

# Bad Bad Roadway

1. How bad (unsafe) is your roadway?
  - a. Can something be done?
  - b. You need to do something!
  - c. Someone is going to get killed!

Goal:

Provide some insight on how engineering decisions are made to address public safety concerns.

## Review 4 common concerns:

1. Rural un-signalized intersection (high speed 2-way stop)
2. Rural signalized intersection
3. Urban signalized intersection
4. Rural segment of highway

# Historical Crash Data - 5 years

1. Rural intersection ( high speed 2-way stop)
  - **22 total**/1 fatality, 1 serious, 11 minor injury, 9 property damage
2. Rural signalized intersection (high speed)
  - **72 total**/ 0 fatality, 19 minor injury, 53 property damage
3. Urban Signalized
  - **224 total**/0 fatality, 1 serious, 69 minor injury, 154 property damage
4. Rural highway segment (13 miles)
  - **75 total** (including intersections) -- 1 fatality, 1 serious injury, 32 minor, 41 property damage
  - **31 total** (segments only) – 0 fatal, 10 minor injury, 21 Property damage

- What is the most dangerous area?
  1. Rural intersection ( high speed 2-way stop)
    - **22 total**/1 fatality, 1 serious, 11 minor injury, 9 property damage
  2. Rural signalized intersection (high speed)
    - **72 total**/ 0 fatality, 19 minor injury, 53 property damage
  3. Urban Signalized
    - **224 total**/0 fatality, 1 serious, 69 minor injury, 154 property damage
  4. Rural highway segment (13 miles)
    - **75 total** (including intersections) -- 1 fatality, 1 serious injury, 32 minor, 41 property damage
    - **31 total** (segments only) – 0 fatal, 10 minor injury, 21 Property damage



What might be some next steps?

# Gather Information

1. Understand concern
2. Gather data
  - Traffic Crashes
  - Traffic volumes
3. Get perspective
  - Ranking
4. Determine possible solutions
5. Benefit vs Cost

- Crash Cost
- Crash Rates
- Type of crashes/locations/time
- Public Opinion
- Trends – Up/down/consistent

# Crash Costs and Rates

- Crash Cost
  - Number and type of crashes x cost per crash type
  - Yearly cost of crashes
- Crash Rates (CR) – help provide perspective
  - Number of crashes per year for each 1,000,000 vehicles entering the intersection
  - State wide averages for similar conditions
  - Compare individual site rates to state averages



# Crash Rates Comparison

1. **Rural intersection ( high speed 2-way stop)**
  - 22 total/1 fatality, 1 serious, 11 minor injury, 9 property damage
    - **Actual CR = 1.38/CR = 0.25 ----- Crash Cost = \$607,880**
2. **Rural signalized intersection**
  - 72 total/ 0 fatality, 19 minor injury, 53 property damage
    - **Actual CR = 1.49/CR = 0.45 ----- Crash Cost = \$448,160**
3. **Urban Signalized**
  - 224 total/0 fatality, 1 serious, 69 minor injury, 154 property damage
    - **Actual CR = 2.39/CR = 0.70 ----- Crash Cost = \$1,632,680**
4. **Rural highway segment (13 miles including intersections)**
  - 75 total/ 1 fatality, 1 serious injury, 32 minor, 41 property damage
    - **Actual CR = 0.62/CR = 0.60 ----- Crash Cost = \$340,000**

# Statewide Average Crash Rates Intersections

<i>Five Years of Crash Data</i>		<b>CR</b>	<b>SR</b>	<b>FR</b>	<b>FAR</b>
<b>Signals</b>	Low Volume, Low Speed	0.52	0.71	0.09	0.42
	Low Volume, High Speed	0.40	0.55	0.06	0.32
	High Volume, Low Speed	0.70	0.97	0.12	0.76
	High Volume, High Speed	0.45	0.63	0.11	0.48
<b>No Signals</b>	Urban Thru/Stop	0.18	0.26	0.09	0.33
	Rural Thru/Stop	0.25	0.41	0.45	1.05
	All Way Stop	0.35	0.50	0.14	0.57
	Other	0.16	0.21	0.05	0.17

# Statewide Crash Rates for Sections

Five Years of Crash Data	Non-Junction Crashes				All Crashes			
	CR	SR	FR	FAR	CR	SR	FR	FAR
<i>Rural 2-lane : ADT ∈[0,1499]</i>	0.40	0.72	1.00	2.76	0.61	1.07	1.50	3.97
<i>Rural 2-lane : ADT ∈[1500,4999]</i>	0.31	0.51	0.75	1.61	0.53	0.87	1.14	2.53
<i>Rural 2-lane : ADT ∈[5000,7999]</i>	0.30	0.48	0.58	1.37	0.60	0.96	0.98	2.42
<i>Rural 2-lane : ADT ∈[8000,∞)</i>	0.35	0.53	0.60	1.13	0.76	1.15	0.87	1.97
<i>Urban 2-lane : ADT ∈[0,1499]</i>	0.61	1.13	2.18	6.55	1.46	2.45	2.91	10.19
<i>Urban 2-lane : ADT ∈[1500,4999]</i>	0.39	0.58	0.62	1.37	1.32	1.88	1.16	2.87
<i>Urban 2-lane : ADT ∈[5000,7999]</i>	0.57	0.79	0.32	1.16	1.80	2.53	0.45	2.77
<i>Urban 2-lane : ADT ∈[8000,∞)</i>	0.67	0.93	0.34	1.16	2.24	3.12	0.58	2.56
<i>Rural Freeway</i>	0.45	0.61	0.21	0.65	0.56	0.76	0.23	0.75
<i>Urban Freeway</i>	0.82	1.09	0.12	0.49	1.13	1.51	0.16	0.67
<i>Rural Expressway</i>	0.34	0.50	0.24	0.70	0.66	0.98	0.56	1.60
<i>Urban Expressway</i>	0.50	0.69	0.20	0.61	1.64	2.35	0.57	2.02
<i>Rural 4-lane Undivided</i>	0.29	0.43	0.00	0.78	0.64	0.95	0.00	1.36
<i>Urban 4-lane Undivided</i>	0.86	1.11	0.13	0.79	3.80	5.03	0.59	3.37
<i>Rural 4-lane Divided</i>	0.29	0.44	0.20	0.61	0.87	1.28	0.51	1.78
<i>Urban 4-lane Divided</i>	0.62	0.82	0.20	0.70	2.76	3.70	0.53	2.91
<i>3-lane Undivided</i>	0.56	0.77	0.39	0.77	1.95	2.76	0.64	2.19
<i>5-lane Undivided</i>	0.76	1.03	0.00	1.16	2.59	3.60	0.00	2.89

# Vote after Crash Rate Information

# Vote

Did you change your mind?

# Crash Rates Comparison

1. **Rural intersection ( high speed 2-way stop)**
  - 22 total/1 fatality, 1 serious, 11 minor injury, 9 property damage
    - **Actual CR = 1.38/CR = 0.25 ----- Crash Cost = \$607,880**
2. **Rural signalized intersection**
  - 72 total/ 0 fatality, 19 minor injury, 53 property damage
    - **Actual CR = 1.49/CR = 0.45 ----- Crash Cost = \$448,160**
3. **Urban Signalized**
  - 224 total/0 fatality, 1 serious, 69 minor injury, 154 property damage
    - **Actual CR = 2.39/CR = 0.70 ----- Crash Cost = \$1,632,680**
4. **Rural highway segment (13 miles including intersections)**
  - 75 total/ 1 fatality, 1 serious injury, 32 minor, 41 property damage
    - **Actual CR = 0.62/CR = 0.60 ----- Crash Cost = \$340,000**



What other data may be needed?

# Additional Crash Data

- What type of crashes are occurring?
  1. Rural un-signalized intersection – 60% (12 of 22) Right angle
  2. Rural Signalized intersection – 90% (57 of 72 ) rear end
  3. Urban Signal – 78% rear end (174 of 224)/7% right angle/misc.
  4. Rural Highway Segment –
    - Including junctions – 75 total -- 20% rt angle/15% head-on/37% rear end/16% run-off-road
    - Not including junctions – 35 total --- 37% run-off-road/26% head-on/23% other

# Where and Why Discussion

1. Rural un-signalized intersection – 60% (12 of 22) Right angle
  - Poor gaps selection or running stop sign?
2. Rural Signalized intersection – 90% (57 of 72 ) rear end
  - Where occurring? Congestion related? Timing related
3. Urban Signal – 78% rear end (174 of 224)/7% right angle/misc.
  - Limited public outcry/ mostly property damage
4. Rural Highway Segment –
  - Including junctions – 75 total -- 20% rt angle/15% head-on/37% rear end/16% run-off-road
  - Not including junctions – 35 total --- 37% run-off-road/26% head-on/18% deer/ 19% other



# Possible Solutions

1. Rural un-signalized intersections (right angle)
  - Additional signage/sight distance/RICWS/Reduced Conflict Intersection/Signal?
2. Rural Signalized Intersection (Rear-End)
  - Advanced warning flashers/Conspicuous signal heads/lighting
3. Urban Signal (Rear-end)
  - Improved signal timing (low costs)
  - Congestion management (very high costs)
4. Rural highway segment (mixture of)
  - Rumble stripes (low cost) – centerline and shoulder (head-on & run-off-road)
  - Rural left turn lanes (high costs/\$250,000 each plus R/W)

# Other Helpful Information

- Cost vs Benefit
  - Improvement costs
  - Monies available
  - Impact – expected reduction in crashes
- Priority
  - Ranking – District 12 counties
- Planned road work
  - STIP/CHIP – 4 year work plan/10 year work

- Where might one spend their limited Safety Funds?
  - Best bang for buck
    - Low cost more coverage area
  - Focus on serious crash risk areas?
    - High probability future fatality risk
  - Engineering can mitigate

# Strategies Rural Segments

- Rumble Stripes
  - Centerline/Edge line
- Enhanced Edge line
  - Durable wet reflective/6 inch
- Safety Edge
- Shoulder Paving/widening
- Buffers between opposing lanes – 2 lane highway
- Clear Zone enhancements/maintenance
- Ditch/embankment Improvements
- Constrictor Intersections
- Turn Lanes

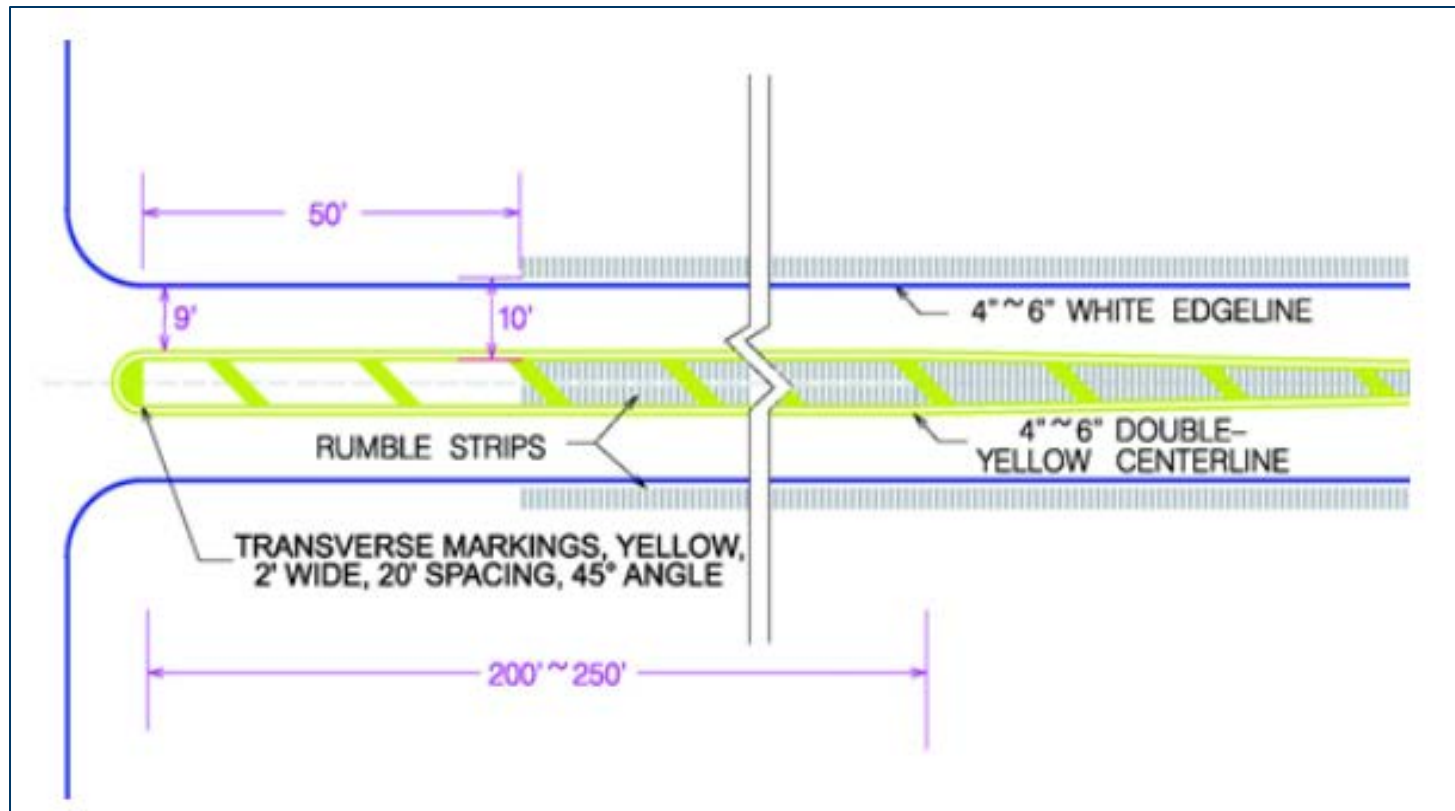
# Strategies Rural Segments

- Expressways
- Reduced conflict intersections
  - Eliminates the crossing movement
  - Similar or better safety benefits than traffic signals
  - Only affects approx. 5% traffic - cross street thru/left
- Rural Intersection Collision Warning System (RICWS)
- Traffic signal?

# Strategies Urban Segments

- Signals
  - Blue light indicators
  - Retro Reflective back plates
  - Improved signal timing
- Completed Streets
  - Bump outs at intersections
  - Narrower lanes
  - Better sidewalks/trails
- Narrower lanes
  - Manage speeds
- Roundabouts – including mini

# Constrictor Intersection



# Constrictor Intersections





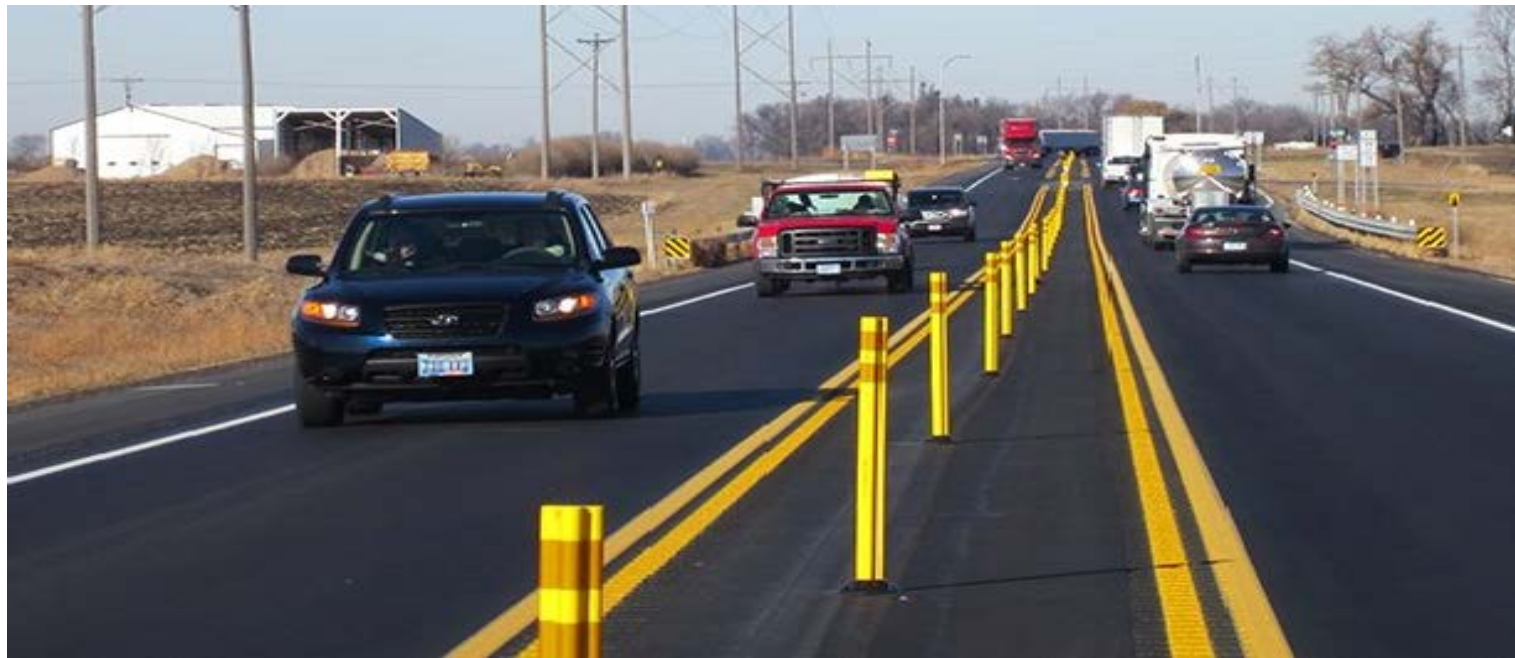
# Rural Intersection Collision Warning (RICWS)



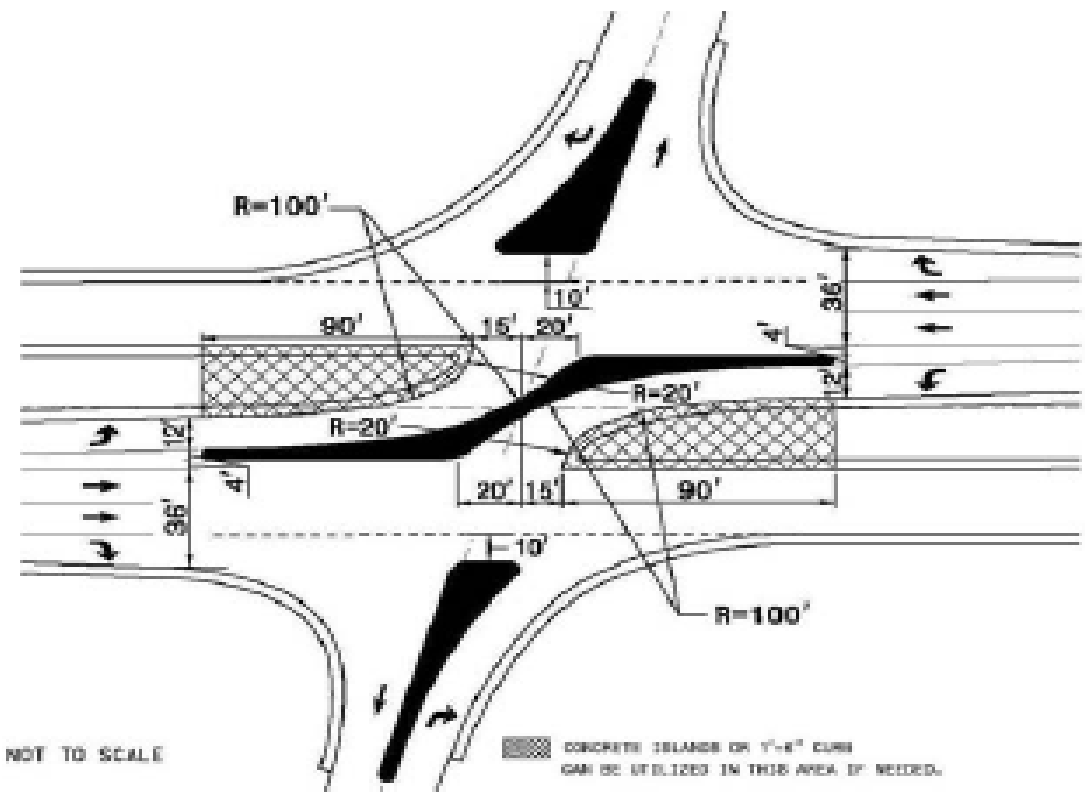
# Centerline Rumble Stripes



# Centerline Buffer



# Reduced Conflict Intersection

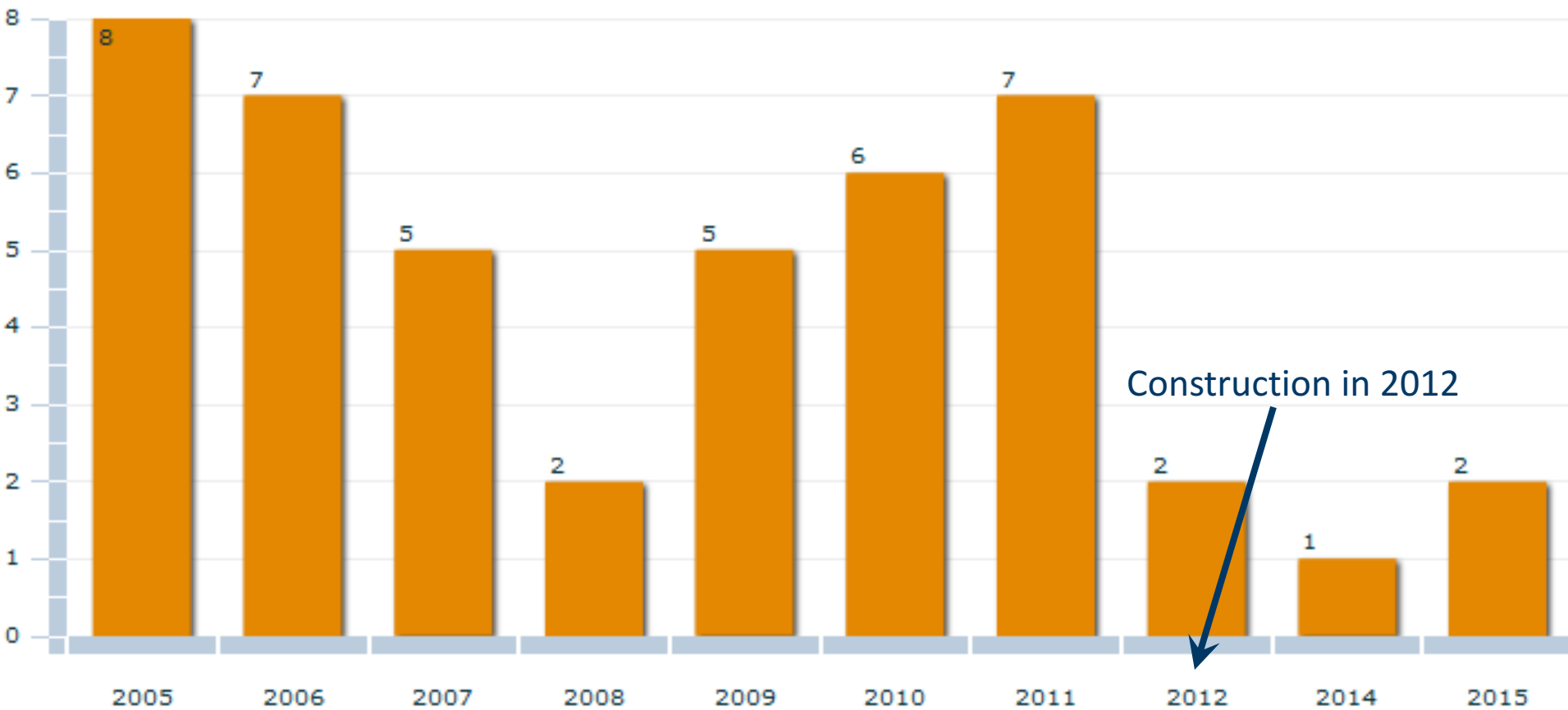


# Cologne: US 212 – Mn 284



Photo courtesy Bolton & Menk, Inc.

# 2005 – 2015





**2008-12-04**

**13:45:45 UTC**



**2008-12-04**

**13:45:45 UTC**



# Dynamic Speed Feedback Signs



# Questions?

## Thank you again!