 km away from the center of the site. This distance far exceeds the comfortable walking distance of 0.5 km, and indicates that Holiday Town needs to provide a variety of community facilities on site, not only for the Holiday Town residents, but also for those living in neighboring developments.

This diagram is not used to imply that community facilities should be concentrated at the center of the Holiday Town site. The rings are used as a practical matter to estimate the average distance that a resident of Holiday Town would have to travel to access a neighborhood amenity.

Source: Vanke
<table>
<thead>
<tr>
<th>Location in reference to holiday town</th>
<th>Commercial:</th>
<th>Indoor community:</th>
<th>Outdoor community:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. retail</td>
<td>shopping districts, shopping centers</td>
<td>city hall, library system, universities, junior colleges, school district</td>
<td>municipal park system</td>
</tr>
<tr>
<td>2. entertainment</td>
<td>movie theaters, discos/clubs, karaoke</td>
<td>museums, theaters, symphony</td>
<td>Bund, plazas, monuments</td>
</tr>
<tr>
<td>3. prepared food</td>
<td>restaurants, ethnic cuisines</td>
<td>ju wei hui (neighborhood committees)</td>
<td>municipal facilities</td>
</tr>
<tr>
<td>4. grocery/convenience</td>
<td>supermarket, wet market</td>
<td>Holiday Club; chess &amp; card (&amp; mahjong) playing room</td>
<td>Holiday Club; basketball court, table tennis court, snooker/pool room, gym, jogging corridor</td>
</tr>
<tr>
<td>5. services</td>
<td>post office, bank, police station, hospital</td>
<td>Holiday Club: chess &amp; card (&amp; mahjong) playing room</td>
<td>Holiday Club: swimming pool, tennis courts</td>
</tr>
<tr>
<td>6. transit</td>
<td>commuter rail system, bus system</td>
<td>primary school</td>
<td>linear park (not yet connected)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Community facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>coffee shop (unleased)</td>
</tr>
<tr>
<td>dry-cleaner, hair salon</td>
</tr>
<tr>
<td>bus stop</td>
</tr>
<tr>
<td>private shuttle stop (to light rail station)</td>
</tr>
<tr>
<td>street trees</td>
</tr>
<tr>
<td>diagonal pedestrian walkway, plaza benches, improvised seating</td>
</tr>
<tr>
<td>diagonal pedestrian walkway, plaza benches, improvised seating</td>
</tr>
<tr>
<td>courtyards, ground-floor arcades</td>
</tr>
<tr>
<td>linear park, fitness apparatus</td>
</tr>
</tbody>
</table>
Lisovyi Masyv, Kiev, Ukraine

The housing development of Lisovyi Masyv in Kiev, Ukraine is an example of a planned residential quarter which factored walking distances into its design with respect to the locations of schools and other daily-use facilities. Each block was large and impenetrable by cars, however it was highly accessible by pedestrians and outside residents. This high level of public accessibility and openness allowed for many basic amenity kiosks to locate consistently throughout the interior of the residential blocks, along the numerous pedestrian paths provided.

Source: MIT Kiev Studio (2005)
## Community Facilities

<table>
<thead>
<tr>
<th><strong>Location in Reference to Lisovyi Masiv</strong></th>
<th><strong>City Scale</strong></th>
<th><strong>Main Vehicular Rd.</strong></th>
<th><strong>Semi-Public Intermediate Rd.</strong></th>
<th><strong>Residential Pedestrian Rd.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commercial:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Retail</td>
<td>Shopping Mall</td>
<td>Bookstore / Shoestore</td>
<td>Small Shops / Newstand Smoke Shop</td>
<td></td>
</tr>
<tr>
<td>2. Prepared Food</td>
<td>Special Occasion Restaurant / Ethnic Food</td>
<td>Full Service Restaurant / Food Court</td>
<td>Bar / Late Night Shop / Bakery</td>
<td></td>
</tr>
<tr>
<td>3. Grocery / Convenience</td>
<td>Large Grocery</td>
<td>Market</td>
<td>Convenience Store</td>
<td>Small Kiosk / Basic Amenities</td>
</tr>
<tr>
<td>4. Entertainment</td>
<td>Movie / Disco / Clubs</td>
<td>Internet Cafe / Lounge-Bar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Services</td>
<td>NA</td>
<td>Laundry / Daycare / Shuttle Bus Stop Route</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Transit</td>
<td>Subway Station</td>
<td>Bus Stops</td>
<td>Local Bus Stop Route</td>
<td>Shuttle Bus Stops to Further Transportations</td>
</tr>
<tr>
<td><strong>Indoor Community:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Civic</td>
<td>City Hall / Library / School / Universities</td>
<td>Elementary School</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Cultural</td>
<td>Galleries / Museums / Performance Halls / Places of Worship</td>
<td>Neighborhood Exhibition Space</td>
<td>Ball Playing / Street Sports</td>
<td>Informal Sports</td>
</tr>
<tr>
<td>3. Community Space</td>
<td>Library / School</td>
<td>Multi-Purpose Hall</td>
<td>Swimming Pool / Fitness Center</td>
<td></td>
</tr>
<tr>
<td><strong>Outdoor Community:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Physical Recreation</td>
<td>Municipal Facilities (Athletic Fields)</td>
<td>Tennis, Basketball Courts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Green Space</td>
<td>Large City Park</td>
<td>Tree Lined Boulevards</td>
<td>Street Trees</td>
<td></td>
</tr>
<tr>
<td>4. Plaza &amp; Hardscape</td>
<td>Monuments / Plazas</td>
<td>Pedestrian Walkways / Improvised Seating Areas</td>
<td>Informal Seating</td>
<td></td>
</tr>
</tbody>
</table>

*Image of city scale, main vehicular road, semi-public intermediate road, and residential pedestrian road.*
Woodlands New Town, Singapore

In this case study, we see an even distribution of schools throughout the new town, but a clustering of "weekly use" facilities such as community centers and retail facilities, particularly around major transit hubs. Just as the Vanke Holiday Town site is bordered by a highway on one side and by a canal on another, this Woodlands New Town estate in Singapore is bordered on two sides by two highways, and on a third by the Straits of Johor. This effectively reduces the radius of accessible amenities to about a quarter of its potential size. This illustrates the importance of taking physical barriers that may prohibit or hinder access into account in assessing the accessibility of surrounding amenities. A related point is that it is not merely distance that determines the convenience of a community facility, but also its relation to other facilities. Clearly the distance as the bird flies is not a meaningful measure of convenience. Factors that need to be considered include path of travel, level of service by public transit, and proximity to other complementary facilities.
### Community Facilities

<table>
<thead>
<tr>
<th>Location in Reference to Marsiling Estate</th>
<th>City Scale</th>
<th>Main Vehicular Rd</th>
<th>Semi-Public Intermediate Rd</th>
<th>Residential/Pedestrian Rd</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commercial:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Retail</td>
<td>Shopping districts, shopping centers</td>
<td>Ground Floor Retail: beauty &amp; apparel, florist &amp; gift shops, books/stationary, hardware, home furnishings, electronics, telecom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Entertainment</td>
<td>Movie theaters, discos/clubs, karaoke</td>
<td>Ground Floor Retail: coffee shops, confectionaries, bakeries, fast food, snack shops, hawker stalls, 24-hour food court</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Prepared Food</td>
<td>Restaurants, ethnic cuisine</td>
<td>Ground Floor Retail: banks, ATMs, barbers/salons, dry-cleaners, tailors, photo shops, clinics, pharmacies, reflexology, printing/photocopy shops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Grocery/Convenience</td>
<td>Supermarket, wet market</td>
<td>Neighborhood grocery, mini mart</td>
<td>Mini mart</td>
<td>Mini mart</td>
</tr>
<tr>
<td>5. Services</td>
<td>Post office, bank, police station, hospital</td>
<td>Ground Floor Retail: banks, ATMs, barbers/salons, dry-cleaners, tailors, photo shops, clinics, pharmacies, reflexology, printing/photocopy shops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Transit</td>
<td>Mass rapid transit system, bus depot</td>
<td>Subway station, bus stops</td>
<td>Bus stops</td>
<td></td>
</tr>
<tr>
<td><strong>Indoor Community:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Civic</td>
<td>City hall, library system, universities, junior colleges, school district</td>
<td>Children’s library branch</td>
<td>Kindergartens, primary schools, secondary schools</td>
<td></td>
</tr>
<tr>
<td>2. Cultural</td>
<td>Museums, theaters, symphony</td>
<td>Ground Floor Retail: banks, ATMs, barbers/salons, dry-cleaners, tailors, photo shops, clinics, pharmacies, reflexology, printing/photocopy shops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Community Space</td>
<td>People’s Association community clubs/centres, places of worship</td>
<td>Ground Floor Retail: banks, ATMs, barbers/salons, dry-cleaners, tailors, photo shops, clinics, pharmacies, reflexology, printing/photocopy shops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Physical Recreation</td>
<td>Municipal facilities, fitness clubs</td>
<td>Ground Floor Retail: banks, ATMs, barbers/salons, dry-cleaners, tailors, photo shops, clinics, pharmacies, reflexology, printing/photocopy shops</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Outdoor Community:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Green Space</td>
<td>Botanic gardens, municipal parks</td>
<td>Heritage roads, landscaped medians</td>
<td>Pocket parks</td>
<td>Pocket parks, benches</td>
</tr>
<tr>
<td>2. Plaza/Hardscape</td>
<td>Waterfront plazas, riverside pedestrian promenades</td>
<td>Ground Floor Retail: banks, ATMs, barbers/salons, dry-cleaners, tailors, photo shops, clinics, pharmacies, reflexology, printing/photocopy shops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Physical Recreation</td>
<td>Municipal fields</td>
<td>Ground Floor Retail: banks, ATMs, barbers/salons, dry-cleaners, tailors, photo shops, clinics, pharmacies, reflexology, printing/photocopy shops</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Community Facilities**
Milton Keynes, England

Milton Keynes was built as part of the New Towns program in Great Britain in the 1960s, a time of rising levels of automobile ownership (similar to the trends currently projected in China) and thus resulted in a low-density, car-dominated travel environment. In Milton Keynes, just as in Holiday Town, there is a concentration of amenities within 3 km of the subject neighborhood unit. However, the key difference between the two is that there is also a concentration of amenities within 1 km of the case study site in Milton Keynes, whereas there is a distinct lack of facilities within that range at Holiday Town. This is a good distribution scheme because services are within easy reach of one another, but are also dispersed throughout the city; this arrangement accommodates both the car and the pedestrian.

Land use on the smallest streets, which are public but functionally analogous to the private roads in Holiday Town, is generally limited to parks and housing. Locating most services and amenities on the main road allows the greatest number of people access to them.
<table>
<thead>
<tr>
<th>Location in reference to Milton Keynes</th>
<th>City Scale</th>
<th>Main Vehicular Rd</th>
<th>Semi-Public Intermediate Rd</th>
<th>Residential/Pedestrian Rd</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commercial:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Retail</td>
<td>shopping mall at city center</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Entertainment</td>
<td>movie theaters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Prepared Food</td>
<td>restaurants at city center</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Grocery/Convenience</td>
<td>grocery stores at city center</td>
<td></td>
<td></td>
<td>convenience stores</td>
</tr>
<tr>
<td>5. Services</td>
<td>service centers</td>
<td></td>
<td></td>
<td>day care</td>
</tr>
<tr>
<td>6. Transit</td>
<td>bus system</td>
<td></td>
<td></td>
<td>bus stops</td>
</tr>
<tr>
<td><strong>Indoor Community:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Civic</td>
<td>city hall, library system, universities, junior colleges, school district</td>
<td>library, elementary schools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Cultural</td>
<td>museums, theaters, symphony</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Community Space</td>
<td>community centres, places of worship</td>
<td>churches</td>
<td></td>
<td>churches</td>
</tr>
<tr>
<td>4. Physical Recreation</td>
<td>municipal facilities, fitness clubs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Outdoor Community:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Green Space</td>
<td>linear park system</td>
<td>landscaping along main roads</td>
<td>street trees</td>
<td></td>
</tr>
<tr>
<td>2. Plaza/Hardscape</td>
<td>city center</td>
<td>playgrounds at schools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Physical Recreation</td>
<td>redways, tennis courts, etc.</td>
<td>redways</td>
<td></td>
<td>redways</td>
</tr>
</tbody>
</table>

Community Facilities
Holiday Town: Shanghai, China

PROPOSED AMENITY LOCATIONS

Through the analysis of the preceding case studies of residential developments in various parts of the world, the diagram to the right depicts our projection for future location of amenities in Holiday Town. The overall objective is to locate more daily-use amenities within a .5 to 1 km walking distance from the center of the site.

1. Increased number of Schools
   Lisovyi Masyv: Kiev, Ukraine: reveals a strategic placement of numerous local school facilities to service each individual residential "patch" or development block. This dispersion of smaller schools allows for easier access by walking, and also allows these school facilities to dual function with local community activities.

2. Adjacency of School & Public Transit
   Singapore’s Woodlands New Town illustrates the importance of an extensive public transit system that connects people to high-intensity uses such as schools and commercial hubs. Public transit is not only a convenience for residents to get from Point A to Point B, it also serves as a place-maker. Critical masses of retail and services develop around major transit stops, providing for the economic sustainability of small businesses as they cluster to form a destination and attract customers. In addition, these agglomerations provide residents with much needed amenities in easily accessible locations.

3. Connection to neighboring developments
   Milton Keynes is successful at providing a variety of amenities convenient at different locations because they are places where they can be most easily accessed by residents of several neighborhoods. Thus, future planning for Holiday Town and new developments like it must pay special attention to the surrounding community. By making facilities accessible to neighbors, Holiday Town could have supported more facilities that it could have benefited from, itself.

Holiday Town, Shanghai, China

Source: Vanke
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Commercial</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Retail</td>
<td>Shopping mall</td>
<td>Bookstore / shoestore</td>
<td>Small shops / newstand smoke shop</td>
<td></td>
</tr>
<tr>
<td>2. Prepared Food</td>
<td>Special occasion restaurants / ethnic food</td>
<td>Full service restaurant / food court</td>
<td>Bar / late night noodle shop / bakery / tea shop</td>
<td></td>
</tr>
<tr>
<td>3. Grocery / Convenience</td>
<td>Large grocery</td>
<td>Market</td>
<td>Convenience store</td>
<td>Small kiosk / basic amenities</td>
</tr>
<tr>
<td>4. Entertainment</td>
<td>Movie / disco / karaoke</td>
<td>After school / business center / massage parlor</td>
<td>Internet cafe / lounge-bar</td>
<td></td>
</tr>
<tr>
<td>5. Services</td>
<td>Test prep</td>
<td>Business center / massage parlor</td>
<td>Laundry / daycare / massage parlor</td>
<td></td>
</tr>
<tr>
<td>6. Transit</td>
<td>Light rail station</td>
<td>Bus stops</td>
<td>Local bus stop route</td>
<td>Shuttle bus stops to further transportsations</td>
</tr>
<tr>
<td><strong>Indoor Community</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Civic</td>
<td>City hall / library / school</td>
<td>Elementary school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Cultural</td>
<td>Galleries / museums / performance halls / places of worship</td>
<td>Neighborhood exhibition space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Community Space</td>
<td>Library / school</td>
<td>Multi-purpose hall</td>
<td>Mahjong / cards / singing</td>
<td>Mahjong / cards / singing</td>
</tr>
<tr>
<td>4. Physical Recreation</td>
<td>Fitness club</td>
<td>Swimming pool / fitness center</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Outdoor Community</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Physical Rec.</td>
<td>Municipal facilities (athletic fields)</td>
<td>Tennis, basketball courts / fitness park</td>
<td>Playground</td>
<td></td>
</tr>
<tr>
<td>2. Green Space</td>
<td>City park / system</td>
<td>Tree lined boulevards</td>
<td>Street trees</td>
<td>Tai chi hardscape space / pocket parks</td>
</tr>
<tr>
<td>4. Plaza / Hardscape</td>
<td>Monuments / plazas</td>
<td>Pedestrian walkways / improvised seating areas</td>
<td>Informal seating</td>
<td></td>
</tr>
</tbody>
</table>
SITE SYSTEMS
description

Our site design analysis is organized around six systems that influence the environmental impact of the site: water, energy, landscape ecology, waste, surfaces, and circulation. These systems cannot be considered independently; they need to be considered in concert. Additionally, sustainability does not have to conflict with aesthetics or design choices. For example, green roofs, constructed wetlands, and the incorporation of small-scale renewable energy sources can become features of a site that are aesthetically as well as environmentally important.

There is no single approach to designing a sustainable site. For each system below, a variety of approaches are identified, ranging from very easy and incremental steps to scenarios that represent cutting-edge approaches to sustainable design.

framework

Values
Goals
Conceptual Introduction
Alternatives
Site Application
Case Study

site systems
WATER

Values:
Reduce use and improve water quality

Goals:
Create small scale, biological systems of water treatment

Between 1991 and 2001, the city of Shanghai made amazing strides in improving its capacity to treat wastewater. However, increases in household wastewater volume of nearly 9% per year threaten this progress. To help Shanghai maintain the progress it has made in wastewater treatment, there is a need for new developments to take responsibility for their own wastewater generation. At the same time, Shanghai’s per-capita water resources are about half that of the Chinese average. By reusing wastewater, developers can more efficiently deal with water both coming into and going out of the site.

Alternative A: Develop vegetated swales for conditions adjacent to hard surfaces
Conventional runoff control measures require significant land area and destruction of natural site systems. Natural systems are often more efficient than conventional systems on a linear meter basis, but are often more complicated to design, and require greater consideration of the natural systems already on-site. At the street level, storm water curb extensions absorb runoff, while beautifying the street. In the US, studies have shown that swales are cheaper to construct than conventional pipes, but the technology faces barriers because of existing environmental regulations and because contractors are unfamiliar with the technology, leading to higher labor costs. Because in China labor is a lower proportion of costs and stormwater management regulations are more stringent than in the US, cost savings could be dramatic.

Alternative B: Develop rooftop rainwater catchment systems to capture, treat and re-use water for non-potable applications. Rooftop water can be successfully used for irrigation, toilet flushing, and watering lawns at the household or facility-level without the need for secondary treatment. See Figure 2 for how much water could be captured on-site using roofs in existence. Even in multifamily buildings, greywater captured on the roof can be used for landscaping, and in community bathrooms.

Alternative C: Build constructed wetlands to capture, treat, and reuse greywater volume for infiltration and groundwater recharge.
Constructed wetlands used to treat greywater make thriving wildlife habitats and beautiful water features for the site. Wetlands also recharge local groundwater, preventing subsidence (shrinking of the water table, causing buildings to sink). Constructed wetlands can also provide efficient and effective tertiary treatment of black water, but must be moved away from people. Although black water can be treated to a potable level, as a safety precaution, it is not recommended for direct reuse applications.

Integration with Site Design:
When going with an approach that utilizes natural systems, it is important to integrate storm water sewerage and landscape design early in the design process, so that opportunities to marry the two systems are not missed. Green roofs, detention ponds, and constructed wetlands can become major features of a site. If storm water effluent can be treated to a recreational water-use standard, storm water management components such as detention ponds can become water features for community enjoyment.

Figure 1: describes the relationship of the imported and exported water within the site and suggests the relevancy of recycled water systems
Case Study: Grey Water Flush System
Quayside Village Cohousing, North Vancouver

When building their homes, the 20 residents of Quayside Village elected to include a greywater system that recycles greywater and uses it to flush toilets. Using a multi-step filtration process, the water is renovated to standards suitable for showering (although regulations prohibit it at this time). The system processes 20,000 liters per day and is expected to reduce consumptions by 40%. The initial cost for installation was $115,000 and maintenance is expected to be about $100 dollars. In reality, this experimental program is not cost-effective; however, this is at least in part due to the fact that there are redundancy requirements and use restrictions that could be eliminated as the technology is developed.

Source: www.betterbuildings.com

Figure 2: The plan on the left describes the amount of detention on the site estimated at 11,300 cubic meters with a questionable edge and bottom detail to facilitate ecological water management. The plan on the right describes the amount of additional wetland needed to detain greywater and stormwater present on the site.

Calculation A:

Conditions
Typical people in a household:
  3 household
Average per capita flow/person:
  91 liters/person
BOD5 removal goals:
  (e) = 140 mg/L

\( p = 10 \text{ mg/L} \)

Input
Homes \(	imes\) People per home \(\times\) per capita flow
4,239 homes \(\times\) 3 People \(\times\) 91 \(\text{L}\) \(\times\) 1,157,247

L/Day or 1.157 \(\text{m}^3\) per day

Removal
BOD Removal \(\text{KG of water} \times\) Days in Year
(140 \text{mg/L - } 10 \text{mg/L}) \times (1.157 \text{m}^3/1000) \times

365 \text{days} = 54,900 \text{kg per year}

Sizing
Assume that influent BOD5 is reduced at a rate of 2.5 kg/day per square meter of wetland and that the wetland is nominally 2 meters deep.

\( 54900 \text{ kg/person} / 2.5 \text{kg/person} = \text{21,959 m}^2 \text{ of 2-meter deep wetland to facilitate 4,239 homes} \)
**ENERGY**

Values:

Promote alternative and more decentralized sources

Goals:

Reduce load required on municipal grid to less than zero

Urban electrical demand in China is predicted to increase over 4% per year through 2025. Especially as the use of household appliances increases rapidly, household-level demand will probably increase faster than industrial demand. This increase in energy demand will place great stress on the municipal grid and stress conventional sources of energy. To deal with these two issues, developers should take concurrent steps toward incorporating renewable energy sources on-site, and creating the infrastructure that will allow independence from the municipal grid.

Alternative A: Integrate small-scale renewable energy sources (wind, solar) on site

At the smallest scale, solar panels and wind turbines can power particular site functions, such as night-time lighting (see case study). Although these types of interventions make only a small impact on total energy consumption, they can be important in creating community awareness of renewable sources of energy, and can be quite effective in marketing the site as “green.”

Alternative B: Use solar roofs throughout the site to generate power

Solar panels in particular, if propagated throughout the site, can make some difference in energy demand within buildings. With increasing energy prices, what may seem like a small impact now may be a larger financial impact as conventional sources of power become more expensive, and air pollution regulations become more strict. See figure 1 for the opportunity within photovoltaics and the associated costs.

Alternative C: Provide back up for the municipal grid

China’s chronic energy shortages will place more stress on the municipal grid in the coming years. Guaranteed back-up power generation that provides power throughout blackouts or brownouts will become a valuable site amenity. In addition, setting up the infrastructure that provides connection between generation facilities on-site and households can pave the way for future, larger-scale power generation to occur on-site when the cost of conventional energy rises or the cost of renewable energy becomes competitive enough to make local generation cost-competitive with the grid.

Alternative D: Build power generation at district scale

In large residential districts, new towns could collaborate to produce energy at the district level, and even to sell power back to the municipal grid. This would provide total self-sufficiency from the grid, and would keep the area free of municipal power generation facilities in the future, giving the community more control over its environment.

**Case Study: Urban Wind Farm**

Belmar, Denver, CO

The lights in Belmar’s parking lot were a great marketing tool for Lakewood, Colorado’s large-scale mall redevelopment project. Each was equipped with a wind turbine that provided power for the light poles that supported them. Highly visible from a main arterial road, these turbines reminded shoppers that Belmar was an “innovative place.” In the meantime, they helped cut down on electricity bills, although the savings probably won’t pay for themselves. There are 14 turbines in all, which produce 700,900 kilowatt hours per minute.


**Figure 1B** Holiday New Town potential contribution to a New Town Energy Load based on application of solar panels to all roof surface. (Note: calculations assume pitched roofs and south side installation only.)
LANDSCAPE

Values:
Treat landscape as a connected ecological system

Goals:
A development that contains a living ecosystem

Although much of modern residential development seeks to eradicate the past, environmental design requires the use of landscape ecology as an organizing principle. Landscape ecology is a sub-discipline of ecology, focusing on the study of landscape patterns, the interactions among the elements of pattern, and how patterns and interactions change over time in the human-focused environment.

Alternative A: Develop a soil improvement program
The intent of such a program is to restore life to the site resource that has withstood historical agriculture and new development. Inputs of microorganisms create a biological condition that provide better growing conditions. Additionally, healthy soils provide an improved rate of infiltration and detention as it relates to stormwater runoff. Using mulches and soil conditioners like compost can decrease landscape irrigation needs by up to 30%. Natural compost is much preferable to fertilizers because it has less nitrogen, decreasing the BOD load on storm sewerage systems. In addition to natural mulches like wood chips, there are also mulches made from recycled plastic that can keep soil moist and prevent localized erosion.

Alternative B: Develop low irrigation plant pallet to reduce irrigation needs
By choosing appropriate landscape elements and using water-saving maintenance practices, developers can decrease water usage by more than half without compromising the design or the aesthetic of the site. The “xeriscape” movement in the US, started in the state of Colorado, promotes the creative use of landscape elements that do not require any net addition of water to survive in their habitat. In a sub-tropical climate like that of Shanghai, there are many options for plants that do not require additional water. Using plants that are the most adaptable to the local climate not only save water, but also make the site easier to maintain through extremes of weather, protecting the future brand image of the development.

Alternative C: Create wildlife habitats specific to local species
Upon completion of a survey of the regional urban wildlife, the landscape should be designed to provide places for movement within its open space system. Opportunities should be found in the canopy layer for avian species as well as the shub and groundcover layer for terrestrial species.

Alternative C: Collaborate with adjacent new towns to create habitat patches and corridors
Since a particular site is an arbitrary division of land, it is usually too small to be an independent wildlife habitat. By collaborating with other new towns early in the design process, a corridor can be created to allow wildlife to move through the new town with ease. Providing a corridor and allowing wildlife to move off and on the site decreases the habitat pressure on the site that can cause conflicts as small mammals come into contact with human development.

Case Study: Continuous Ecological Corridor
Groningen, Holland
A recent plan for the redevelopment of a former distribution plant and gasworks site in Groningen, Holland paid careful attention to its environmental context. This 10 hectare mixed use project sat between two existing urban parks. In order to provide a pathway for birds and natural drainage for site runoff, a modest open space area was aligned so that it connected the two existing parks.

LANDSCAPE ECOLOGY

Figure 1: Describes an approach for connecting the regional landscape system with the local landscape through a series of land purchases and easements and an understanding of the species present in the region. At the new town scale, site planning that creates a connective tissue to the larger landscape completes the system.
WASTE

Values:
Reduce, Reuse, Recycle

Goals:
Extend the life span of every material that enters the site to its maximum

The increasing amount of waste that accompanies an increasing standard of living threatens the environment in several ways. Dumps produce harmful methane gas, and are a major source of run-off pollution. A modern landfill is lined with waterproof material to prevent contamination, but requires a large amount of land. The best way to decrease the impact of waste on the environment is to decrease the amount of waste, but in terms of site systems, the focus must be on decreasing the impact of waste once it is generated.

Organic waste can provide valuable resources for the site in the form of compost, which can make a great fertilizer for households or for landscaping. Although recycling is not yet cost-effective, it provides a way of dealing with waste proactively on-site that can lead a change in resident behavior and less litter in the neighborhood. Recycling programs in the US have been credited not only with the amount of materials recycled, but of raising the awareness of environmental stewardship overall.

Alternative A: Recycle building materials during construction
The costs associated with recycling separated construction and demolition debris vary greatly, depending on how materials are handled, and the type and quantity of materials generated. Planning for reuse, salvage and recycling at the front end of the project can significantly reduce material handling and overall waste disposal costs. Some US states, such as California, require builders to submit a Waste Reduction and Recycling Plan during the permitting stage of building. If such a requirement were created in China, a developer that could create an efficient plan for recycling materials would have a significant cost advantage. Recycled building materials are competitive in price and quality with new materials, and are resource-efficient because they close the recycling loop while avoiding extraction of more resources. Online and regional markets for recycled materials exist in the US and in most of Europe. According to our initial research, this market is not yet well-developed in China.

Alternative B: Provide community facilities for recycling and composting
In most cultures, the great majority of waste is organic, so taking organic waste out of the waste stream greatly decreases the load on local waste management services. Many community composting plans start in schools and are implemented by school maintenance staff in cooperation with students, and the product is used in the school garden and landscape, and is provided freely to parents for household use. The infrastructure for recycling is inexpensive, but a program takes strong community commitment. Community composting facilities can be provided at schools, in the back of multi-family buildings, or at the block level in single-family developments. Although some training is required to get started, composting takes little time or skill and can be a voluntary effort undertaken by the community.

Alternative C: Collaborate with city to recycle at the household level
Recycling mitigates many forms of pollution and environmental degradation by reducing the amounts of raw materials, energy, water, and waste products required to produce goods. Household recycling can also be an important step toward recycling at a scale that makes it economically viable, and promotes environmental sustain-

ability at the household level. Japan has one of the most effective recycling systems in the world, through a decentralized system run by prefectural and municipal governments that requires recyclable materials to be separated at the household level, or they will not be picked up. In Japan, approximately 50% of solid wastes are recycled in Japan, compared to about 30% in the United States. Many Japanese municipal governments have waste management boards composed of business and community stakeholders who manage the process. Many of these boards do exchange programs with other countries to share their experiences and progress.

Alternative D: Biogas generation
Potentially, one of the most useful decentralized sources of energy supply is biogas – an approximately 60/40 mixture of methane and carbon dioxide produced by anaerobically fermenting organic waste. Biogas burns with a clean flame and causes little air pollution. Biogas is used throughout China in industrial and village uses, and can be used at the household or the community level, generated by organic trash or by human or animal waste. On the site, biogas is produced in tanks called digesters, which are often placed underground, and the gas is usually used directly for cooking, heating, or light, but can also be made into electricity through a generator. Equipment can also run off a gas-powered engine rather than using electricity. In addition to generating electricity, biogas digestion reduces methane emissions, which are a key contributor to global warming. Approximately 10% of global methane emissions from human-related sources are emitted from landfills and dumps.
Case Study: Municipal Waste Cogeneration
Sheffield, England
Sheffield, England uses its household waste to both generate electricity and heat homes. Each year the system, which was completed in 1994, burns 140,000 tons of municipal waste, generates 125,000 megawatt hours per year, and heats 3,600 homes, two universities, a hotel, a sports venue and all other commercial activities in the town.

Source: Pinderhughes,
SITE SURFACE

Values:
Maximize ground water recharge

Goals:
Maximum possible permeable and green surfaces

In general, approximately 60 to 90% of residential building sites are paved to accommodate surface parking. Asphalt is a fossil-fuel product that retains heat, raises the ambient temperature around buildings (the "urban heat island" effect) and thus increases cooling loads. To reduce run-off and heat island effects, it is important to maximize the use of permeable, non-asphalt surfaces, and especially the share of the site covered by vegetation.

Alternative A: Incorporate permeable pavement
There are many commercially available proprietary types of semi-permeable paving surfaces that help absorb runoff while also providing a surface that is easy to walk or drive on. Although using semi-permeable paving surfaces can reduce runoff loads, this runoff is still polluted by its contact with cars and pesticides. Therefore, a site that uses more permeable surfaces but still has little green space is not as good an option as having more green space. These surfaces are NOT meant to be used in lieu of green space. The best way to prevent pollution is by limiting the share of paved surfaces altogether. Our understanding is that permeable parking lots may already be in use in Holiday Town due to Shanghai’s green space regulation.

Alternative B: Create a goal for canopy coverage to mitigate urban heat island effects

and improve air quality
Heat islands can be measured directly by comparing the air temperature in the most dense development to that in a forested area. Many cities fight the heat island effect by mandating a particular level of tree coverage, usually measured as the percentage of impervious surface area covered by trees, as indicated by aerial photography. Many cities have coverage ratios of around 20%. In addition to simply providing shade, tree canopy is very efficient in dissipating solar energy received through leaf surfaces. Canopy coverage is especially effective in parking lots. Studies have demonstrated that increasing tree cover in parking lots from 8% to 50% reduces evaporation of hydrocarbons from car fuel tanks and start-up emissions. Also, drivers will notice that their cars do not get as hot in the sun in a “greener” parking lot, even when their car is not directly in the shade.

Alternative C: Incorporate green roofs into the design
Green roofs (sometimes called "cool roofs"), unlike traditional roof gardens, are designed to be virtually self-sustaining and require a minimum of maintenance. They can be established on a very thin layer of "soil" (most use specially formulated composts). Green roofs reduce heat island effects, improve the heating and cooling efficiency of a building, and decrease stormwater runoff. Green roofs are often a popular choice for environmentally friendly developments because they are also considered open space amenities for residents. Also, green roofs do not have to be green - in Bordeaux, France, an air traffic control center green roof was planted entirely in lavender, a crop traditionally associated with the region, and has become a tourist attraction. The green roof industry is well developed in Europe and many companies specialize in plants that can live in the minimal soil levels required.

Figure 1: Holiday New Town Baseline Impervious Surface as a calculation of roof areas and paved surfaces on the site

Baseline

Impervious Surface Area in km²

- 15
- 10
- 5
- 0

Current Plan

Keywords: site systems
Case Study: Porous Asphalt
Walden Pond, Massachusetts
In 1977 Walden Pond, a recreation area outside of Boston, MA built an asphalt parking lot that allows rainwater to permeate through its surface. The purpose of the system is to utilize natural water filtration and recharge the water table. The system costs 25% to 50% more than standard asphalt, but a drainage system is not required, so it may actually minimize costs. As of 2001 the lot was still in operation and hosting about 600,000 visitors a year.

CIRCULATION

Values:
Encourage walking, biking and public transportation

Goals:
Monitor and reduce vehicular miles traveled

The need to limit impervious surfaces is further balanced with the need to create pedestrian, bicycle, and vehicular circulation systems that encourage walking and community interaction. Keeping areas accessible to pedestrians makes communities particularly attractive to the fastest-growing segment of the marketplace – the elderly. However, exactly how to create a “walkable” neighborhood is up for debate, is often culturally specific, and has evolved over time.

Alternative A: Provide post-occupancy measures of VMT
Vehicular miles traveled per capita (VMT) is the main measurement used to measure car dependence. As more of Shanghai’s citizens buy cars, VMT will probably increase exponentially. However, at the site level, VMT per car can be used as a proxy for how well localities are creating walkable communities, and increasing alternate mode share. By tracking VMT through a post-occupancy survey, and comparing VMT between developments, it can be discovered which developments are more successful at creating a walkable environment. VMT has a direct relationship to air quality. In the US, even though emissions per mile traveled have steadily decreased since 1970, any decreases in air pollution that this trend may have caused have been erased by the massive increase in VMT.

Alternative B: Provide a street pattern that connects to adjacent street network
Compact circulation systems with connected block patterns encourage people to walk and bike, rather than drive short distances. Even the US, the most entrenched of “car cultures,” has seen a market premium emerge for New Urbanists communities with the traditional small block patterns reminiscent of the pre-automotive era.

Alternative C: Allow for use of different modes within each transportation corridor
As more people get used to driving their cars, the share of trips made by car will increase. Short trips that could be made by other modes but that are now made in the car unnecessarily add to air pollution and fossil fuel demand, without adding to residents’ standard of living. Decreasing short vehicular trips can have a huge impact on VMT. To encourage walking and other modes, land use plans should make sure that the distance between any residential unit and commercial and community uses should be within a culturally specific “walking distance”. This distance is often considered to be about a half-mile in urban areas in the US, but may be higher in China.

SUSTAINABLE RESIDENTIAL DEVELOPMENT HANDBOOK

Case Study: Neo-Traditional Circulation
Stapleton, Denver, CO
In reaction to the contemporary pattern of suburban development, which is dominated by cul-de-sacs and provides few, if any, pedestrian amenities, neo-traditional developments have incorporated a loose interpretation of the grid system with the intention of providing pedestrian connections, legibility and safety. Stapleton is one of the largest examples of such an approach. The project will eventually span 1,902 hectares. The portion developed thus far contains about 15 units per hectare on small residential blocks that range from 0.4 to 2.2 hectares. Pedestrian and vehicular traffic are rarely separated by more than a curb, and in only a few cases divert from an orthogonal street system. This approach stands in contrast to neighborhoods such as Radburn, NJ which seek to completely separate walkways from roadways and capitalize on topographical conditions to evoke a bucolic environment. Each approach has its own merits and is best evaluated within its own context and culture.

Source: Stapleton site plan.
OPEN SPACES
INTRODUCTION
In this section we analyze design components of parks and other recreational open space that serve to beautify a development. First, we define the different scales of open space. Second, we examine how design components should accommodate different uses of open space and address problems with use. We also look at basic considerations for designing open space, including comfort, visual quality, safety, and access. We will use a variety of case studies throughout our analysis to illustrate our main points. In the fourth section we analyze Holiday Town as an example of open space and address successful and unsuccessful features of open spaces in the development. Much of our work is based on Western data and case studies, because this was the richest information available. We hope to discern the more culturally specific issues of open space in China during our visit in January.

Why have open space?
A Singapore case study of three housing developments (Hee, Tsou, Ooi, and Lam) demonstrates a variety of perceived reasons for having open space in public housing, summarized in Chart 1. Because the most important reason was the improvement of the physical environment, design of open space should be attractive. However, this is not enough. Open spaces can fulfill a number of needs; for example, it is also important for open space to offer safe spaces for solitary time, social interactions, and physical activity. Designers of open space have the ability to facilitate certain kinds of uses.

Chart 1. Reasons for Using Open Space (Chinese)
Source: Design, Use & Social Significance of Public Space in Public Housing: Case studies of Singapore and Hong Kong

The Design of open space must also consider convenience, proximity, and level of access. Chart 2 (Hee, Tsou, Ooi, and Lam) demonstrates the frequency of use of public spaces. This study found that residents in Singapore tend to use public space associated with a purpose and nearer to commercial areas most frequently, but parks near the home are more frequently used than central community public space.
While cultural values differ around the world, we may be able to apply Singapore residents' reasons for not using public space to residents in other countries such as China (see Chart 3). However, these reasons will not only vary according to culture but also according to the intended use of a specific site.

Open space is a necessary component of housing developments, but poor design of open space can lead to unused areas, undesirable behavior, strain on management, and other difficulties. In the following sections, we will attempt to outline methods of creating successful open spaces that are attractive, comfortable, and useful for a variety of residents, appropriate to the scale of the space. In particular, we support what we consider a sustainable version of recreational open space, which includes open space that:

1. is reasonable to manage and upkeep;
2. adds to the value of the development;
3. is flexible in use and therefore adaptable;
4. fosters a sense of ownership so that residents become involved in maintaining the space;
5. and has a positive impact on the surrounding natural resources.

Chart 2, Source: Design, Use & Social Significance of Public Space in Public Housing: Case studies of Singapore and Hong Kong

Chart 3, Source: Design, Use & Social Significance of Public Space in Public Housing: Case studies of Singapore and Hong Kong
In terms of scale, open space is divided into urban public open space, community public open space, semi-private open space and private open space. In this chapter, we only analyze the first three kinds of open space.

**Urban Public Open Space**

**Size:**
40 feet- 450 feet or 70-100 M
( Maximum distance for being able to see facial expressions: 20-25 m)

**Service area:**
900 feet or 4- minute walk

**Location:**
Corner location, mid-block location, a widened sidewalk. Mixed use, closed to retail stores & restaurants. Connect to pedestrian system

**Uses and activities:**
Almost all, group and individual use

**Main features:**
Central, equal access, variety of elements

**Case study:**
First National Bank Plaza

**Community Public open space**

**Size:**
various

**2 factors affect the design:**
the overall surrounding housing density & income

**Uses and activities:**
Smaller gatherings and play spaces, multi-purpose but for fewer uses

**Main Features:**
Supplements to public spaces, smaller, quieter, closer to home

**Case study:**
Gore Street Park, Cambridge, MA
Golden gate heights park, SF
Mission dolores park, SF
Boeddeker park, SF
Sidney Walton square, SF

**Semi-private open space**

**Size:**
One house lot wide

**Location:**
Corner lots, mid-block lots, through-the-block lots

**Site selection:**
four-block radius walking without major streets

**Uses and activities:**
Gardens, visual enjoyment only, circulation

**Main features:**
Near/between buildings, number and location of building entrances determines type and frequency of use. Often separated with fences or landscaping

**Case study:**
Charlie Dorr minipark, Berkeley, California
Urban public open space case study: First National Bank Plaza, Chicago

Location and context:
cover half block, next to high rise commercial buildings and small restaurant building. Access to main streets and the high rise building.

Size:
100*55 M

Facilities:
Fountain, seatings, large wall of painting, three levels consist of squares one upon another.

Activities:
multi-purpose public space for multi-users, adaptable for special events such as exhibits and entertainment programs.

Source: CLIP: Contemporary Landscape Inquiry Project
### Community open space comparison

**Neighborhood**

<table>
<thead>
<tr>
<th>Density:</th>
<th>Medium</th>
<th>Medium</th>
<th>High</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income:</td>
<td>Medium</td>
<td>High</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Activities:</td>
<td>More depend on the site</td>
<td>Less depend on the site</td>
<td>More depend on the site</td>
<td>Less depend on the site</td>
</tr>
<tr>
<td>Facilities:</td>
<td>Sports courts, children’s playground</td>
<td>Sports courts, planting, Benches</td>
<td>Small sports facilities, children’s playground</td>
<td>Seating, fountain, sculpture, planting</td>
</tr>
<tr>
<td>Users:</td>
<td>Single parents, young professionals, elderly</td>
<td>Dogs and fairly wealthy couples</td>
<td>All ethnic and age groups</td>
<td>Office workers and families</td>
</tr>
</tbody>
</table>
Case study: Charlie Dorr minipark, Berkeley, California

Location and context:
In a largely black, low to moderate income residential neighborhood. It’s located on a narrow, quiet, tree-lined street of neat single-family houses.

Size:
0.22 acre, Through block lot

Serve area:
Users walk or bike to this park from a 3-4 block radius.

Uses and facilities:
play structure with swings, playfield for children, climbing structure, sand play area, picnic tables, bench and drinking fountain.

Six-to twelve-year-olds form the largest group. Teenagers and young adult males use the arbor area for hanging out. Relatively few parents come here with their children.

Successful feature:
Good use made of a very small site variety of surfaces, textures, materials, and levels.

From the view of the back, looking toward the entrance.
OVERVIEW OF OPEN SPACE DESIGN
In the following section we will analyze the design of open space according to different categories, including:
1. Use
2. Comfort
3. Visual Quality
4. Safety
5. Convenience/Access

DESIGN ACCORDING TO USE
Parks can designed to accommodate a number of uses. In the following section we analyze use of open space and corresponding design features. Attention to use can prevent conflicts between intended use and actual use, and between adjacent or overlapping uses.

Gore Street Park in Cambridge, Massachusetts will serve to illustrate various aspects of use. Because it is large-scale, it accommodates a large number of uses.

- Scale: Urban public
- Size: 11,770 square meters
- Location: Situated between a Cambridge neighborhood and an outdoor mall (large grocery store, drug store, clothing stores, beauty store, movie rental store, fast food restaurants, and other businesses)
- Uses: Baseball and basketball, ice hockey and skating in an indoor rink, play on two different playgrounds, dog walking, picnicking, studying, socializing, circulation between neighborhood and shopping area

Gore Street Park, Cambridge, Massachusetts, USA
Source: Google Earth
Use: Children 1-5
Children of different age groups require different playgrounds. As Vanke has experienced, cultural standards of play may vary, so equipment built in one country may not be appropriate for the intended age group in another country.

Recommended design elements for children ages one through five include (Marcus and Francis):
- Separated by hedges or fences low enough that parents can watch
- Visible from apartments or from benches beside the play area for supervision
- Located away from busy streets
- Easily accessible restrooms with diaper changing facilities
- Smooth surfaces leading to play area
- Manipulable water space for play (stream bed, fountain)
- Play equipment strong enough for some adult use
- Provide water source for drinking and cleaning

Gore Street Park Playground
(Picture 2, outlined in red in picture one)
Successful features:
- Surrounded by a chain link fence.
- Easy observation by parents
- Near a simple fountain (Picture 3) and hopscotch area (both outlined in blue in Picture 1)

Challenge:
- Located near a busy secondary street
Use: Children 6-12
Children ages six through 12 may require more interactive, exploratory environments.

Recommended design elements for this age group include (Marcus and Francis):
- Undesigned component(s)
- Varied topography: undulating and flat
- Water play: natural streambeds are attractive and interactive
- Hardy, low branching trees away from fences and incorporation of other natural elements
- Play equipment that require physical exertion and challenge
- Loose props: anything from loose boards to actual toys

Gore Street Park Playground
(Picture 2, outlined in red in Picture 1)
Successful features:
- Larger playground separated by a fence
- Composed of more complex equipment providing greater physical challenge

Benches provided for supervision (Picture 3)

Challenges:
- Close to busy street (Picture 2)
- Fountain in park too simple and controlled for optimal play
- Does not incorporate many natural elements for play
- Simple topography
**Use: Teenagers**
Teenagers also require accommodation for play and other activities, but often interact in larger groups.

**Recommended design elements** for spaces accommodating teen uses are (Marcus and Fracis):
- Separated or distinguished from other spaces, with ample room for group activity
- Located near busy parts of the park so teens can see and be seen by others
- Near a parking lot so those with other cars can pull in (this may not be relevant in China unless many teens drive)

Spaces for teenagers can also include isolated spots for small groups or couples, but there is a risk that undesirable behavior will be encouraged.

**Gore Street Park Teen Use**
**Successful Features:**
- Basketball field, outlined in red in Picture 1, separate from other areas of the park
- Baseball field, outlined in blue in Picture 2, with places from which to watch games
- Ice skating rink in front, outlined in purple in Picture 1, in front of which teenagers lounge

**1. Gore St. Park**
*Source: Google Earth*
Challenges (Teen Use):
Teenagers’ group size and behavior can lead to conflict of use with other groups. One way to avoid undesirable activity in inappropriate places is to allow for the same activity in a controlled environment.

For example, many cities in the U.S. have built skate boarding parks where teenagers can gather in groups and skateboard in a safe environment. Ideally, this prevents damage to city property and prevents illicit behavior by teenagers in groups in unmonitored environments. Parks like this can also be commercialized. For example, a snowboarding store in Boston, Massachusetts offers a skate ramp where young people of all ages can pay a suggested $2 donation each use or a yearly $25 membership.
Use: Young Adults/Adults
Adults may use open space for a variety of reasons. As noted in the introduction to this section, common reasons include (Hee, Tsou, Ooi, and Lam): proximity to shopping; to experience a more natural environment; social group activities (eating, chatting, friends, family); small group games; to spend time as couples; to supervise children; and for solitary time.

Relevant design components include (Marcus and Francis):
- Easily describable spots for meeting
- Variable seating arrangements, including moveable seats
- Knolls and other more natural spots for sitting and gathering
- Visually attractive walkthroughs and strolling paths
- Design allowing certain areas to be claimed by regulars

Gore Street Park Young Adult/Adult Use
Gore Street Park does not offer a wide variety of uses for adults beyond supervising children and dog walking.

Successful features:
- A grassy knoll, outlined in red in Picture 1, where adults can read or study (Picture 2)
- Paths and open grassy areas for dog walking (Picture 3)
- Direct pathways to the shopping area

Challenges:
- Lacks separate spaces for adult use
- Secondary paths lack privacy or interesting vegetation
- Walkthrough paths are simple and unattractive
- Little variety of features for various group activities
1. Gore St. Park  
*Source: Google Earth*

**Use: Elderly**
Elderly have greater requirements for resting and shade than other age groups. Elderly people may use open space for group gatherings, activities such as tai chi, public solitary time, small group games, and walking alone and in small groups.

**Relevant design components** include (Marcus and Francis):
- Drinking fountains and other nearby facilities
- Limited inclines and stairs with rails
- Benches on pathways, especially at tops of inclines for resting
- Game tables in shelter

**Gore Street Park Elderly Use**
Gore Street Park does not accommodate very much elderly use.

**Successful features:**
- Pathways are flat and easy to navigate (Picture 2)
- Small picnic or game tables (Picture 3, outlined in red in Picture 1)

**Challenges:**
- Few benches along pathways
- Tables are located near children’s playgrounds
- Few open spaces away from younger, louder users for quieter group activities
**Use: Circulation**
An open space can allow for passage directly through or more leisurely strolling within the park. For safety reasons, it should be decided if bicycles will be allowed to access these paths and whether separate paths should be made for such use.

There should be a **hierarchy of pathways** in an open space (Marcus and Francis):
1. Main Circulation Routes: Direct but attractive pathways with benches for resting and people watching
2. Secondary Circulation Routes: Meandering paths with different grades moving away from main circulation routes

Bicycle locks (or parking for other personal transport devices) should be placed in open spaces where people might stop to enjoy various activities.

**Gore Street Park Circulation and Use**
**Successful features:**
- Straight, flat, direct pathways are provided between the neighborhood and shopping area (Picture 2)
- Various access points allow for more direct circulation
- Bicycle locks (Picture 3)

**Challenges:**
- Meandering paths could be more complex, private, and interesting
Use: Miscellaneous
There are additional uses for all age groups that may require specific design elements (Marcus and Francis).

Picnicking:
- Group tables
- Communal barbeque located away from apartments to avoid smell
- Spaces to spread out on ground
- Trash receptacle
- Drinking water source
- Bathroom facilities
- Knolls for sitting on the ground
- Good irrigation for the grass

Picnicking:
Gore Street Park does have ample open green space on which people could have picnics, but there is noticeable waste from dog walking. Communal barbeque facilities also could be provided.

Art Appreciation:
Picture 4 illustrates the only kind of art in Gore Street Park, created by community members on unattractive electrical boxes. Community art could be a way to increase ownership and appreciation of a space.

Gore Street Park Miscellaneous Use
Gore Street Park is currently not well suited for these additional uses.
Problems with Use:
When designing an open space, problems with use should be considered. There are various ways in which these problems can arise (Marcus and Francis).

1. Unintended use
People may use space in a way that is unintended. In Picture 1, an adult is hanging on the children’s play equipment. As previously stated, young people may engage in sports or activities that were not accommodated in design such as skateboarding, cycling, and roller skating.

2. Antisocial use
People may engage in antisocial use such as littering, vandalism, and crime. In Picture 2, a teenager is writing graffiti on a lamp post.

3. Conflicts between uses
There may be conflicts between different uses, such as competition for territory or incompatible groups using space nearby each other. This is likely to occur, for example, between teenagers, who may be noisy and gather in large groups, and elderly, who may prefer quieter spaces and may not understand the kinds of activity teenagers engage in.

Management
After considering design elements, problems with use can be dealt with through appropriate management. Reasonable rules can be established, such as limited times of use and prohibition of the placement of household garbage in trash barrels. If such rules are to be established, however, they must be enforced. However, while presence of uniformed police may increase feelings of security, it may also limit residents’ sense of ownership and freedom to use an open space.
Plan for the redesign of Gore Street Park
Source: City of Cambridge Community Development Department
Solutions: Gore Street Park Redesign
Recently, the City of Cambridge decided to redesign Gore Street Park. The Community Development Department drafted a plan and gave residents the opportunity to provide feedback on, revise, and finalize it in three community meetings. Some of the changes driven both by the planning department and the residents who use the park are below.

Landscaping/Beautification:
In redesigning the landscaping, planners were careful not to detract from the sense of openness in the park, highlighting the tension between a desire for a natural, private environment and a safe, open, public area. They decided on the following changes:
- Add ornamental and shading trees
- Remove trees blocking views at access points
- Plant trees as buffer wall between basketball courts and nearby residences
- Consider art or graphic design on the upper panels of the wall of the ice skating rink adjacent to the main path to the shopping area

Sports:
The plan looks at diversifying use of the two sports fields and enabling more spectators though the following changes:
- Split one basketball court into two half courts to allow for more variety of use
- Lower some baskets for younger children s use
- Install drinking fountain at courts
- Enlarge bleachers and install safety rails near baseball field

Use for adults/elderly:
The plan recognizes that not enough uses for adults and elderly people are currently accommodated. The plan includes the following changes:
- Convert the grassy knoll into a garden with nearby game tables
- Create more strolling pathways
- Construct more direct routes to the shopping district and nearby highway

Safety:
The plan attempts to increase the sense of safety, which is especially important because this is a urban public scale park. Changes include:
- Increase visibility near entrances
- Install fence along mall side of the park
- Install two emergency phones
Playgrounds:
Considering the popularity of this park with families with children, much attention was paid to the existing playgrounds. The plan includes updated play areas with the following changes:
- Make playgrounds accessible to persons with disabilities
- Enlarge playground for one to five year olds
- Move playgrounds closer together for easier supervision
- Introduce natural climbing rock with tunnel
- Incorporate more natural materials in general
- Create circular bike learning and riding area at the edge of the playground

Plan for the redesign of Gore Street Park Playgrounds
Source: City of Cambridge Community Development Department
COMFORT

Open space is enjoyed more and used more often when it is designed to be a comfortable place for people. Whether the space is to be used for exercise, seating and relaxation, gathering, or play, its design should take into account whether it is a comfortable space. This includes psychological as well as physical comfort.

Microclimate

Temperature, water, sun/shading, and wind are all aspects of microclimate that need to be taken into consideration when designing open space. At temperatures above 55 degrees Fahrenheit, the number of people waking, standing, and sitting outdoors in urban malls and plazas typically increases, but at temperatures above 75 degrees Fahrenheit, shading options should usually be included in order to keep stationary users comfortable.

Source: Mark Childs, Squares

Bioclimactic Chart indicating "comfort zones"
The chart on the previous page indicates how a person's typical natural comfort zone based on temperature and humidity can be expanded with the addition of sun, wind, or evaporation (water). Designers of open space can maximize users' comfort and usage of spaces by designing to include sun, wind, and water where appropriate.

*Why consider temperature?*
- Physical comfort

*Water* can be used effectively as a cooling agent in public spaces. Through evaporation and reflection, or as a thermal mass, water in the form of fountains or reflecting pools can cool open space areas. The City of Cambridge has included water features in its newer parks, like Franklin Street Park and Dana Park, which are used by children and adults to cool off daily during the summer.

*Why consider water?*
- Cooling properties
- Opportunities for play
- Natural aesthetic
- Sense of place

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**Fountain in Boston Common**
Boston, Massachusetts  
*Source: skyscraperpage.org*

**Water Play Ftn. at Franklin St. Park**
Cambridge, Massachusetts

**Reservoir**
Lowell, Massachusetts  
*Source: L. Tubbs, gateway.iu5.org*

**Canal by the Boott Cotton Mill**
Lowell, Massachusetts  
*Source: www.mit.edu.*
Sun and shade are essential considerations when designing open space and the buildings around it. A source of energy for plants and people, sun encourages outdoor activity and plant growth as well as improves air quality through reducing mold growth. In many situations, design strategies should try to include as much sun as possible, taking into account structures and the seasonal movement of the sun. [1] However, shading strategies should also be included at temperatures above 75 degrees Fahrenheit. Shade can be included through built components (i.e. buildings, awnings, trellises, umbrellas, etc.) or through landscaping and trees. The density of trees and types of trees (deciduous vs. evergreen) will also have an impact on the availability of shade. In general, since individuals have different tolerance for changes in temperature, outdoor seating and strolling areas should allow a choice of sun and shade at different times of the day.

**Why consider sun and shade?**
- Sun is a source of energy
- Shade controls effect of sun
- Different temperature needs for various uses and users

**Wind** can and should also be controlled to maintain good air circulation, allow light breezes in warm climates, and avoid negative impacts. This can include tunnel effects created by long parallel rows of smoothfaced buildings and downdrafts that can be avoided by stepping facades of tall buildings away from the prevailing wind. [2] The larger building dimension should not face into the predominating wind. In warm areas, on the other hand, streets should be straight, continuous, wide, and oriented 20-30 degrees from prevailing cooling breezes. Wind can be controlled through careful orientation of buildings surrounding open space as well as awnings, walls, trees, and buffer plantings.
Why consider wind?
- Cooling properties
- Good air circulation
- Avoid too-strong wind, downdrafts, and tunnel effects

**Street Furniture/Seating**
Seating areas should be included in nearly all open spaces. Whether for people relaxing, eating, watching children at play, or observing a sporting event, appropriate seating makes open space more usable and comfortable. Seating opportunities should not be limited to formal chairs or benches, as steps or other casual seating arrangements can be conducive to attracting open space users, especially in urban plazas. Designers should also consider sun and shade as well as the safety of children when determining appropriate locations for seating.

Types of Seating:
1. Street furniture benches
2. Tables and chairs
3. Large rocks
4. Low walls and planters
5. Bleachers
6. Steps

Why consider seating?
- Comfort and needs of users

**Boundaries**
Designers of open space should not only consider the bodily comfort of users but also their psychological comfort. This includes understanding the relationship of open space to its surroundings-buildings, streets, and sidewalks-as well as scale.

The relationship of open space to adjacent buildings changes depending on the use and type of building. Frontages with public, semi-public, and private buildings will create different relationships. In urban settings, parks frequently abut residential buildings, as in Franklin Street Park. [1] Gore Street Park abuts a shopping center with a somewhat uncomfortable transition between parking lot and baseball field. [2]
When in public space adjacent to streets, users may feel more comfortable in spaces that feel protected from cars. Landscaping or buffers can be used to protect and transition users. Walls or arcades can also be used, to a different effect. However, the desire for protection should be balanced with a need for visual and spatial accessibility. Walls or landscaping that obscure small public spaces from view may reduce visibility and use. Clearly delineated entrances can help define and open up these public spaces. Within an open space or open space system, diversity of spatial enclosures should be considered.

Parks will also have a different relationship with the street depending on their location within a street block—if it is on a corner, like Cooper Square, if it is midblock, like Franklin Street Park, or if it goes through the block, like Dana Park. [1, 2] Perceptions of openness and accessibility from within the park and outside the park will radically differ.

Plazas and parks should also be differentiated or separated from the sidewalk. While they may be adjacent to each other, the sidewalk is primarily a zone of circulation and movement, and the plaza is a place for lingering. If the relationship between the plaza and sidewalk becomes too blurred, the space may become unusable for both travelers and users.

Why consider boundaries?
- Physical and psychological comfort of users
- Protection from cars and other hazards
- Visual impacts for users and passers-by
- Transition from open space use to other uses/spaces

1. Corner location of Cooper Square
   Cambridge, Massachusetts

2. Dana Park, a through-block park
   Cambridge, Massachusetts
VISUAL QUALITY

The visual quality of open space is an extremely important part of design. While people do frequently use unattractive open spaces that meet a need or provide a use (such as specialized fields or playgrounds), open spaces that are visually appealing and provide a variety of things to explore and see will typically be more successful. This report considers the impact of surface/material, landscaping, public art, and maintenance on visual quality within an open space.

Surface/Material
Surface and materials provide a means to make spaces more interesting and desirable places. The ground and walls (of buildings or freestanding) enclose and frame smaller or urban open spaces. Detail, choice of material, and appropriate variety of material add to the visual complexity of a place and can make it a more attractive or compelling place.
Variety in ground surface in open space is useful not only for visual reasons. Through changes in pattern, texture, or material, it can be used for the following purposes.

Reasons for Variety in Ground Surface
1. indicate a change in ownership or usage
2. control traffic, define paths, or provide wayfinding assistance [1]
3. warn of hazards
4. create a sense of scale or proportion
5. reinforce the character or sense of place
6. define, organize, or unify a space [2]
7. delineate spaces for specific activities or games

Materials that can be used for ground surface in open space include brick, stone slabs, gravel, cobblestone, concrete, grass, tanbark, resilient floor surfaces, artificial turf, etc. These can and should be varied with the use and users of a given space. Gore St. Park is an example that could use more variety. [3]

Why consider surface and material?
- Define or indicate transitions
- Visual complexity and interest
- Sense of place

Landscaping
Landscaping is perhaps one of the first components considered by designers of open space. Some spaces will be more urban in character, while others will be more bucolic, but in nearly all, people desire some sense of a natural or nature-like setting. In addition to utilizing a variety of landscaping for visual interest, designers should consider the use of deciduous trees that change over the course of the year in order to emphasize the seasons and the passage of time. [4] Plantings can also stimulate senses other than the visual, as they can give off fragrances and odors or generate noises with the wind.
Aspects of sustainability should also be considered when selecting landscaping. Native plantings should be used as much as possible in order to reduce water usage, reduce pesticide use, and to attract local fauna. [1]

Why consider landscaping?
- Natural or nature-like aesthetic and character
- Emphasis on changing of the seasons
- Emphasis on local character of a place
- Sustainability and water conservation

Public Art
Public art is an important component of open space. Public art can educate and draw on local history. It can inspire joy and delight. And it can actively engage people and encourage interaction among users. Though not all open spaces include public art, it can fulfill a number of community and individual needs. [2]

Some aspects that should be considered when selecting or commissioning public art for open spaces include: the selection of local artists, the use of a variety of media, whether it works with a site, and appropriate scale for a given location. The selection process itself can be valuable to the community.

Why consider public art?
- Educate and draw on local history/community
- Joy and delight
- Encourage interaction among users
**Maintenance**

The level of maintenance of an open space indicates how much a space is valued. [1] If users value a space, they are less inclined to treat it carelessly, and if owners/managers value a space, they will ensure that someone is responsible for maintaining it. Open spaces are maintained through a variety of different arrangements. Public open spaces in the United States are typically owned and regularly maintained by a government entity, though they may contract with specialty vendors for particular landscaping or construction work. Exceptions include spaces like community gardens, where volunteer associations and individuals may take on the responsibility of landscaping and cleanup. [2] There are also many examples where public open space is owned by private entities (i.e. many public urban plazas in New York that were created through density bonuses are privately owned) will also typically pay for maintenance. Semi-public or semi-private spaces, including open space within residential communities, also typically have paid maintenance staff or vendors.

Who are possible entities responsible for maintenance?
1. Public departments (public works, parks & recreation)
2. Private owners/management companies (developers, property management)
3. Volunteer associations

*Why consider maintenance?*
- Show that a space is valued
- Clarify what entity is responsible for all aspects of long-term care

1. Immaculately maintained courts at Dana Park Cambridge, Massachusetts
2. Signs noting volunteer association role Boston, Massachusetts
SAFETY

Safety is a key consideration for designers of open space, as people will not spend time in a space where they feel threatened or insecure. Some of the key aspects of open spaces that influence an individual’s feeling of safety include defensible space, visibility, management, and the consideration of physical hazards.

Defensible space
Oscar Newman’s concept of defensible space is particularly important in the design of open space located within residential neighborhoods and developments. In line with Jane Jacobs’s concept of eyes on the street, this term refers to an environment designed to allow residents to control the areas in and around it. While public and semi-public open spaces may or may not be technically owned by residents, the building and site configurations can be designed in such a way that residents feel a sense of ownership over certain spaces. [1, 2] Newman’s publications illustrate that designing buildings or a site to reduce the number of users for shared areas can increase a sense of accountability and responsibility. It can be more difficult to design defensible space for high-rises, which serve larger populations.

Why consider defensible space?
- Encourage accountability and responsibility

Visibility
People typically feel safer walking through or using public space when they perceive that there is a high level of visibility. Dark corners and high walls or bushes behind which people can hide should be avoided, and fences and landscaping with some level of transparency are encouraged. [3, 4] Lighting should be bright enough to enable one to see and identify others, yet not so bright to create glare or blind people as they move between darker
and lighter areas. Spaces should be visible from the street or other places within the open space. On the other hand, having some hidden or enclosed subareas can create interesting semi-private spaces that users may enjoy. Designers should be wary of designing bland and uniform spaces simply in the name of visibility and safety.

**Why consider visibility?**
- Safety of users and perception of safety

**Management**
Security of open space is treated differently in public, semi-public, and private space. It can range from no security (as in most public parks) to the provision of emergency phones to cameras and/or security guards in many gated or private communities. [1]

**Why consider management?**
- Clarify appropriate level of security oversight

**Consideration of Physical Hazards**
Ensuring physical safety means not only avoiding the threat of other people but also identifying and marking physical hazards, particularly for children and the elderly. [2] This can include changes in the ground level or the presence of water bodies or the relationship with cars, bicycles, and other vehicles on the street. Designers should be careful to make sure that these transitions are marked through signage or other visual/physical indicators such as barriers or changes in floor surface.

**Why consider physical hazards?**
- Physical safety of users
CONVENIENCE/ACCESS

The location of open space within a neighborhood or development is essential to encouraging use. Designers need to consider how the open space is sited in relationship to residents’ circulation patterns within the site. Are open spaces adjacent to other uses that people seek? Are open spaces located on residents’ paths to and from work or school? Where are open space sites located to attract a variety of users? Will people travel out of their way, and how far will they travel, to get to a specific open space? While the importance of location will vary according to the type of use, spaces that are convenient, more visible, or at well-traveled intersections will typically be used more often.

Circulation within the open space should also be considered in order to make spaces or uses within the space easy to find and pleasant to use.

Signage can also educate residents and visitors on the location of open space. It can publicize what exists and help users find what they want. Signage can also indicate, whether directly or indirectly, for whom a space is designed.

Access to open spaces should also be made possible for disabled users. Disabilities can take a range of forms, so designers should make an effort to think through how a blind person might navigate a space, how a person in a wheelchair could get around a park, how someone with a cane or crutches would want to use a plaza.

Why consider circulation and access?
- Encourage use of public space
- Location of open space within a neighborhood or community or development
- Location of uses within open space
- Access to a variety of users, including disabled users
HOLIDAY TOWN CASE STUDY

In this section, we will apply our findings to various open spaces of different scales in Holiday Town. We will analyze an urban public open space and two community public open spaces. We did not have enough data to analyze a semi-private open space.

Circulation Analysis

Urban Public
This open space is located along the main public street near the publicly accessed shops and restaurants in the development. It makes sense that this area, analyzed further on the next page, would contain a large variety of uses.

Community Public
Most open spaces in Holiday Town are only accessible by smaller roads internal to the development. The largest park located on the south edge of Holiday Town is also bounded on its south edge by a canal. Residents in the north part of the development may consider it too far away, and may not even know about it. Such a large-scale park may be used more frequently if placed closer to public access.

Semi-private
Semi-private open spaces are located off of secondary roads and even more private pedestrian paths. These parks are not visible from the main circulation routes, providing a greater sense of privacy and security but also possibly preventing other residents from noticing the parks and using them.
Urban Public Open Space Case Study

Size: 8,000 square meters
Location: on main public road, near community center and stores
Uses: tennis, swimming, a playground with manipulable water, exercise, walking, socializing, studying, and picnicking

Successful features for use:
- Variety of uses for various ages
- Visible from residences and streets
- Streambeds are the best kind of manipulable water source (Marcus and Francis)
- Largest, most complex playground

Challenges for use:
- No apparent accommodation of elderly uses
- Playground located on busy public street
- Potential to create more commercial spaces such as snack stands around the pool

Successful features for comfort:
- Water features provide cooling properties
- Pergola provides some sun protection
- Seating benches for parents

Challenges for comfort:
- Little wind protection for most users
- Lack of clearly defined boundaries around play area

Successful features for visual quality:
- Variety of surface materials on the ground

Challenges for visual quality:
- Landscaping appears to be disjointed

Successful features for safety:
- Highly visible with significant foot-traffic
- Close to security guard station

Successful features for access:
- Most central location in the development
1. Community public open space
   Source: Vanke

   **Community public open space:**

   Size: 2,800-5,000 m²
   Location:
   1: next to main street, corner location
   2: through block lot, only one entrance to the main street. Difficult to enter
   Facilities: Fountain, seating

   Challenges for use:
   Difficult to use.
   Very few facilities for people to use
   No play area for children, no sports court.

   Successful features for comfort:
   Informal chairs available for residents to use

   Challenges for comfort:
   Few built-in seating options
   Poor sense of enclosure
   Unclear whether there is wind protection or shading from buildings

   Successful features for visual quality:
   Variety of surface materials on the ground
   Sculpture

   Challenges for visual quality:
   Little landscaping
   May be too many ground surface changes

   Successful features for safety:
   Highly visible
   Close to security guard station

   Challenges for safety:
   Unlikely to create sense of defensible space

   Successful features for access:
   Central location in development
   Located on public road
1. Community public open space
   Source: Vanke

Community public open space:

Size: About 1,500 m²
Location: In the center of the block, off of the main street.
Uses: seating, children’s play

Successful features for use:
- Different subareas for different groups of people
- Provides more protected area for children’s play

Successful features for comfort:
- Good sense of enclosure
- Small covered area provides shading
- Some benches available
- Area is protected from cars

Challenges for comfort:
- Seating options look uncomfortable
- Seating may not be coordinated with shade

Successful features for visual quality:
- Variety of surface materials on the ground

Successful features for safety:
- Visible from many housing units

Successful features for access:
- Easy access from the surrounding areas

2. Plantings and seatings
   Source: Liang Zhao

3. Playground for children
   Source: Liang Zhao
Semi-private open space:

Size: About 3,000 m²
Location: Between buildings. No access from the main street. 3 accesses from the community streets
Uses: some seating, walking

Successful features for use:
- Pleasant place for walking

Challenges for use:
- Possibility of disturbing people at home

Successful features for comfort:
- Good sense of enclosure.
- Quiet environment
- Running water cools area

Challenges for comfort:
- Lack of seating options
- Bad water quality

Successful features for visual quality:
- Natural landscaping
- Stream

Successful features for safety:
- Visible from many housing units

Challenges for safety:
- Dense landscaping may hinder visibility

Successful features for access:
- Easy access from the adjacent apartment buildings

Challenges for access:
- People who live in other parts of the development may feel uncomfortable here

Source: Vanke
CONCLUSION

Based on our analysis of successful features of open space, the open spaces in Vanke developments should be designed as a system of integrated, connected parks creating a more livable and attractive development for all residents. To do this, Vanke will need to fully understand the uses of different age groups and genders of the Chinese middle class, the preferred scales of different activities (large groups, small groups, or as individuals), and the frequency of such uses within the development. For example, more playgrounds should be built in a variety of open spaces in a development with a large number of children. A detailed survey of all of the residents in a few of Vanke’s developments could be a useful way to gather this data.

We recommend the following:
- Provide a variety of scales of open space in a given development
- Provide a variety of uses as appropriate according to scale
- Differentiate between spaces to establish a sense of place
- Provide a variety of materials and features
- Make spaces comfortable for all age groups
- Consider conflicts of use and anticipate undesirable use

Vanke should consider how to facilitate healthy social interaction through open spaces. The spaces that encourage the most social interaction often include the following features (Carmona, Heath, Oc, and Tiesdell):
- Located on busy routes
- Physically and visually accessible
- Streets are incorporated as parts of social space
- Built on a level even with the pavement
- Contain implicit (steps, low walls) and explicit (benches) places to sit
- Contain movable seats to enable different kinds of interaction

Key Issues
1. Problems with use of open space
   Vanke should consider what kinds of undesirable behavior can be anticipated and therefore prevented, accommodated, or controlled. Consider again the example of skate parks to accommodate and contain undesirable behavior of teenagers. Skateboarding no longer is undesirable if the activity no longer disrupts circulation or damages property. By designing spaces for certain uses and attempting to control undesirable uses, Vanke can affect residents lifestyles. Rather than minimizing this influence, Vanke should consider what kinds of activities, and in general what kind of lifestyle, it aims to promote in its development by providing the physical environment and design elements necessary to live that lifestyle.

2. Integration as an open space system
   Vanke should consider how best to integrate these open spaces as a system. First, this will create efficient circulation throughout the site. Additionally, a single park can serve a small number of residents in some dimensions, but one park cannot serve all the needs of those users without conflict and competition over space. Creating a system of easily accessible open spaces is a way to address the widest variety of uses and provide all residents with suitable open spaces.

Sources:
BUILDING SYSTEMS
Defining Sustainability for Building Systems

All buildings extract materials and energy from an environmental system. Buildings provide humans with comfort from the physical elements and prosperity.

Materials only serve one moment in time. . . deplete resources and compromise indoor environment.

Energy rely on current energy costs and availability. . . reduce reliance on specific fuels that pollute the air. reduce the amount of energy used and the cost of operation.

Non-sustainable systems . . . Sustainable systems . . .

. . . allow community to adapt and persevere.
. . . limit impact on natural resources and allows healthier living.
**Concept Matrix**

This matrix organizes the components of a building system relative to the importance of considering flexibility, materials and energy.

<table>
<thead>
<tr>
<th>Building Type/Structure</th>
<th>Envelope</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building size</td>
<td>Weather enclosure</td>
<td>Heating and cooling</td>
</tr>
<tr>
<td>Orientation</td>
<td>Window systems</td>
<td>Drinking water</td>
</tr>
<tr>
<td>Structural engineering</td>
<td>Roof and façade systems</td>
<td>Vertical circulation</td>
</tr>
</tbody>
</table>

**Flexibility**

- Shared structures
- Convertible structures
- Concrete Alternatives
- Waste reduction
- Orientation
- Shared surfaces

<table>
<thead>
<tr>
<th>-Ventilation options</th>
<th>-Prefabricated elements</th>
<th>-Fuel source options</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Private Green spaces</td>
<td>-Recycled/Recyclable materials</td>
<td>-Water source options</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>-Insulation/air barrier</th>
<th>-Solar protection</th>
<th>-Reduce Water consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Access to daylight</td>
<td>-Load shifting</td>
<td>-Options for local sources</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>-Reduced Hazardous materials</th>
<th>-Load shifting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-Options for local sources</td>
</tr>
</tbody>
</table>
Expansion and Conversion

Planning for ability to expand, saves available land for the future. Planning for expansion within provides development options in the future. Shared structures saves material and green space.

Housing over parking spaces housing over commercial. Conversions of residential to commercial, Commercial to light industrial, light industrial to parking, etc. Integration of living and working saves transportation energy when workers can telecommute or conduct light manufacturing near their home.

Building Type / Structure: Flexibility
Solar Exposure

Balance solar thermal concerns with maximum daylight penetration orienting building with solar criteria for 10% energy savings from cooling and heating. Integrate overhangs on southern side of building if possible for 1-5% cooling savings. Integrate vertical shading into building on E and W facades.

Ideal orientation achieves a balance. Plan shift approach ensures good thermal exposures with day lighting. Good modulation of massing can achieve the same if plan is aligned.

Building Type / Structure : Energy

Good orientation is east west
For thermal reasons . . .

Bad shapes

Good shapes

Solar energy in Summer

Solar energy in Winter

The daylight from 1 skylight is easily worth 100 meters of photovoltaics in electrical terms

Solar thermal absorbers are a cost effective way to harness solar energy

A global Overview of renewable resources www.agores.org
Prefabricated Stackable Units

A modular manufacturer, developed an 18 wide factory built home that enabled each row house to be constructed with two modules instead of four. Fewer modules sped up factory construction time as well as on-site fieldwork, and allowed for more spacious interiors. Each assembled row house contains 1,338 square feet. Each module used rigid structural steel framing instead of wood because of its lightweight, price, and quality control. Construction waste and disposal costs were very low compared with on-site construction because of controlled factory construction. Also, the factory controlled construction allowed for greater scheduling control, meaning the product was delivered on time, as needed, with greater quality assurance than site built construction, and without any weather or product delays. Finally, the modular construction in this development allowed for reduced labor costs.

Building Type / Structure : Flexibility
**Prefabricated Concrete Wall**

Large wall segments up to 25ft (7m) can be pre-assembled in the factory. These panels may include window frames and part of the reinforcement. Custom sections can be tailor made, elements are taken from the store and glued to specification. No time for curing is needed.

A full truckload can be shipped. The panels are relatively light and can be set in place by light cranes, as concrete is poured on site. Other than with prefab concrete panels, slight adjustments in size can be made on site. Broken panels can be repaired instantly.

**Building Type / Structure : Materials**
Prefabricated Concrete Balcony

The site is prepared. A crane is moved into position. Brackets have already been fixed earlier to the apartment block. These will be used to attach the prefabricated balcony to the building.

The crane lifts the prefabricated component to the top of the balcony stack.

The component is carefully maneuvered into position. After the component is placed in position, the joints are sealed and the component attached to the existing structure.

Building Type / Structure : Materials

Concrete

Fly Ash, a by-product of coal burning power plants can be substituted for energy intensive cement. Tire Rubber, Recycled post consumer aggregate, Ceramic micro spheres, Industrial byproducts can be added to concrete. Concrete with these admixtures requires less cement and has greater insulation value and less weight: Use high strength concrete only where it is required and avoiding long spans (greater than 10 meters) or column plan shifts saves concrete and reinforcing steel. Industrial waste materials as lightweight aggregates to replace sand in mortar. The use of interlocking CMUs (requiring no mortar) is ideal for landscape retaining walls.

Building Type / Structure : Materials
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.

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

- Elevators
- Water pumps
- Exhaust fans
- Fire command center

Building Type / Structure: Energy
**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 venting, operable windows and exhaust fans, cross ventilation in all four apartments can be achieved.

**Closed core area**
- Allows cross ventilation in only two apartments

**Open core area**
- Allows cross ventilation in all four apartments

**No natural ventilation**
- Greater in cooling energy required
- Vulnerability to mold and indoor contaminants

**Wind Driven Cross ventilation**
- Possible to save 5-10 kWh/year/square meter and flush contaminants

**Cross ventilation And fan assisted stack ventilation**
- Ideal. Allows most savings and flexibility.

**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

Photovoltaic power generation
On roof tops, Hoek Van Holland, NL
Photo: ER

Ventilated wood facade
Photo: ER

Green roof on steep slope, Delft, NL
Photo: ER

Garden facade concept
Building floor plan manual
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.

Sources: The HOK guidebook to sustainable design

Envelope: Materials

Heating and cooling

Energy required in typical 10x60 meter 6-story Building with no natural ventilation. KWh/ m²/ year:

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

Aerated autoclaved insulating concrete

Wall materials

' 2005 Xella International GmbH
**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 issues near these interruptions in the façade. 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 façade 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
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.

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.
FIELD TRIP | JANUARY 2006
Car Sharing
Car sharing could stem the tide of multiple car ownership within each unit and encourage sustainable transportation habits in the development. More than half of residents surveyed have cars, and interviews showed that those who have cars use them frequently, and that many residents expressed a need or desire for more than one car. Vanke’s practice of requiring residents to buy, rather than rent a second parking spot discourages excessive car ownership and usage, which has a positive impact on the environment. One possibility for households with one car but needs for an additional car from time to time could be a car-sharing scheme. In this scheme, a car share company owns a fleet of cars. Customers pay a membership fee to join the car share, and then can sign up to use any car for an hourly fee. One US company that uses this model is Zipcar (www.zipcar.com).

Recycling
The Holiday Town development should embrace informal recycling to be at the forefront of a sustainable system of waste management. Some residents recycle materials by selling them to the informal recyclers who collect paper, cardboard, and plastic on their tricycles. Since Holiday Town is close to these workers, a resident reported having to go outside the development to accompany the recycler in, which was inconvenient. To encourage recycling, Vanke could facilitate the informal recycling already going on by providing a place for residents and recyclers to meet at a particular weekly or monthly time or by “licensing” particular recyclers to enter the site at prescribed times. At a policy level it is recommended that recycling is tied to an incentive in order to encourage a sustainable system of waste management as described in the earlier section called “Waste.”

Phasing
Phasing that responds to residents’ needs could create sustainable patterns of use. Residents, especially seniors, enjoy having amenities within walking distance. The three community amenities not offered in the community but most often requested by residents’ are a health clinic, a vegetable market, and a Post Office, all of which are coming in Phase V. This shows that Vanke is responsive to resident needs, but adding these amenities earlier within the phasing of the development would have been greatly appreciated by residents. This is an important issue because having these community amenities in close proximity allows for sustainable patterns of transportation.

Security and Site Wall
Security systems on the site are successful and design and planning innovation should pave the way for a larger, more connected series of developments. Residents overwhelmingly report that they feel very safe in Holiday Town. When asked what makes them feel safe, residents always mention the high quality of the guard staff.

In addition to security functions, they appreciate the guards’ help with errands like getting taxis and carrying packages, and that the guards know the residents well and are very polite, providing a sense of community. Some residents expressed concern that there was high turnover among the guards.

It is interesting to note that the interviews revealed that resident perceptions of security correlate to the guards, not to the wall that surrounds the community. Security is a big concern and one that is currently being addressed, but the wall is in conflict with larger sustainability issues such as landscape connectivity and community interaction as mentioned below. Opportunity exists and should be studied to develop creative wall solutions that balance resident safety and sustainability through design and planning.
Site Landscape Ecology

Ecological function should become integrated with a hierarchy of open spaces to give function to the landscape. The landscape system in Holiday town is carefully designed and maintained, and is a key amenity to residents. However, the system provides an opportunity to create not just an aesthetically beautiful amenity, but an ecologically significant feature that contributes to the community infrastructure. In our initial analysis, the plant and water systems of Holiday Town are being under utilized as tools for storm water management, flood control and water quality improvement mechanisms. Design and technology studies should be conducted to deeply explore the potential function of these landscapes. The implementation of ecological function provides an opportunity for greater diversity in the landscape.

Regional Landscape

Landscape ecology must occur in the framework of a region and Vanke as a leader China should be on the forefront of this effort.

A complete ecological landscape system cannot be created by simply addressing on-site considerations: landscape ecology must be planned at a regional scale. The diagrams in the chapter "Site Landscape Ecology" illustrate this concept. Unfortunately, district, city and national government have done little to coordinate such efforts, and with time, this may effect or restrict the health of the environment in Holiday Town. For this reason, Vanke - as the most innovative developer in China - has the ability and interest to provide the missing leadership in this regard.

For example, the canal which forms the southern edge of the site exhibits tremendous potential to become a district, if not a regional greenway. This potential is currently precluded by a lack of coordination between neighboring development projects and the desire to protect the park from outsiders. The benefits of creating a recreational canal corridor will outweigh the costs of overcoming these barriers. Although district or city government could provide the leadership to make this possible, it may be faster and more effective to collaborate with neighboring developers and neighborhoods in order to begin the restoration process. Ultimately, government intervention will be required at a regional scale to mitigate and prevent pollution.

In addition to creating a continuous ecosystem corridor for wildlife and water management, the canal can add considerable value to the development. In our interviews, one resident mentioned that he would like to be able to jog or walk on a more interesting, continuous path that extends beyond the Holiday Town site. Coordinating a canal corridor would certainly enable this type of recreation.
Adaptability of exterior space

Recreational and utilitarian use must be both accommodated:
Balcony space is coveted utility and recreational area. The architecture should accommodate resident adaptation while maintaining standard for safety and orderly appearance.

Natural ventilation should be maintained:
Residents should avoid blocking ventilation paths with glass enclosures.

Establish guidelines for safe modification:
A menu of balcony modifications might create a selling point for certain unit types.
**Interior spaces**

Open floor plan kitchen-dining-living area is appreciated by most residents:

Open floor layout, which is adaptable with sliding divisions provide flexible layouts. Similar layouts with other adaptable components might be researched for more options.

Most residents report that bedroom, kitchen, and circulation spaces are well proportioned:

Residents seem most likely to customize bathroom layouts rather than bedrooms.

Ground floor utility/storage room for local storage:

Balcony spaces often take this role. Storage on ground floor available for rental/purchase seems marketable.
Thermal Comfort

Current strategy is electricity intensive:
Most A/C and space heating is electrical, leaving all residents dependent on affordable electricity. Fa ade installation and penetrations for evaporator units are often problematic. Consider district heating and cooling for cost and energy savings.

Varying levels of comfort depending on region of origin, generation:
New solutions should allow residents to save/consume according to preference.

Consumption expected to increase with next generation:
Younger residents more likely to seek more comfortable heating and cooling systems including, in-floor radiant heating, dehumidification/humidification, air filtration, insulation.

Elderly residents/fixed income residents may not have access to affordable heating and cooling in the long term:
If electrical costs continue to rise, some residents may lack adequate summer cooling or winter heating if not allowed southern exposure, insulation, or fossil fuel based heat.
Windows and Doors

Insulated glass is of value to residents, and provides better moisture control. Residents noted that single pane glass windows were uncomfortably cold in the winter, with condensation contributing to a damp environment in the apartment.

Insulated, weather stripped, and screened systems provide flexibility and energy savings. Some residents have self-installed weather stripping and retrofitted screens on their window systems. Designers should consider offering more flexible window systems with options for adding screens, exterior shading, and shutters, according to preferences of residents.
Roofscape

Encourage greening of roofscape
Residents commented that a view over a pleasant roofscape contributed to unit selection decision. Ecological roofing or resident gardening could contribute to this.

Consider insulation and ecological roofing systems
Top-floor residents commented that lack of insulation above contributed to excess heat gain/loss.

Discourage large, heavy non-functional features on rooftops
Designers should consider rooftop features that provide shade in the summer, and do not contribute to maintenance problems.

Preserve view corridors as much as possible
Some tall buildings block view corridors from lower ones.

Establish guidelines for residential solar hot water installation
The roofscape could be designed in a manner which encouraged solar installations. Piping and support points could be pre-installed for residents.

Consider rainwater harvesting:
Rooftops can collect water for irrigation, washing, and discharge.
Building Types

South orientation is critical selling point amongst traditional Chinese buyers

Southern orientation seems critical for practical (ie laundry) and recreational (sun bathing) purposes.

Walk ups seem to be more popular; with larger units (low maint)

Some residents mentioned that their first choice was a walk up unit, and that they planned to move to elevator building later.

Elevator building layouts seem less efficient and not well ventilated

Some units in elevator buildings lack capacity to naturally ventilate. Space is lost to vestibule and backup elevator.

Elderly residents change units to gain elevator access:

Accommodation of small elevators in some unit types might encourage long term residents. A cost effective alternative might involve shared elevator cores, or deferred installation of elevators.
**Noise**

Between units is managed well by layout:

Residents commented on the advantage of having living rooms facing each other and bedrooms on the end of the building.

Roadways to north and west could be attended to:

Residents noted on the advantage of buildings which were not on the street or highway. Landscape and building systems could be designed in a manner which reduces noise penetration.

**QUESTIONNAIRE FOR VANKE HOLIDAY TOWN**
MIT Questionnaire for Vanke Holiday Town

This is a research conducted by MIT on Vanke Holiday Town Residential Development in Shanghai. The purpose of this research is for academic use and improvement of service. Questions are multiple choices. Thank you for coordination!

1. Commuter #1 __ minutes from home to work, Via
   - Own Auto
   - Shared Auto
   - Bicycle
   - Walk
   - Taxi
   - Bus
   - Vanke Shuttle
   - Other Shuttle
   - Rail
   - Other

2. Commuter #2 __ minutes from home to work, Via
   - Own Auto
   - Shared Auto
   - Bicycle
   - Walk
   - Taxi
   - Bus
   - Vanke Shuttle
   - Other Shuttle
   - Rail
   - Other

3. Apartment information: __ Bedrooms, __ Floor, Elevator Yes  No, Year moved in __

4. Family Composition (Please fill in numbers of your family members)
   - Under 18 __,      18-25 __,      25-60 __,      Over 60 __

5. Income Range
   - <2,000 □
   - 2,000-6,000 □
   - 6,000-10,000 □
   - >10,000 □

6. Your previous residence was built since 2000 □
   - 95-2000 □
   - 78-95 □
   - 49-78 □
   - before 49 □

7. Do you own an auto? Yes □ No □ Where do you park?
   - Garage in the building □
   - Parking lot next to the building □
   - Central garage □
   - Central parking lot □
   - On Street □
   - Off-site □

8. Usage of Vanke Club House: how many times do you use the following per month?
   - Total __ Pool __ Meeting Room __ Ping-pong __ Badminton __ Other __

9. Commuter __ minutes from home to work, Via
   - Own Auto
   - Shared Auto
   - Bicycle
   - Walk
   - Taxi
   - Bus
   - Vanke Shuttle
   - Other Shuttle
   - Rail
   - Other

10. Commuter __ minutes from home to work, Via
    - Own Auto
    - Shared Auto
    - Bicycle
    - Walk
    - Taxi
    - Bus
    - Vanke Shuttle
    - Other Shuttle
    - Rail
    - Other

11. Are you interested to be interviewed by MIT survey team? Yes □ No □

12. If yes, please fill your name ____________ Tel:__________  Apt: __________

13. Community Facilities

14. Do you own an auto? Yes □ No □ Where do you park?
   - Garage in the building □
   - Parking lot next to the building □
   - Central garage □
   - Central parking lot □
   - On Street □
   - Off-site □

15. Usage of Vanke Club House: how many times do you use the following per month?
   - Total __ Pool __ Meeting Room __ Ping-pong __ Badminton __ Other __

16. Commuter __ minutes from home to work, Via
    - Own Auto
    - Shared Auto
    - Bicycle
    - Walk
    - Taxi
    - Bus
    - Vanke Shuttle
    - Other Shuttle
    - Rail
    - Other

17. Commuter __ minutes from home to work, Via
    - Own Auto
    - Shared Auto
    - Bicycle
    - Walk
    - Taxi
    - Bus
    - Vanke Shuttle
    - Other Shuttle
    - Rail
    - Other

18. Do you own an auto? Yes □ No □ Where do you park?
    - Garage in the building □
    - Parking lot next to the building □
    - Central garage □
    - Central parking lot □
    - On Street □
    - Off-site □

19. Usage of Vanke Club House: how many times do you use the following per month?
    - Total __ Pool __ Meeting Room __ Ping-pong __ Badminton __ Other __

20. Commuter __ minutes from home to work, Via
    - Own Auto
    - Shared Auto
    - Bicycle
    - Walk
    - Taxi
    - Bus
    - Vanke Shuttle
    - Other Shuttle
    - Rail
    - Other

21. Commuter __ minutes from home to work, Via
    - Own Auto
    - Shared Auto
    - Bicycle
    - Walk
    - Taxi
    - Bus
    - Vanke Shuttle
    - Other Shuttle
    - Rail
    - Other
Preliminary Vanke Holiday Town Resident Survey Results and Analysis

The following preliminary survey analysis follows the order of the original survey. Additional, in-depth analysis will require a database to enable category links and correlation of interviews to survey results.

NUMBER OF RESPONSES

<table>
<thead>
<tr>
<th>Household Total</th>
<th>Adults Under 60</th>
<th>Adults with Child(ren)</th>
<th>Adults and Seniors</th>
<th>Adults, Seniors, and Children</th>
<th>Seniors Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Respondents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>376</td>
<td>137</td>
<td>140</td>
<td>39</td>
<td>41</td>
<td>19</td>
</tr>
<tr>
<td>Percent of Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100%</td>
<td>36%</td>
<td>37%</td>
<td>10%</td>
<td>11%</td>
<td>5%</td>
</tr>
</tbody>
</table>

The “Seniors Only” responses do not constitute a large enough sample size to draw reliable conclusions. We have, however, included some observations about seniors at Holiday Town since there are limited information sources available.

APARTMENT INFORMATION

- A surprising number of “Senior Only” households, which are predominantly 2 person households, live in 3+ bedroom units.
- A notably large percentage of households with seniors live on floors one through three.

REASONS FOR MOVING TO HOLIDAY TOWN

Reasons for Moving to Holiday Town were ranked (by total population, not weighted by sample size) in the following order.

1. Vanke management
2. Reputation of Vanke
3. Good Physical Environment Within the Development
4. Building Style
5. Price
6. Unit Layout
7. Good Environment Outside the Development
8. Convenient Services
9. Convenient Transportation
10. School
11. Other
Far and away, Vanke management and reputation were the highest ranked reasons for moving across all household types. Good environment consistently ranked third and, among the third rankings, was ranked highest by "Seniors Only."

FAMILY SIZE AND INCOME
Two person and three person households each constituted approximately one third of the responses. Households in the 6,000 – 10,000 RMB/month and 10,000+RMB/month income categories each constituted over one third of the total responses. Over 40% of the “Adults Under 60” and “Adults with Child(ren)” were in the highest income category. There were no “Senior Only” households in the highest income category.

PREVIOUS RESIDENCE
Over half of the responding households previously lived in a residence built between 1995 and 2000. This may indicate a propensity to move often, with implications for sustainability, resale, and ability to maintain the Vanke image.

AUTO OWNERSHIP
Nearly 70% of the responding households own a car. Car ownership was nearly 100% amongst “Adults Under 60” and lowest amongst “Senior Only” households.

PARKING
“Parking lot next to the building” was the most popular parking location over all, and particularly amongst “Adults with Child(ren).” ”Adults Only” were as likely to park in a “garage in the building” as in a “parking lot next to the building.”

COMMUTER ONE
Overall, Commuter One travels as average of 49 minutes, with a 46-60 minute commute being the most common time category. “Adults, Children, and Seniors” households are more likely to have commutes within this time category, but less likely than other groups to have commutes over 60 minutes.

COMMUTER TWO
Overall, there were fewer “Commuter Two” responses. These responses indicated a 37 minute commute, on average, with “own auto,” “Vanke shuttle,” and “rail” being about equal as the most popular modes of transportation.

COMMUNITY FACILITIES
*Note that respondents could indicate multiple modes of travel for each community facility use.

For grocery shopping, driving and walking had the highest number of responses overall. Bike use appears to be limited and primarily for grocery shopping. Household types that included seniors indicated markedly more frequent exercise. Across all household types, walking is by far the most popular way reach to restaurants. Restaurant use per month is slightly higher by “Adults Under 60” than by other groups. Across all community facilities and household types there were very few responses indicating “Shared auto” use. “Senior Only” households had no “own auto” or “shared auto” use responses for any community facility.

HOLIDAY TOWN CLUBHOUSE
Overall clubhouse use indicated by “Adults Under 60” and “Adults with Children” was much greater than other groups. Only one “Seniors Only” survey indicated clubhouse use. More households reported using the clubhouse to play badminton than for any other use. However, the pool had the highest number of uses per month. “Other” uses received the second highest number of total uses and uses per month.