Narrower Lanes, Safer Streets

Complete Mobility
@DewanMKarim

Dewan Masud Karim
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The views expressed in this article are those of the author and do not necessarily reflect the views of the City of Toronto or the Toronto’s Planning Department.
Passion for Lane Width Investigation

“Find out what it is that touches you most deeply. Pursue it, learn about it, explore, expand on it. Live with it and nurture it. Find your own way and make your own contribution.”

Leonard Nimoy, Interview at MIT

Objective of This Research is Contribute to the “Scientific Approach of Lane Width
"I believe in evidence. I believe in measurement, observation and reasoning confirmed by independent observers. I will believe in anything, no matter how wild or ridiculous, if there is evidence for it. The wilder and more ridiculous something is, however, the firmer and more solid the evidence will have to be."

Isaac Asimov, Science Fiction Writer
Standards will Shield Engineers from Liability

"Who will guard the guards themselves?"

“The more we run from a problem, the more we’re actually running into it”

Pico Iyer: British-born essayist and novelist of Indian origin
“A change from a system of road-safety delivery rooted in opinion, intuition, and folklore to one that is founded in science and based on factual knowledge is underway.”

Complex World of Safety Culture

Actual Crash Rates

Reactive Approach

Random Error
- “Accidents”
- “Safer Streets”
- “Wider is

Proactive Approach

Systematic Error
- ”Collisions”
- “Safer Streets”
- “Narrower is”

Human Feeling

Crash
Implications of Unnecessary Wide Lanes

Imbalanced Distribution of Street Space Among the Multimodal Users

Very Wide Curb Lane

Unused space of very wide lane creates extremely narrow and unsafe lane

No waiting area for Pedestrians

Narrower and substandard sidewalk width next to very wide lane
Very Wide Lanes: Overdesign is Safe?

Where are even current standards?

Lack of Public Space Distribution and How to Use Current /new Standards

6.0m
Very Wide Lanes: Lack of Safety Knowledge?

Recent Resurfacing Example, Pickering Parkway

Removed Bike Lane to Install >5.0m Travel Lane?
Human Scale and Infrastructure Limits

Delicate Sense of Human Scale: Size Varies Based on Demand but Limiting Scale

Product of Inca Civilization Engineering
Social Cost of Collisions In Ontario

$18 Billion

Congestion Cost in Ontario

$3.3~6.0 Billion

Toronto Urban Area Collision Cost

$2.0 Billion

"Perhaps, if the travelling public knew the extent of ignorance about safety with which roads are created and operated, the requisite pressure would materialize." – Dr. Ezra Hauer

“A persistent myth that seems to be rooted within the profession is that all vehicular lane widths must be 12 ft.”

Dr. Hillary Isebrands,
Dr. Tracy Newsome,
Frank Sullivan

Previous Research Clues: Detrimental Range of Lane Width

“The relationship between lane width and crash experience is non-linear with optimal safer range of lane width bottoms out…” when it crosses a boundary limit (such as, widening lanes beyond 12 ft or 3.6m may be detrimental to safety).

Previous Research Findings: Speed and Lane Width

The traditional belief of “wider is safer” is highly questionable and contradictory to this logical sequence.
Research Data

Toronto Database:

Tokyo Database:
190 intersections in Tokyo (1992 to 1995)
Types of Crashes in Database

- Side-Impact Crashes
- Left-turn Collisions
- Right-turn Collisions
- Right-Angle Collisions

Right-Angle Collisions:
- Angle Accident: AG2
- Right-Angle Accident: AG2

Left-turn Collisions:
- Left-turn Accident: AG2
- Right-turn Accident: AG1
Prototype Styles of Road-safety Delivery Practice

**Pragmatic Style**
- Based on Lay Beliefs & Self-interest Organizations
- Require no Knowledge of Fact
- No Need for Results of Actions

**Rational Style**
- Based on Expected Consequences
- Need Factual Information
- Learns from Experience

Research Approach

Creating Framework for Scientific Approach of Lane Width Selection Among the Transportation Practitioners

Key Focus

- Safer Lane Width Zone
- Large Vehicle Considerations
- Pedestrian & Cycling Impact
- Intersection Design Principles
- Congestion & Capacity Impact
- Reallocation of Public Space

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Key Findings: Lane Width and Crash Frequency

Shape of Functional Relationship between Lane Width and Crash Rates

Findings: Safer Range of Lane Width is 3.0~3.3m
Key Findings: Behaviour of Crash Types

Shape of Functional Relationship between Lane Width and Crash Rates for Different Types

**Findings:** Safer Range of Lane Width is 3.0~3.3m
Key Findings: Behaviour of Crash Types

Shape of Functional Relationship between Lane Width and Crash Rates for Different Types

Findings: Safer Range of Lane Width is Varies with Types of Lane
Implications of Unnecessary Wide Lanes: Case Study

Very Wide Curb Lane

Consequences of Very Wide Lane

- Illegal Drop-of-pick-up
- Illegal Taxi, Delivery
- Unofficial Bus Stop

Narrow, Sub-standard Boulevard
**Key Findings:**

1) Extremely high right-turn collision rates in southbound direction

2) Higher Sideswipe and changing lanes collision in North & southbound directions

3) Despite high volume, shared right-turn is safest form of turning facility
Implications of Unnecessary Wide Lanes: Right-turn

**Key Findings:**
1) Shared Right-turn lane experiences best safety records
2) RT lane with island is most dangerous form turning facility

**Crash Rates**

- **Number of Right-Turn Crashes per Year per Million Vehicle:**
  - Shared Right-turn lane: 0.43
  - RT lane with island: 0.37
  - Flared Right-turn lane with island: 2.66

- **Crash Rates (Georgia DOT)**
  - Number of Right-Turn Crashes per Approach per Year:
    - Shared Right-turn lane: 0.81
    - RT lane with island: 1.57
    - Flared Right-turn lane with island: 0.63

- **Crash Rates (Texas DOT)**
  - Number of Right-Turn Crashes per Approach per Year:
    - Shared Right-turn lane: 0.11
    - RT lane with island: 0.21
    - Flared Right-turn lane with island: 0.67

Source: Kay Fitzpatrick and William H. Schneider IV. Turn Speeds and Crashes within Right-turn Lane, Report 0-4365-4, February 2005

http://nacto.org/docs/usdg/turn_speeds_and_crashes_within_right_turn_lanes_fitzpatrick.pdf
Key Findings: Culture of Lane Width “Practice”

Distribution of Lane Width

Findings: Tokyo practitioners uses relatively safer range of lane width.

Gap in Practice
Key Findings: Narrower Lanes Impact on Congestion

Findings: Safest Range of Lane Width Carries Highest Volume of Traffic
Key Findings: Narrower Lanes Impact on Congestion

Approach Traffic Volumes for Different Lane Width

Findings: Safest Range of Lane Width Carries Highest Volume of Traffic
Key Findings: Large Vehicles Impact

Distribution of Large Vehicles Lane Width

Findings: Safer range of lane width carries similar large vehicle volumes
**Key Findings: Narrower Lanes and Bicycles/Pedestrians**

**Findings:** Narrower lanes helps to accommodate bicycle/pedestrian demand without additional ROW.
**Findings:** Narrower lanes helps to squeeze more lanes without additional ROW
Example from Real World: Safety Margins

Highway Example of Safety Margins
Example from Real World: Comfortable Safer Zone

Safer Lane Width is Visible During the Snowstorm

Desire lines of optimum lane width created by drivers where they “feel” safe
Example from Real World: Comfortable Safer Zone

Safer Lane Width is Visible During Summer Time Construction

Bike lane created by car drivers during school construction
Liverpool Road, City of Pickering
1. Serious Gap of Lane Width Safety Understanding Between Tokyo and Toronto Professionals
2. Tokyo Practice of Narrower Lane Width Produced Better Safety Records

**Background Research**
1. No Evidence Found How Initial Standards of Lane Width were Established
2. Wider (>3.4~3.6m) Lanes Detrimental to Safety

**Professional Practice**
1. Narrower Lanes Provides More Options for Bicycles
2. Wider Lanes Reduces Space for Pedestrians

**Pedestrian & Bicycles**
1. Between 2.8~3.1m for Left-turn
2. Between 2.9~3.2m for through travel Lane
3. Between 3.3~3.4m for Curb Lane

**Safer Lane Width Zone**
1. Highest Traffic Capacity for Narrower Lane Width
2. No Capacity Reduction and No Impact on Congestion

**Capacity & Congestion**
1. Narrower Lanes Carries Similar Large Vehicle Volumes Like Wider Lanes
2. Large Vehicle on Curb Lane

**Key Findings**
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**Research Conclusions**
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**Research Conclusions**
1. No Evidence Found How Initial Standards of Lane Width were Established
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Research Outcome: Context-Based Lane Width

Equitable Allocation of Public Space

<table>
<thead>
<tr>
<th>Lane Width (m)</th>
<th>Standard Bike Lane</th>
<th>Wider/Buffered Bike Lane</th>
<th>Contra-flow Bike Lane</th>
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<tbody>
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- Transportation Modes:
  - Local/One-way Streets
  - Transit Vehicle Only
  - Low Vol
  - Med-High Vol
  - Left Turn

- Lane Width (m):
  - 1.5
  - 1.8
  - 2.0
  - 2.2
  - 2.5
  - 2.8
  - 3.0
  - 3.3
  - 3.4~3.6
  - 3.8
  - 4.0
  - 4.25

- Safety Implication of Lane Width:
  - Unsafe
  - Safer

Traffic Volume Influence on Lane Design

Med-High Vol

Local/One-way Streets

Low Vol

Contra-flow Bike Lane

Downtown/General Parking Lane

Left Turn Travel Lane

Transportation

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Med-High Vol Traffic Volume

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Accepting Evidence in Practice

1. It is Ridiculed
   - Raising Doubts of “Traditional” Safety Approach

2. It is Violently Opposed
   - Complete Street Outcomes
   - Research Findings Confirmed by Multiple Observers

3. It is Accepted as Being Self-evident

Stages of Establishing Truth
“The Most urgently needed change of road-safety culture is to make intuition-based road-safety delivery *socially unacceptable*”

Dr. Ezra Hauer,
Leading Contributor of Highway Safety Manual

Thank You for Your Time