Urban Forms and Pedestrian, Transit-Oriented Urban Design

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Sr. Urban Transport Specialist
Outline

• Urban Transport Problem
• How urban forms affect people’s travel
  density, accessibility and walkability
• Pedestrian- oriented urban design
  guidelines and best practices
• Transit-Oriented Development (TOD)
  guidelines and a case study
• Q&A
Urban transport problem in a global city...
Building more roads is not a solution

Whenever a street is widened, a few more [cars] are able to trickle in, with the net result that they and not the general public are benefited. Congestion has not been relieved, nor will it be by any such public improvement until adequate restrictive measures are adopted.

A 1926 NYC TRAFFIC COMMISSION REPORT
Beijing Guomao Interchange
Vicious Cycle: “Lock-in” affect of land and transport development

CONGESTION

INCREASED CAR TRAFFIC

The number of movements increases

The average length of movements increases

URBAN SPRAWL IS FAVORED

NEW CAPACITY FOR CARS

Car movements are much easier

More investments and land for roads/parking

World Bank
Is there any solution?
Transit/public transport is a solution...
Performance of UT Modes

Many factors affecting use of transit...
Density is an important factor…

Source: UITP
Atlanta vs. Barcelona

The Built-up Area of Atlanta and Barcelona Represented at the Same Scale

Atlanta:
- 2.5 million people (1990)
- 4,280 km² (built-up area)

Barcelona:
- 2.8 million people (1990)
- 162 km² (built-up area)

Source: Alain Bertaud, 2002
Difficult for transit if density is low...

- Public transport modal share
  - Atlanta: Barcelona - 4%: 30%

<table>
<thead>
<tr>
<th></th>
<th>Atlanta</th>
<th>Barcelona</th>
</tr>
</thead>
<tbody>
<tr>
<td>area: km²</td>
<td>4280</td>
<td>162</td>
</tr>
<tr>
<td>population (1990) million people</td>
<td>2.5</td>
<td>2.8</td>
</tr>
<tr>
<td>Approximate length of bus lines required to provide an accessibility of 800 mto every bus stop</td>
<td>km</td>
<td>4,280</td>
</tr>
<tr>
<td>people per km of bus line</td>
<td>people/km</td>
<td>584</td>
</tr>
<tr>
<td>density p/ha</td>
<td>5.84</td>
<td>172.84</td>
</tr>
<tr>
<td>Assumption on average speed during rush hour km/h</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Frequency of buses during rush hour minutes</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Distance between buses at rush hour km</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Minimum number of buses during rush hour</td>
<td>2,853</td>
<td>108</td>
</tr>
</tbody>
</table>
Density also has a long term “lock-in” impact ....
First subway
First elevated train line
Inter-State Highway Program
Transit and Non-Motorized Modes Dominant
Automobile Dominant
But density is not the only key factor....
Beijing has the highest density...

Population density in 10 km increments from Metropolitan Center

Source: Creod, 2006
high density = high transit modal share?

Modal share by public transport for commuting to the central city

Sources:
London: National Census 2001 + City of London
Case Studies

New York
- Grand Central
- 34th Street

London
- Oxford Circus
- Bank Street

Beijing
- Guomao
- Xidan
Case Study 1:

Grand Central Station

NEW YORK CITY
10 Minute Mark

The total commercial area accessible within 10 minutes walking from the optimal station exit is approximately 88,500,000 sq ft. The number of jobs is assumed based on this figure so a separate image for the approximate 300,000 jobs accessible within 10 minutes was also created; it would appear identical to this one.
Total commercial area within 20 minutes walking is approximately **265,300,000 sq ft.**
The number of jobs is estimated at **884,000**
Case Study 2:

Oxford Circus Station

LONDON
10 Minute Mark

The total number of jobs accessible within 10 minutes walking from the optimal station exit is approximately **120,400**

The area of commercial space is assumed based on this figure so a separate image for the estimated **36,000,000** square feet of commercial floorspace within 10 minutes was not created; it would appear identical to this one.
Total number of jobs within 20 minutes walking is approximately **277,000**

The estimated area of commercial floorspace is **83,200,000** square feet
Case Study 3:

Guomao Station 国贸地铁站

BEIJING
由国贸地铁站出发可到达的工作岗位数

49327

10 min.

90898

20 min.
Jobs reached in 10 min walk

- NYC: 1,800,000
- London: 800,000
- Beijing: 100,000
Jobs reached in 20 min walk

- NYC: 1,800,000
- London: 800,000
- Beijing: 100,000
Significant difference in accessible jobs...
Compactness

Difference in block size, building density and road network design

Grand Central Station, New York
Oxford Circus, London
Guomao, Beijing
Guomao, Beijing

步行设施和视觉环境
Street space

New York City

London

Beijing
<table>
<thead>
<tr>
<th>City</th>
<th>Average Size (feet*feet)</th>
<th>Number of Blocks in 20-min catchment area</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYC</td>
<td>656*197</td>
<td>178</td>
</tr>
<tr>
<td>London</td>
<td>689*312</td>
<td>143</td>
</tr>
<tr>
<td>Beijing</td>
<td>853*590</td>
<td>84</td>
</tr>
</tbody>
</table>
## Building Density

### Approx. Number of Buildings in “20-min walk”

<table>
<thead>
<tr>
<th>City</th>
<th>Approx. Number of Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYC</td>
<td>710</td>
</tr>
<tr>
<td>London</td>
<td>430</td>
</tr>
<tr>
<td>Beijing</td>
<td>220</td>
</tr>
</tbody>
</table>
# Road Network Characters

<table>
<thead>
<tr>
<th>City</th>
<th>Average Road Width (feet)</th>
<th>Approximate Length (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYC</td>
<td>66</td>
<td>21</td>
</tr>
<tr>
<td>London</td>
<td>43</td>
<td>17</td>
</tr>
<tr>
<td>Beijing</td>
<td>98</td>
<td>10</td>
</tr>
</tbody>
</table>
Pedestrian Route in Beijing
Walkability is another key factor....
Importance of Walking as a Mode

• All trips, irrespective of mode involve walking
  □ To/from another mode (e.g., PT, auto/parking) or
  □ For the entire travel distance
• The use of public transport will increase if walking safe, secure, easy and pleasant
  □ Reducing the use of motorized transport or
  □ Totally replacing motorized trips
• Walking can contribute to health
  □ Physical fitness
  □ Mental health
Walking distance/time is critical: Commuters do not like to walk for too long…

### Traveler’s Perception of Walking Time Relative to In-Vehicle Time*

<table>
<thead>
<tr>
<th>Mode</th>
<th>Work</th>
<th>Leisure</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>1.37</td>
<td>1.74</td>
<td>1.55</td>
</tr>
<tr>
<td>Bus</td>
<td>1.67</td>
<td>1.66</td>
<td>2.02</td>
</tr>
<tr>
<td>Rail, Metro</td>
<td>1.99</td>
<td>1.97</td>
<td>1.37</td>
</tr>
</tbody>
</table>

*Source: The Demand for Public Transit, A practical Guide, TRL, UK, 2004
Quality of walking is also important: Commuters can walk longer on roads with better walkability

* From paper by Yang Jiang done for World Bank
Walk without the tree...
Below-Expressway Corridor
Walk under the tree...
Integrated-Boulevard Corridor
Corridor Walkability: PT User Perspective

Trees on sidewalks make walking comfortable.

- Arterial-edge (n=464): 48%
- Integrated-boulevard (n=356): 39%
- Below-expressway (n=946): 70%

Facilities along streets meet my demand.

- Arterial-edge (n=464): 58%
- Integrated-boulevard (n=356): 49%
- Below-expressway (n=946): 42%
PT Users Walk Further in Good Walking Environments
Street crossings also affect walkability
Drainage is good when raining.

Impossible crossing after a rain.
“Take the 100-footstep detour to avoid the 1-footstep shortcut’s danger.”
Pedestrian-Oriented Urban Design Guidelines and Best Practices
Improve walkability

• Create walkable and safe environment to encourage people to walk
• Extend reach of public transport

\[ S = \pi R^2 \]

If \( R_2 = 2R_1 \) then \( S_2 = 4S_1 \)
Shared streets – segregation – Shared Space

Source: Buchanan et al, 1963
Guidelines for Walkable Environments

- Interesting, lively adjacent land uses
  - Not parking lots, blank walls
- Minimum distances, level changes
- Good way-finding signage, markings

Santiago, Chile
Guidelines for Sidewalks, Other Walkways

- Safe and Secure
  - Physically separated from high speed traffic
  - Wide enough to allow 2-direction walking without spillover into street
  - Well lit, open without hiding places
- Well maintained
- Continuous; no obstructions,
  - e.g., parked cars, hawkers, merchandise

LA CBD
Protected Surface Crossings are Generally Preferred

- No level changes
- Open and lit
  - Secure and safe!

Singapore

Boston, US
Climate is important factor in walkability

- Must be considered in most cities, at least in some seasons
  - Hot/cold temperatures, humidity, wind, rain
- Focus areas
  - Walking to/from public transport
  - Waiting time at public transport stops
  - Walking as a primary mode
  - Public gathering places near public transport stations and terminals
Providing Walkability in Extreme Climates

- First-Story Pedestrian Walkways
  - Minneapolis (cold winters) Skyways

13 KM
Providing Walkability In Extreme Climates

• Underground Pedestrian Walkways
  - Montreal, Toronto (cold winters)
  - Houston (hot summers)

Montreal – 32 KM

Houston – 11 KM
Underground Walkways Integrated with Shopping

*Images From Wikipedia

Houston

Montreal
Streetscaping Can Provide Shade
Superblocks vs Smallblocks

Walking distance between any two given points is far greater in Superblocks than Smallblocks

Courtesy: Energy Foundation
Kunming New Urban Design

Street Hierarchy in Existing Plan   Street Hierarchy in New Plan

Courtesy: Energy Foundation
Block Size in Existing Plan

Block Size In New Plan

Courtesy: Energy Foundation
Urban retrofit around transit stations

Railway line
Street
Circle of 800m 'as the crow flies' from rail station
Limit of 800m walking distance from rail station
Rail station
Green pathways
Expanded pedestrian catchment area
Ped-shed analysis

Railway line
Street
Circle of 800m 'as the crow flies' from rail station
Limit of 800m walking distance from rail station
Rail station
Bank Street, London

- Railway line
- Street
- Circle of 800m 'as the crow flies' from rail station
- Limit of 800m walking distance from rail station
- Rail station
- Green pathways

Fig. 85. London:
- a. Mansion House.—b. Stock Exchange.—
[From Martin]
Markham Town Centre, York, Toronto

VIVA Stations

Enterprise Drive Transitway
Transit-Oriented Development (TOD)
What is Transit Oriented Development (TOD)?

• Development near *public transport* stops, stations and interchange terminals
  - Compact, mixed-use developments
  - Encourages walking, cycling and transit use by residents, employees, shoppers, visitors
  - Development occurred by *planning and design*

• Often linked with rapid transit (bus, rail)
  - Can happen with mixed traffic bus and streetcar systems
Curitiba, Brazil
Benefits of TOD

• Reduces the need for personal motorized trips

• Shortens trip lengths when mixed use development is emphasized

• Can help pay for public and non-motorized transport improvements
  e.g., tax increment financing, direct development of land
Market Factors that Support TOD

- A healthy development market in the city
- Stops, stations, terminals sites that are accessible to/from entire city
  - By public transport and/or walking
- Large volumes of public transport customers traveling to/from stops, stations, terminals
TOD Case Study: Arlington, Virginia
Arlington, Virginia
TOD on the Ground: Washington Metro: Arlington, VA
Arlington, Virginia

- Across river from Washington, D.C.
- Home of the Pentagon
- Great development potential for government agencies, government contractors
Arlington, Virginia

- Development pattern
  - Central street with historic shopping nodes between Roslyn and Ballston
  - Low-density suburban development elsewhere
- Early 1970s
  - Commercial areas and housing stock in central spine had declined, were run-down
Metro Becomes the Catalyst

• New metro system being planned in 1960s
• Original alignment proposed in Median of I-66 Freeway Highway
• County Board saw future metro stations as the basis for redevelopment and upgrading
  - Requested that metro stations be located on Arlington’s traditional main street
  - Approval was granted
• Master plan updated
  - Focus new high-rise, high density development around upcoming Metro stations on spine
  - Limit development elsewhere
• Site plan design criteria revised
  - Promote mixed-use development
    - Encourage commercial on the first floor of all office space
  - Limit parking
Original Alignment Proposal Rejected: Interstate Highway 66 Median
Metro Stations as Development Nodes Along Arlington’s Traditional Main Street

“Bull’s Eye” Concept

* Image courtesy of Robert Dunphy, Urban Land Institute
Metro Alignment
Planned as New “Main Street”

* Image courtesy of Robert Dunphy, Urban Land Institute
Rosslyn-Ballston Today
Rosslyn
Mixed Use Above Rosslyn Metro Station

East View

West View

Metro Entrance
Courthouse
University over Court House Metro Station
Ballston
Offices, Hotel, Apartments, Shops, Restaurants, Parking in One Building

Metro Entrance
Lessons Learned from Successful TOD Efforts

Creating a successful TOD is like baking a cake ….

You need the right ingredients!!!
Public Transport Ingredients for Successful TOD

• Transportation Value
  ❑ Fast, frequent, reliable city-wide connections
  ❑ Significant people flows

• Permanent, attractive facilities

• Quality image, unique identity
Development Ingredients for Successful TOD

• Good development climate
• Supportive public policies and actions
  ▪ Macro land planning, zoning/floor space ratios
  ▪ Site plan review criteria
  ▪ Tax abatements, other public investments

Cleveland State University
On “Health Line” (BRT)
Avoid huge, single activity tracts
  - e.g., residential developments, office parks widely separated from other activities

Foster mixed-use development!!!!!!!!

Arlington: Apartments Over Shops
Site Planning Ingredients for Successful TOD

- Pedestrian environment
  - Safe and secure
  - Short, direct connections
  - Environment friendly
  - Active, interesting

- Integration of facilities into land & streetscape

- Make transit stations public gathering places
Bogota Center City
Example of a Public Gathering Place
Take-Home Messages

• Complicated links between urban forms and public transport:
  - Density
  - Accessibility to jobs/homes
  - Walkability

• Key elements of pedestrian and transit-oriented urban planning
  - Increase accessibility to jobs/houses by transit
  - Improve walkability in areas surrounding stations
  - Increase density in areas surrounding stations
  - Expand “catchment areas” by walking from stations
Questions?

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or: http://weibo.com/worldbank