Traffic Safety and the Smart Growth Street Network

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Or this?
Or this?
Or this?
Characterizing Street Networks

Streets networks are devilishly complicated

- The possible variations are infinite and even subtle differences can have a huge impacts

- Street networks simultaneously operate at numerous geographic scales while serving many different – some times conflicting - functions

- The common descriptors are not all that good for illuminating the differences between networks
California Cities Study of Street Networks

*Does the Street Network Matter?*

Twenty-four Cities

[Map of California with city names marked and arrows pointing to various cities.]
Davis, CA
14 % of people ride to work
Davis, CA
Road Fatality Rate: 1 per 100,000
Road Fatality Rate for All 157 California Cities Over 40,000

number per 100,000 population
Road Fatality Rate for All 157 California Cities Over 40,000

*number per 100,000 population*

Davis, CA
Road Fatalities per 100,000
*California Cities of 40,000 to 120,000*

Pre-1950: 5.6
Post-1950: 6.3
Risk of Fatality

(Fatalities as % of Injuries)
California Cities of 40,000 to 120,000

- Pedestrians: Pre-1950 = 3.8, Post-1950 = 5.4
- Bicycle Riders: Pre-1950 = 0.72, Post-1950 = 1.01
- People in Vehicles: Pre-1950 = 0.55, Post-1950 = 0.75

- Pre-1950
- Post-1950
Chance of Pedestrian Fatality vs. Impact Speed

Evolution of the Street Network

Pre-1950’s

Post-1950’s

Adapted from Stephen Marshall
How Did This Drastic Change Occur?

One important agency in getting rid of the grid network was the Federal Housing Authority.

FHA Technical Bulletin No. 7 (1938)
Planning Profitable Neighborhoods
According to the FHA the grid layout was

- Monotonous
- Had Little Character
- Uneconomical
- Posed Safety Concerns
Evolution of the Street Network
Characterizing the Street Network

- Shape and Configuration
- Street Network Scale
- Street Network Connectivity
Citywide Street Network

<table>
<thead>
<tr>
<th>Linear</th>
<th>Tree</th>
<th>Grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tributary</td>
<td>Radial</td>
<td></td>
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</tbody>
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Adapted from Stephen Marshall, *Streets & Patterns*
550 Intersections per Square Mile
110 Intersections per Square Mile
Network Scale

45 Intersections per Square Mile
Network Connectivity

- Link-to-Node Ratio = 1.61
- Link-to-Node Ratio = 1.13
- Link-to-Node Ratio = 1.16
Variables included in Our Safety and Travel Choice Models

Street Network Properties

Street Design Properties
- Average Total Number of Lanes
- Average Outside Shoulder Width
- Raised Median
- Painted Median
- On-Street Parking
- Bike Lanes
- Raised Curbs

Travel and Activity Level

Distance from City Center

Income

Mix of Land Use
Safety Analysis Based on Geo-coding 230,000 Accident Records in 24 California Cities
Safety and Travel Choice Analysis done for **1040** Census Block Groups

*24 California Cities*
versus
Risk of Severe Injury or Fatality*

versus

Chance of being Severely Injured
30% Higher

Chance of being Killed
50% Higher

*Given that an injury occurred
Odds of Dying in a Road Accident based on Intersection Density*

*Given that an injury occurred
Does Street Network Matter for Safety?

The street network plays a huge role in terms of traffic safety.

1. Street density seem to be the most important factor.
2. Street network configuration is also important.
3. The results with respect to ‘connectivity’ is a bit more complicated.
What About Connectivity?

Street patterns types that are more connected are safer

Within each type of street pattern increasing connectivity – measured by link-to-node ratio - was not correlated with improved safety
Clipping the Grid in Berkeley

Very high connectivity can be a mixed blessing
Why Does Street Network Matter?

Why does street network matter for safety?
Understanding this issue is important helping us understand how to develop a new approach for designing street network.

Street network affects
• Speed control
• Travel mode choice and VMT
• Traffic distribution

Speed control reduces accident severity

More diverse mode choice and good traffic distribution reduces the demand for road capacity and means that we are more likely to keep the streets to a human scale.
Design for Safety

The two most important characteristics of the street network in designing for safety are:

1. Dense (Fine Grained) Fabric
2. Functional Connection for walking within and between neighborhoods
Connected?

Yes... based on convention matrices
Functionally Connected for Walking?

No.... Each neighborhood is an isolated pod
Traffic Safety and Smart Growth

The same street design features that supports traffic safety also
   – Promote use of active transportation
   – Reduce VMT
   – Create value

In other words, a safe street network is also a smart growth street network
Percentage of People **Walking**, **Biking** or **Taking Transit**

![Diagram](image)

- Walking: 2%
- Biking: 1%
- Taking Transit: 2%

![Diagram](image)

- Walking: 9%
- Biking: 4%
- Taking Transit: 9%
Percentage of People Walking, Biking or Taking Transit

Effect of Intersection Density for Cul-de-sac Network

Percentage vs. Intersection Density

- 10%
- 5%
- 0%

< 81  81-144  144-225  225+

(Chart showing the correlation between percentage of people walking, biking, or taking transit and the density of intersections for a cul-de-sac network.)
Percentage of People Walking, Biking or Taking Transit

Effect of Intersection Density for Gridded Network

- 10%
- 5%
- 0%

- < 81
- 81-144
- 144-225
- 225+
Street Networks for Smart Growth

There is no one type of ‘smart growth street network’
Smart Growth Street Network?
Smart Growth Street Network?

No
What is a Smart Growth Street Network?
Smart Growth Street Network?

Yes
Connectivity Standards

A handful of number of jurisdictions have enacted connectivity standards

Connectivity standards by themselves will not necessarily produce safer communities or smart growth communities

We need more focus on the issues of street network scale and functional connectivity
After years of ignoring the role of street network on traffic safety we are beginning to build a body of knowledge – we need to embrace the complexities of the issues
Great cities are built on the foundation of a Great Street Network