A Study on the Spatial Simulation of City Slow-moving Traffic Network in the Perspective of Low Carbon Footprint: a Preliminary Case Study in Downtown Area of Nanjing, China

XU Jian-gang, QI Yi, QIN Zheng-mao
xjg129@sina.com
Nanjing University

The 4th IACP Conference
June 19, 2010 – Shanghai, CHINA
Introduction

* Carbon footprint and sustainable urban development
* Slow-moving traffic and green traffic

Slow-moving traffic network planning framework

* 4 stages: scope, corridor, nodes and landscape design
* The case of Nanjing
  * Spatial properties: multiple natural features
  * Slow-moving traffic system constructions

Evaluation on carbon emission reduction

* The local slow-moving traffic system
* Calculation of carbon reduction

Conclusion & discussion
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Carbon footprint and sustainable urban development

* Low carbon economy

* Cities are the major carbon emissionors

* Low carbon footprint has been proven itself to be a measurable, a comparable and an operational approach to achieve sustainable development.

“There is also a general acceptance of the required CO2 levels needed to reduce climate change damage. In order to keep the average global temperature increase below 2°C, an 80% reduction in CO2 emissions by 2050 will be required. (Prescott, 2009)
The Green Transportation Hierarchy (Bradshaw, 1994)

- green transportation priority

- Walking > biking > public transportation > co-driver car > single-driver car

Slow-moving traffic

UK domestic green house gas emission structure (National atmospheric emissions inventory (IPCC categories), 2007)
Mobility is demanded globally

Traffic structure transition in Shanghai, China

<table>
<thead>
<tr>
<th>Year</th>
<th>Non Motor Vehicle</th>
<th>Public Transit</th>
<th>Public Transport</th>
<th>Taxi</th>
<th>Car and Motorcycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>31.3%</td>
<td>41.3%</td>
<td>24.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>41.7%</td>
<td>30.4%</td>
<td>17.0%</td>
<td>3.0%</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>30.6%</td>
<td>29.2%</td>
<td>18.5%</td>
<td>5.2%</td>
<td>16.5%</td>
</tr>
</tbody>
</table>

Situation in the first 4 months of year 2009, Beijing, China

- Biking: 19.7%(-0.6%); public transport: 37.3% (+0.5); taxi: 7.2%(-0.2%); car: 33.9%(+0.3%)

Mobility=freedom? Maybe NOT!
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Theoretical basis

理论基础：共享理论与环境心理学

* Sharing theory
  * Large-scale of slow-moving traffic had a negative impact
    * Motorized traffic will be pushed into other areas
    * More difficulties in organizing road crosses
    * Accessibility vs safety, diversity vs vitality
  * “Equal coexistence of people and vehicles” instead of “separation of people and vehicles”
  * Slow-moving traffic system needs to be interconnected to motorized transportations as well as sharing the same space and time

* Environmental psychology
  * People's psychological needs shall be adopted further in environment designs
  * Slow-moving traffic shall be adapted to the surrounding environment
Slow-moving traffic network planning framework

* Four-stage analysis and planning
  * Define the scope
  * Find possible corridors
  * Set exchange nodes
  * Optimize landscape designs for slow-moving traffic

* Effect evaluation
The study area: Nanjing

- Rich natural features
- Integrated urban ecological corridors
  - Urban rivers
  - Green cores
  - Road green

丰富的自然要素、较完整的生态廊道系统
Analysis on landscape features for slow-moving traffic network

Neighbouring space defined by areas which can be reached in 5 min on foot.

<table>
<thead>
<tr>
<th>Analysis Target</th>
<th>Neighbouring area size</th>
<th>Area percentage of the old city region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium size (&gt;1000 m²) green space patches</td>
<td>2417 ha</td>
<td>60.19%</td>
</tr>
<tr>
<td>Big (&gt;1.0 ha) green space patches</td>
<td>1458 ha</td>
<td>36.32%</td>
</tr>
<tr>
<td>Waterfields</td>
<td>1840 ha</td>
<td>45.82%</td>
</tr>
</tbody>
</table>
Construction of the slow-moving traffic system

Overlay:
- Neighbours of big green space patches
- Neighbours of medium green space patches
- Neighbours of waterfields
- Slow-moving traffic corridor
- Bus transfer node
- Metro transfer node
- Business center node
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Evaluation zone

- Squares and green spaces
- Tourist spots
- Accessibility scopes
- Buffered zone
- Building density
- Floor area ratio (FAR)
- Historical spots and regions
- Landuse
The local slow-moving traffic system

* Slow-moving landscape corridors
  * On both sides of the Qinhuaie River

* Slow-moving traffic corridors
  * Along Dinghuaimen St.
  * Along Qingliangmen St.
  * Along South Zhongshan Rd.
Calculation of carbon reduction

- Population coverage
  - 0.8 Million
- Transport status
  - Vehicle quantity: 0.15 Million
  - Average daily usage: 50km
- Traffic capacity
  - 0.05 ~ 0.1 Million per day
- Average slow-moving traffic time
  - 20 out of 30 minutes
- Average distance
  - $3 \times 2 = 6$ km
- Carbon reduction assessment
  - 0.9 kg every occupant per day
  - 50 ~ 90 tones per day in all
  - 5 ~ 10% of daily transport carbon emissions in the area

Slow-moving traffic corridor
Slow-moving landscape corridor
Bus transfer node
Metro transfer node
Landscape node
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Construction of slow-moving transport system in big cities should consider properties of each specific city especially their spatial features.

The case study shows a 5~10% drop of carbon emission in the study area which has supported the idea of green transport strategy in China as well as sustainable urban planning and urban development.

More detailed simulations and controlled experiments can be done to further explore the slow-moving traffic planning framework in order to achieve a better result.
- The End –

Thanks for your time.

XU Jian-gang  
Professor  
mailto: xjg129@sina.com

QIN Zheng-mao  
Master Candidate  
mailto: zhengmaoqin@163.com

QI Yi  
PhD, Lecturer  
mailto: jnjnqy@gmail.com

School of Architecture and Urban Planning  
Nanjing University  
22 Hankoulu Rd.  
Nanjing 210093  
P.R. China