Comparison to other States (2016 Fatality Rates)

<table>
<thead>
<tr>
<th>Fatality Rate</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. MA</td>
<td>0.63</td>
</tr>
<tr>
<td>2. RI</td>
<td>0.64</td>
</tr>
<tr>
<td>3. MN</td>
<td>0.66</td>
</tr>
<tr>
<td>4. DC</td>
<td>0.75</td>
</tr>
<tr>
<td>5. NJ</td>
<td>0.78</td>
</tr>
</tbody>
</table>

National Average = 1.18

Comparison to other Countries

- MN population: 5.6 million
- Sweden: 9.9 million

Comparison to other States (2016 Fatality Rates)

Comparison to other Countries

- Minnesota: 7.1
Safe Systems Approach

Did You Know?

6 Countries Have Already Adopted a Safe Systems Approach to Road Safety
- Australia
- Luxembourg
- Netherlands
- New Zealand
- Sweden
- United Kingdom

Comparison to other Countries

America's Deadly Roads

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>3.8</td>
<td>3.4</td>
<td>2.9</td>
<td>2.5</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2.9</td>
<td>2.8</td>
<td>2.1</td>
<td>1.9</td>
</tr>
<tr>
<td>Canada</td>
<td>2.0</td>
<td>1.7</td>
<td>1.4</td>
<td>1.2</td>
</tr>
<tr>
<td>Canada (South)</td>
<td>1.6</td>
<td>1.3</td>
<td>1.1</td>
<td>0.9</td>
</tr>
<tr>
<td>United States</td>
<td>5.1</td>
<td>4.9</td>
<td>4.7</td>
<td>4.5</td>
</tr>
<tr>
<td>Norway</td>
<td>1.5</td>
<td>1.2</td>
<td>1.0</td>
<td>0.9</td>
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<tr>
<td>Germany</td>
<td>2.2</td>
<td>1.8</td>
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<td>1.4</td>
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<tr>
<td>France</td>
<td>2.0</td>
<td>1.7</td>
<td>1.4</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Minnesota Roadway Fatalities

<table>
<thead>
<tr>
<th>Year</th>
<th>Fatalities</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>615</td>
<td>-36</td>
</tr>
<tr>
<td>2006</td>
<td>579</td>
<td>-36</td>
</tr>
<tr>
<td>2007</td>
<td>551</td>
<td>-28</td>
</tr>
<tr>
<td>2008</td>
<td>528</td>
<td>-23</td>
</tr>
<tr>
<td>2009</td>
<td>503</td>
<td>-25</td>
</tr>
<tr>
<td>2010</td>
<td>473</td>
<td>-30</td>
</tr>
<tr>
<td>2011</td>
<td>459</td>
<td>-14</td>
</tr>
<tr>
<td>2012</td>
<td>442</td>
<td>-17</td>
</tr>
<tr>
<td>2013</td>
<td>430</td>
<td>-13</td>
</tr>
<tr>
<td>2014</td>
<td>422</td>
<td>-8</td>
</tr>
<tr>
<td>2015</td>
<td>411</td>
<td>-11</td>
</tr>
<tr>
<td>2016</td>
<td>401</td>
<td>-10</td>
</tr>
</tbody>
</table>

Policy changes:

- Increased fine for texting and driving
- Second offense
- Expanded GDL laws
- Driver license sanctions
- Increased hours of practice for teen drivers
- Driver educators to offer parent training
- Cell phone ban (under 18 and provisional drivers)
- Primary seat belt, booster seat, expanded GDL laws
- Full license has same penalties for DWI
- Texting prohibited while driving
- Expanded GDL laws
- Driver license sanctions
- Ignition interlock
- Work zone speeding fines
- Increased fine for texting and driving
- Second offense
What is it?

“Safe System is the management and design of the road system such that impact energy on the human body is firstly avoided or secondly managed at tolerable levels by manipulating speed, mass and crash angles to reduce crash injury severity.”

Safe system approach

- Based upon original Vision Zero (Sweden) & Dutch Sustainable Safety Principles and adopted by Australia, New Zealand and several Canadian Provinces

Key Principles:
1) Human beings make mistakes and crashes are inevitable, but the consequences should not result in a fatality or severe injury.
2) The human body has a tolerance to crash forces before harm occurs.
3) System designers and system users share responsibility for managing crash forces to levels that do not result in death or severe injury.

Australian Road Safety Commissioner Iain Cameron explains the ‘Safe System’ approach

https://www.youtube.com/watch?v=M1gxAusDjkw
Four Guiding Principles:
1. Recognition that people make mistakes that can lead to crashes

“A system that is safe only if people don’t make mistakes, is not a system made for humans.”

Peter Furth – Civil Engineering Professor Northeastern University
http://www.northeastern.edu/peter.furth/

2. The human body has a physical tolerance to crash forces before harm occurs

When crashes do occur, manage their energy so that the outcomes are not severe.

\[ K.E. = \frac{1}{2}mv^2 \]

Designing for Kinetic Energy

3. Shared responsibilities among users and those who design, build and maintain vehicles and roads

4. Strengthen all parts of the system so users are protected if one part fails

When crashes do occur, manage their energy so that the outcomes are not severe.

Instead of asking who or what caused the crash, we should instead be asking: “how did the road system as a whole allow this death or serious injury to occur?”

A crash needs to be considered as a system failure and not just a road user failure.

Speed and impact severity

Australian PSA

60 kph (37 mph) vs. 65 kph (40 mph)
What about automated/connected vehicles?

Pedestrian Detection and Full Autonomous Braking System

Speed and braking

Four Guiding Principles:

1. Safe systems approach
   - Safe systems approach
   - Increased attention to pedestrian protection
   - Crash prevention, not just response

2. There is a shared responsibility for road safety:
   - Road users - to act with care and within traffic laws
   - Vehicle manufacturers
   - Emergency response / Post-crash care
   - Transportation agencies that design, build and manage roads

3. All parts of the system must be strengthened in combination to multiply their effects and provide redundancy to protect road users if one part fails

Swiss Cheese Model:
A crash occurs when the “holes” in the layers line up

2+1 roads
- First built in 1998
- Now 2100 km
- Up to 90% reduction in fatalities
- Production cost 200-300 US$/meter
- Widely accepted among road users
Safe system for intersections

Safe System intersection design principles:
- Minimize conflict points
- Remove/simplify road user decisions
- Minimize impact angles
- Minimize entry and impact speeds

Intersection conflict points

If a user commits an error (poor judgement or traffic control violation) ...

Conflict Points are “Crash Potential”

Intersection crash severity is highly influenced by SPEED and ANGLE of IMPACT

Rear-end  Sideswipe  Angle  Head-on  Least severe

Most severe

Changing the angle of impact from 90° to 40° has about the same result as lowering the speed by 30 kph (19 mph)

Using design to reduce conflict points

MUT and RCUT Can Reduce Conflict Points by 50%
Median U-Turn Intersection – Pedestrians

Counterpoint: Why Hwy. 52 and other roads in Minnesota are getting those new intersections

A full freeway? One day. But the reduced-冲突
intersections are a change we can make now, at a relatively
low cost, to address the worst kind of crash and save lives.
It’s working.

By Streets User and Douglas Caster | MAY 13, 2018 — 10:09 AM

Highway 47 (University)  Highway 65 (Central)
Fatalities by Land Use

- 17,216 fatalities in rural areas in 2017 (rate 1.78).
  - A decline of 18.0% since 2008.
  - Rural VMT decreased by 2.1% from 2008 to 2017.
  - Rural fatality rate per 100 Million VMT decreased by 16.0%.
  - Rural population decreased by 11.8% from 2007 to 2016 (2017 population estimate is not yet available).

- 19,038 fatalities in urban areas in 2017 (rate 0.85).
  - An increase of 17.4% since 2008.
  - Urban VMT increased by 13.1% from 2008 to 2017.
  - Urban fatality rate per 100 Million VMT increased by 3.7%.
  - Urban population increased by 12.7% from 2007 to 2016 (2017 population estimate is not yet available).

Fatalities by Land Use

From 2008-2017, for fatalities when land use was known:

- Passenger vehicle occupant fatalities:
  - rural areas decreased by 18%.
  - urban areas increased by 9%.
- Pedestrian fatalities:
  - in rural areas decreased by 8%.
  - in urban areas increased by 48%.
- Pedalcyclist fatalities:
  - in rural areas decreased by 15%.
  - in urban areas increased by 15%.
- Motorcyclist fatalities:
  - in rural areas decreased by 25%.
  - in urban areas increased by 15%.
My question to design engineers:

• Can the Safe Systems approach work on “urban expressways” like these?

Opportunities

• Strategic Highway Safety Plan due for update in 2019. How can it be more impactful?
• Road Design Manual re-write.

My question to design engineers:

• Through urban/suburban expressways, is it possible to design a highway that?
  - Moves 30,000 vpd thru the corridor (slower, but reasonably efficiently).
  - Reduces vehicle speeds → lowers energy.
  - Reduces intersection conflict points.
  - Reduces intersection impact angles.
  - Is safe for pedestrians and other vulnerable users.
  - Less severe/less of a barrier for the communities they pass thru.

Resources
A Safe Systems Approach to Intersection Planning & Design in the United States

FHWA Project awarded to VHB and Univ. of North Carolina Highway Safety Research Center

Objective:

Develop a Safe Systems for intersections framework to provide a technical basis by which practitioners can apply Safe Systems principles to inform intersection planning and design decisions.