



2012 NCAUPG Centerline Rumble Strips

Greg Schieber
Kansas DOT

History

- 1999 – KDOT started looking at Centerline Rumble Strips
- K-State University has completed several research reports
 - Dr. Eugene Russell
- K-State University Completed Phone Survey
 - No standards for type and dimensions
- Proposed Test Section

1999 Test Section

- 12 Test Patterns
- Three Different Patterns
 - Continuous 12” on Center
 - Continuous 24” on Center
 - Alternating 12 & 14” on Center
- Four Widths
 - 5, 8, 12, and 16”
- Depth – 0.5”
- Evaluate dB and steering wheel vibration level

1999 Test Section



1999 Test Section

- Seven Vehicles – left wheel on rumble strip
 - Two Dump Trucks
 - Full-size truck
 - Full-size passenger car
 - Compact passenger car
 - Minivan
 - SUV
- 60 mph
- Recorded decibel at ear level of driver
- Recorded vibrations on steering wheel

1999 Test Section

Vehicle	Pattern Tested											
	P12	P11	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1
1996 IH 4900 DT 466 Dump Truck (GW=75,000)	---	---	92.24	92.84	91.47	93.41	93.35	92.23	94.12	92.94	92.16	91.23
	---	---	0.852	0.490	0.482	0.546	0.346	0.494	0.429	0.373	0.685	0.316
1995 Ford L8000 Dump Truck (GW=48,000)	---	88.21	92.31	90.54	90.03	92.01	91.43	90.48	92.73	91.07	90.73	91.34
	---	0.445	0.950	0.283	0.433	0.456	0.592	0.440	0.465	0.587	0.263	0.915
1991 Chevrolet 2500 Pickup Truck	---	---	85.29	84.11	81.44	88.77	84.18	82.68	87.47	83.77	82.86	83.50
	---	---	1.117	0.753	0.614	1.242	0.896	0.572	0.796	0.452	0.845	1.194
1993 Pontiac Bonneville Full-Size Passenger Car	82.86	79.01	83.32	83.75	79.46	83.59	84.65	79.61	84.24	83.48	80.01	82.89
	1.053	0.703	0.786	0.459	0.371	0.970	0.374	0.150	0.274	0.179	0.312	0.568
1994 Ford Escort Wagon Compact Passenger Car	---	85.60	88.42	88.62	87.75	89.74	87.44	86.57	89.97	87.76	86.22	87.34
	---	0.390	0.990	0.083	0.465	0.483	0.238	0.083	0.430	0.508	0.351	0.711
1995 Ford Aerostar Minivan	82.56	80.62	87.83	84.09	82.83	89.49	86.12	84.97	87.77	85.59	85.89	88.33
	1.255	1.083	0.437	0.604	0.851	0.692	0.668	0.530	0.600	0.612	0.904	1.146
1997 Jeep Cherokee SUV	---	---	---	82.82	79.87	86.76	84.22	80.48	88.65	83.80	81.24	85.63
	---	---	---	0.563	0.725	0.683	1.014	0.419	0.338	0.544	0.821	0.676
GRAND MEAN	82.71	83.36	88.24	86.68	84.69	89.11	87.34	85.29	89.28	86.92	85.59	87.18



12" continuous






12" and 24" alternating



24" continuous

1999 Test Section

Vehicle	Pattern Tested								
	P9	P8	P7	P6	P5	P4	P3	P2	P1
1996 IH 4900 DT 466 Dump Truck (GW=75,000)	---	---	---	---	---	---	---	---	---
1995 Ford L8000 Dump Truck (GW=48,000)	1.44 0.178	1.24 0.146	1.30 0.194	1.56 0.167	1.14 0.149	1.31 0.197	1.46 0.198	1.23 0.149	1.35 0.232
1991 Chevrolet 2500 Pickup Truck	1.42 0.372	1.09 0.093	1.93 0.402	1.51 0.245	1.26 0.141	2.05 0.255	1.68 0.293	1.38 0.204	1.69 0.459
1993 Pontiac Bonneville Full-Size Passenger Car	1.35 0.420	1.14 0.206	1.97 0.249	1.25 0.166	1.24 0.133	1.44 0.269	1.21 0.240	1.44 0.112	1.69 0.373
1994 Ford Escort Wagon Compact Passenger Car	1.47 0.139	1.06 0.145	1.14 0.139	1.25 0.186	1.32 0.129	1.19 0.154	1.45 0.203	1.33 0.106	1.34 0.138
1995 Ford Aerostar Minivan	1.42 0.353	1.37 0.201	1.52 0.327	1.68 0.184	1.34 0.191	1.47 0.223	1.69 0.272	1.43 0.220	1.59 0.310
1997 Jeep Cherokee SUV	1.64 0.265	1.34 0.183	1.49 0.302	2.31 0.229	1.85 0.391	1.93 0.185	2.33 0.364	1.60 0.322	1.73 0.396
GRAND MEAN	1.46	1.21	1.56	1.59	1.36	1.57	1.64	1.40	1.57

 12" continuous
  12" and 24" alternating
  24" continuous

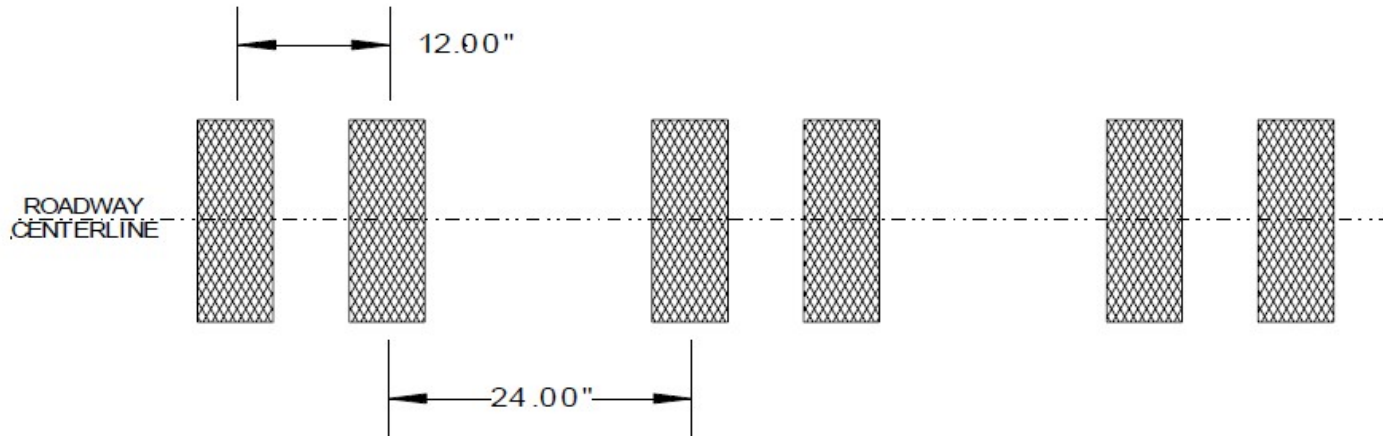
1999 Test Section

- Conclusions
 - Continuous 12”
 - Highest dB levels
 - 2nd highest vibration
 - Alternating 12” and 24”
 - 2nd Highest dB levels
 - Highest vibration
- Field test
 - 12” long, continuous 12” center
 - 12” long, alternating 12” and 24”

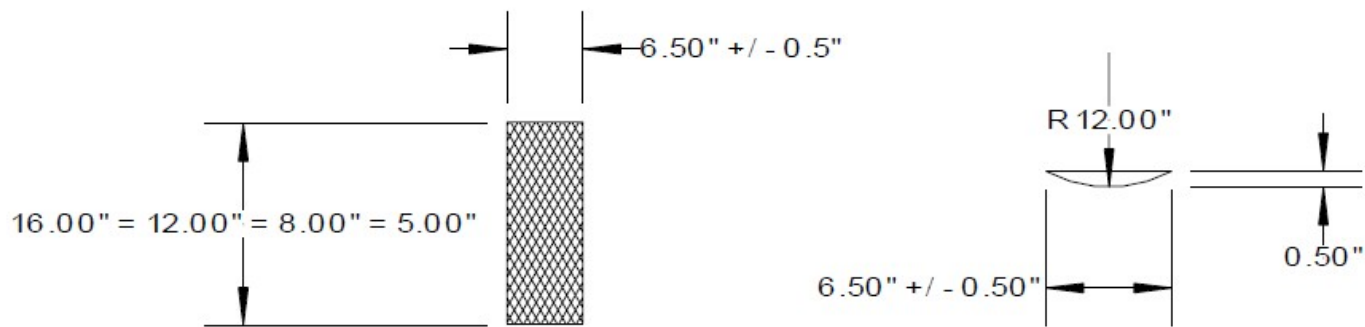
First Field Section

- 14 mile stretch on US-50
 - 7 miles continuous 12"
 - 7 miles alternating 12" and 24"
- Constructed June 2003

First Field Section



**ALTERNATING 12 INCH AND 24 INCH ON CENTER
MILLED CENTERLINE RUMBLE STRIP PATTERN**



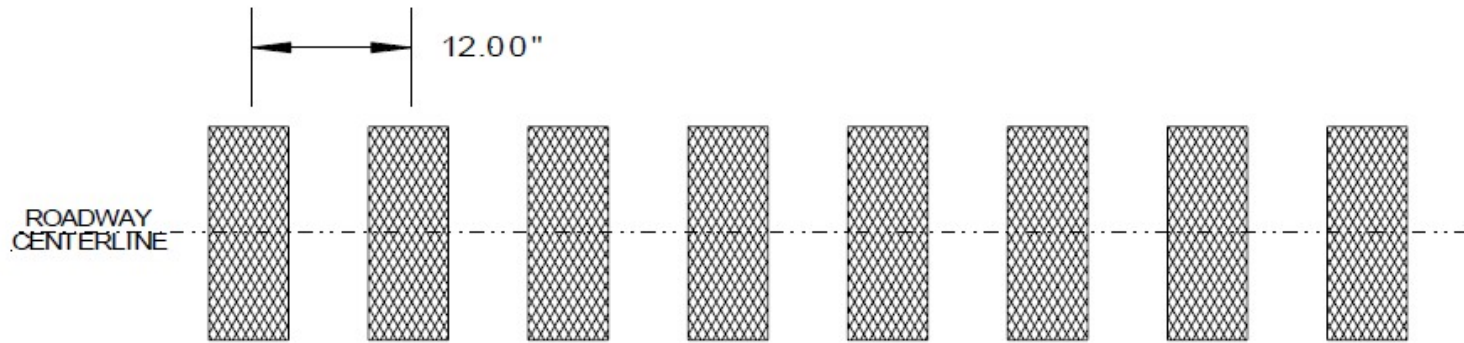
TOP VIEW

SIDE VIEW

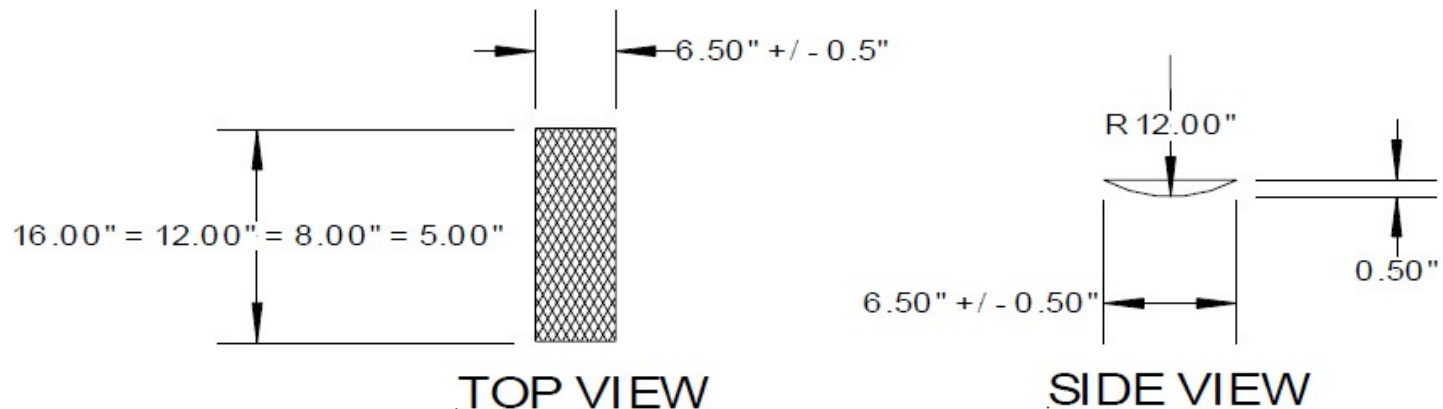
RUMBLE STRIP DETAIL

** NOT DRAWN
TO SCALE

First Field Section



**CONTINUOUS 12 INCH ON CENTER
MILLED CENTERLINE RUMBLE STRIP PATTERN**



RUMBLE STRIP DETAIL

** NOT DRAWN
TO SCALE

Public Survey

- 36% felt both patterns were loud enough
- 34% felt continuous was louder
- 34% felt both patterns had good vibration
- 36% felt continuous pattern had better vibration
- 38% recommended continuous
- 96% felt they would reduce accidents



8THS

To read length in centimeters, use the final zero after the index line. To read length in millimeters, include the final zero.

LINEAR METRIC UNITS AND SYMBOLS

1000 millimeters (mm) = 1 meter (m)

1000 meters (m) = 1 kilometer (km)

100 centimeters (cm) = 1 meter (m)

1000 meters (m) = 1 kilometer (km)

CONVERSIONS

1 inch = 2.54 centimeters

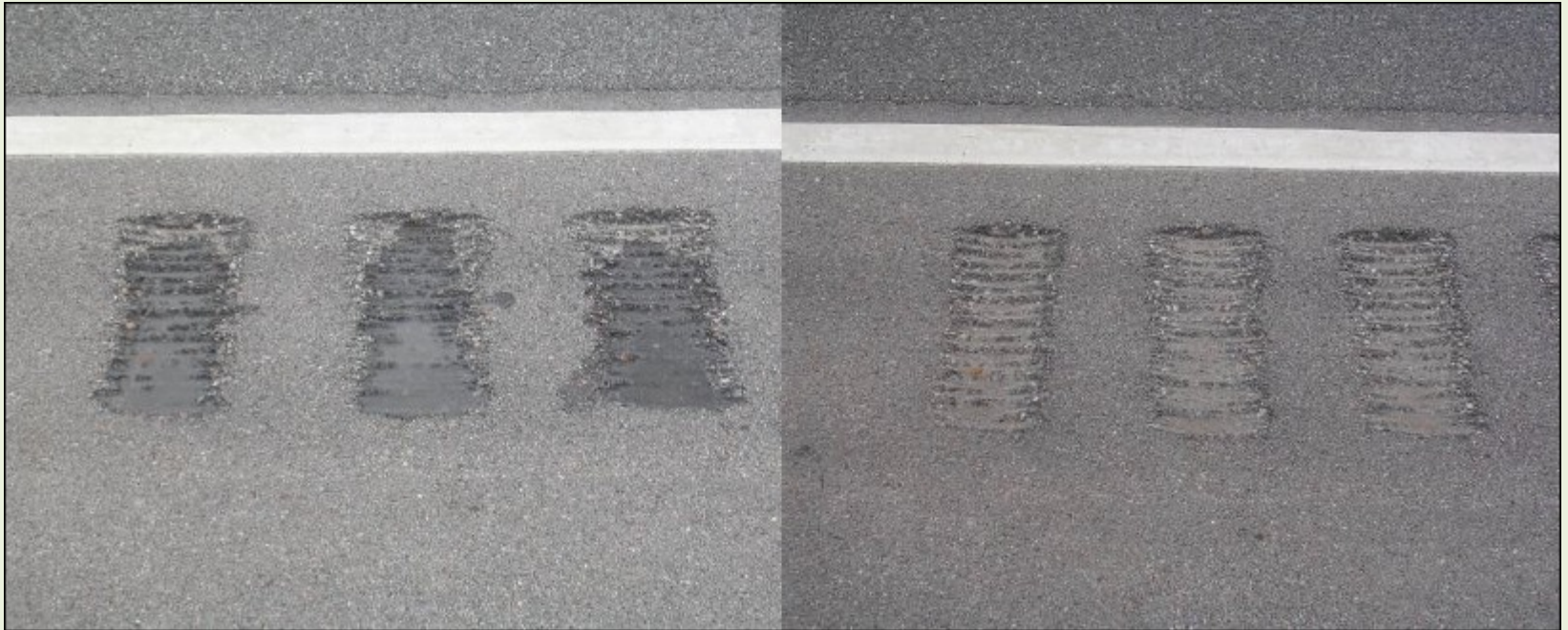
1 foot = 0.3048 meters

1 yard = 0.9144 meters

1 mile = 1.609344 kilometers

10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390 400 410





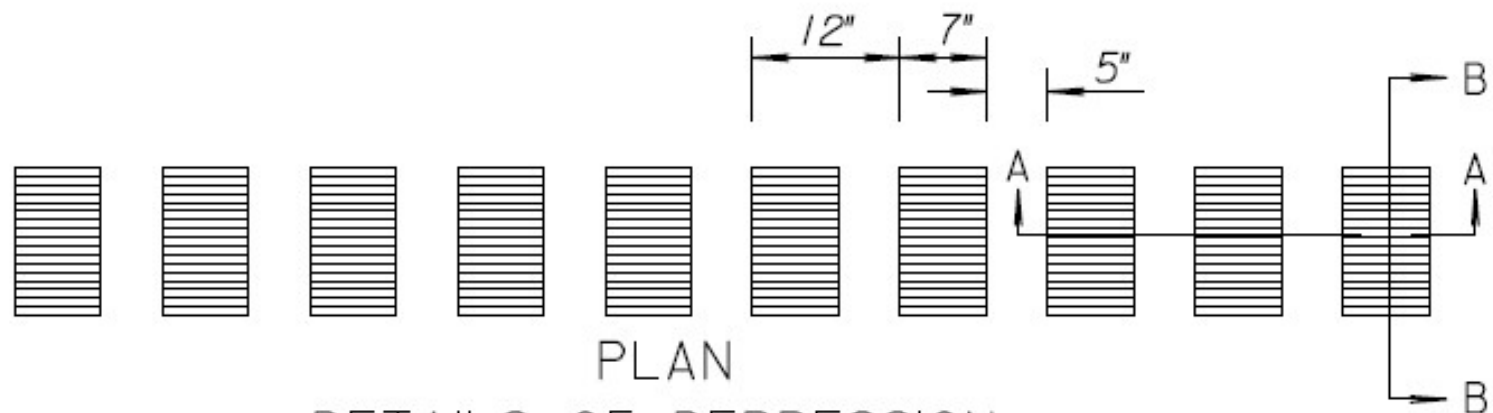
Current Policy

- Issued July 2007
 - HMA Pavements Only
 - Two-lane Rural Highways
 - Class B
 - Class C
 - District Engineer

INTERSECTION WITH LEFT TURN LANES

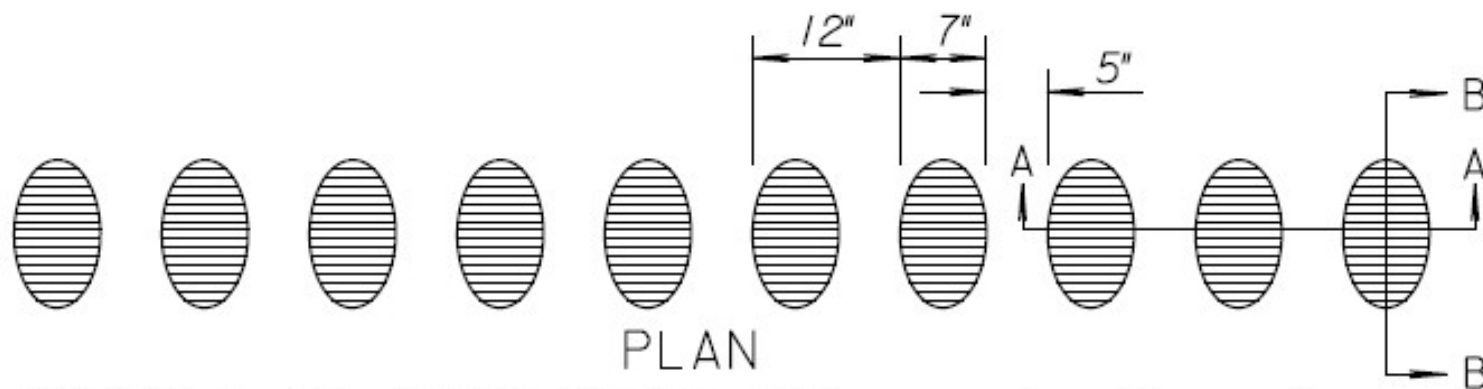


ELEVATION



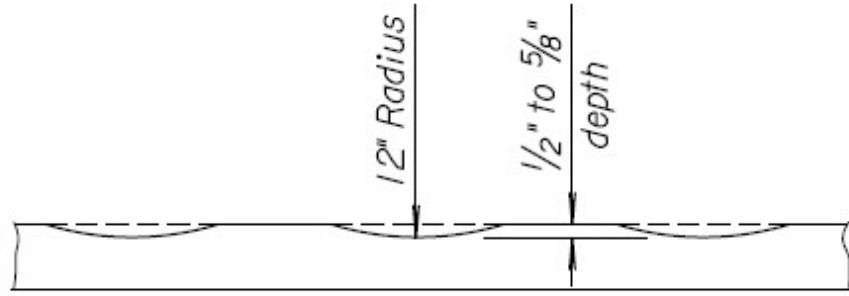
PLAN

DETAILS OF DEPRESSION

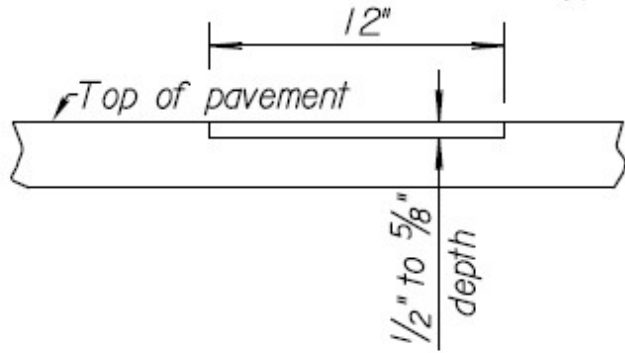


PLAN

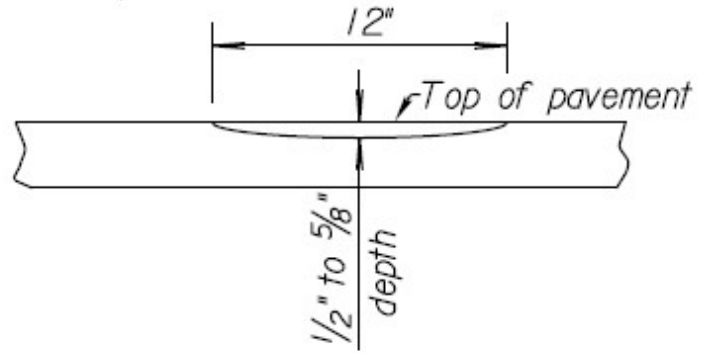
DETAILS OF DEPRESSION (Alternate Shape)



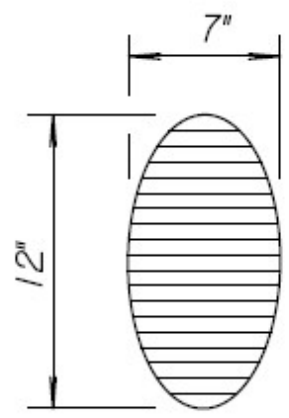
SECTION A-A
(Typical for both shapes)



SECTION B-B



SECTION B-B (ALT. SHAPE)



NO.	DATE	REVISIONS	BY	APP'D
2	11-15-10	Revised notes	S.W.K.	J.O.B.
1	9-24-09	Rem € rumble strips thru sdrd.	S.W.K.	J.O.B.

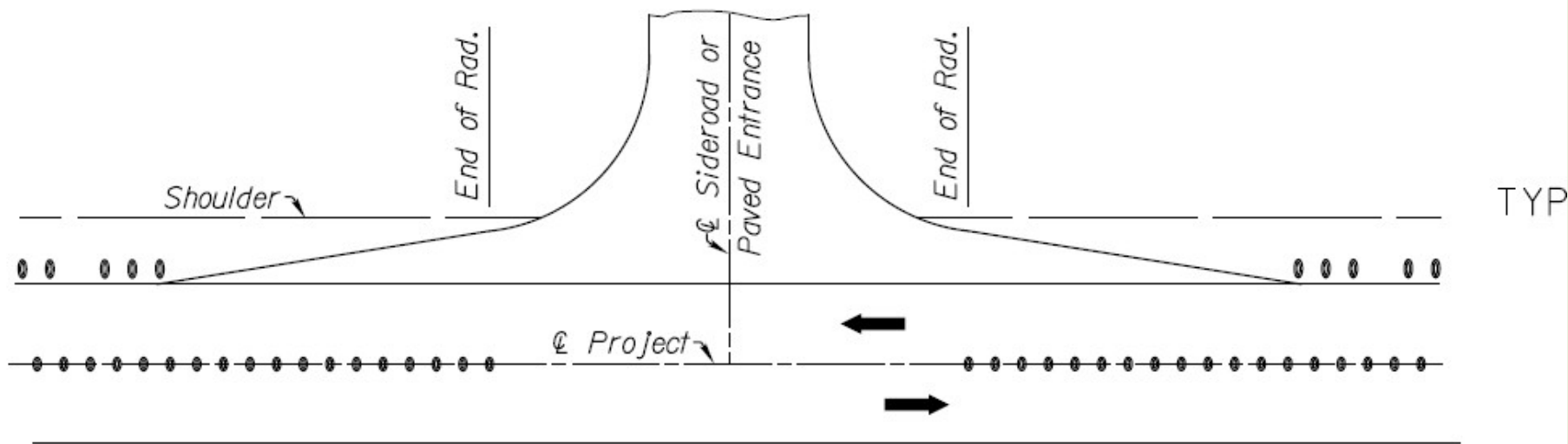
KANSAS DEPARTMENT OF TRANSPORTATION

MILLED RUMBLE STRIPS (CENTERLINE)

RD706

FHWA APPROVAL	5-26-11	APP'D.	James O. Brewer
DESIGNED	DETAILED	QUANTITIES	TRACED
DESIGN CK.	DETAIL CK.	QUAN. CK.	TRACE CK. King

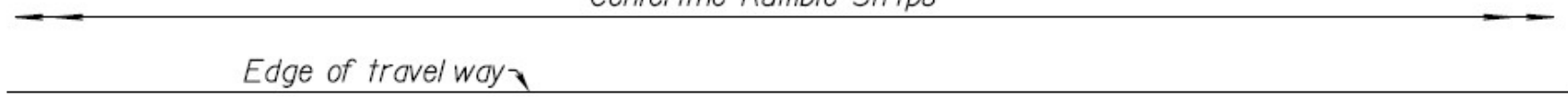
...T. RUMBLE STRIP SHAPE



TYP

TYPICAL MINOR SIDEROAD OR ENTRANCE

Centerline Rumble Strips



Traffic ←



Traffic →

Edge of travel way ↘

Current Policy

- Since Fall of 2007
 - 130 projects
 - Approximately 1,350 miles of rumble strips
- One Bid Item by Station
 - Cost – average \$16 per STA
 - Varies range \$4 to \$48

Accident Study

- US-50
 - Rectangular section, 12'
 - Before period – January 1998 to June 2003
 - After period – July 2003 to December 2007
- US-40
 - Football shaped section, 12'
 - Before period – January 1998 to May 2005
 - After period – June 2005 to December 2007

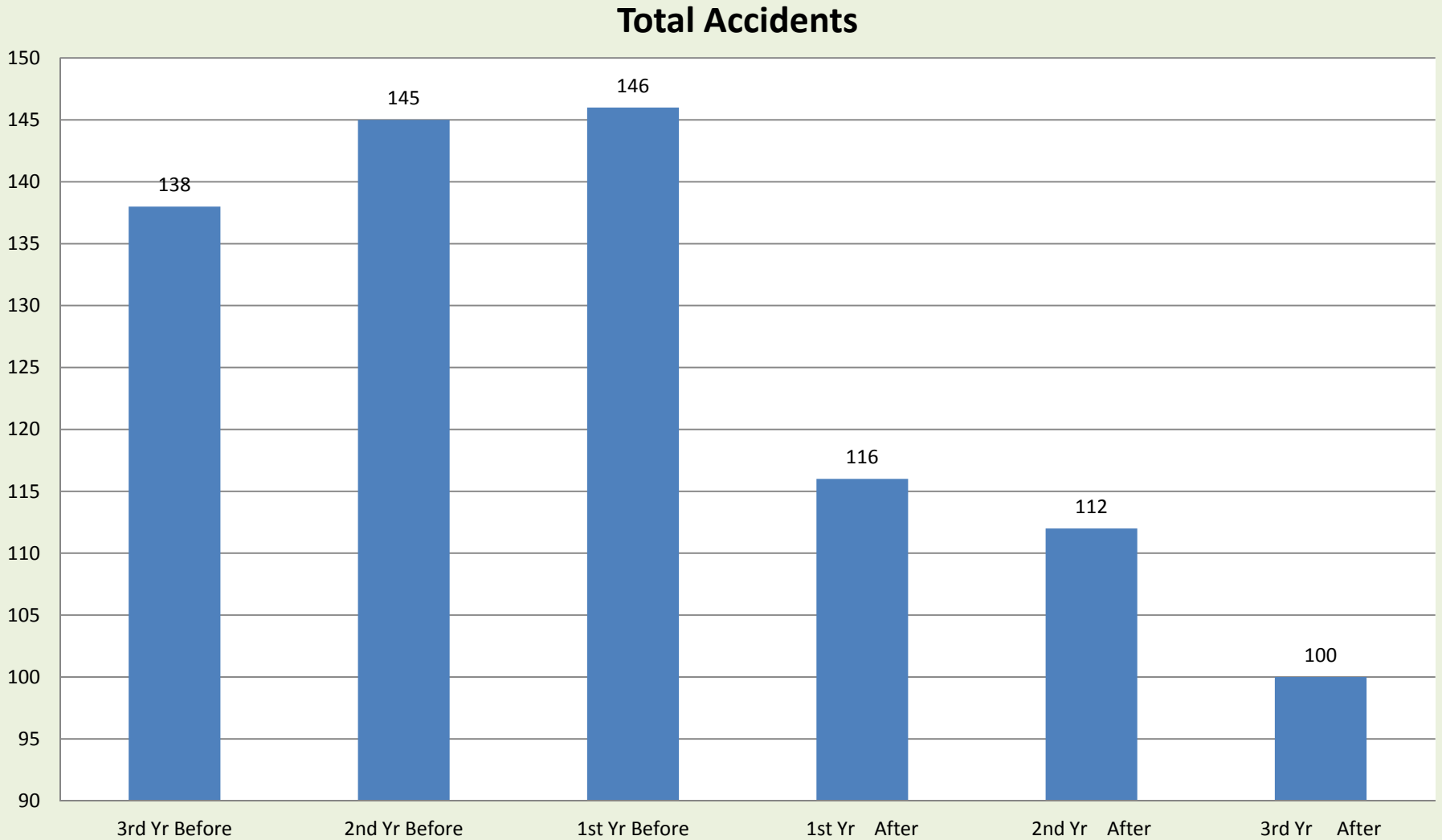
Accident Study

	Section	Length (miles)	Installation	Years		# Acc Before	# Acc After	Rate Before	Rate After	Reduction
				Before	After					
Total	A on US-50	15.18	June, 2003	5.5	4.5	75	38	0.90	0.56	38.07%
	B on US-40	10.76	May, 2005	7.42	2.58	205	32	2.57	1.15	55.11%
	Overall	25.94				280	70	3.47	1.71	50.69%
HO + OPP SW	Section	Length (miles)	Installation	Years		# Acc Before	# Acc After	Rate Before	Rate After	Reduction
				Before	After					
	A on US-50	15.18	June, 2003	5.5	4.5	6	1	0.07	0.01	79.63%
	B on US-40	10.76	May, 2005	7.42	2.58	9	0	0.11	0.00	100.00%
Overall	25.94				15	1	0.18	0.01	92.07%	

Accident Study

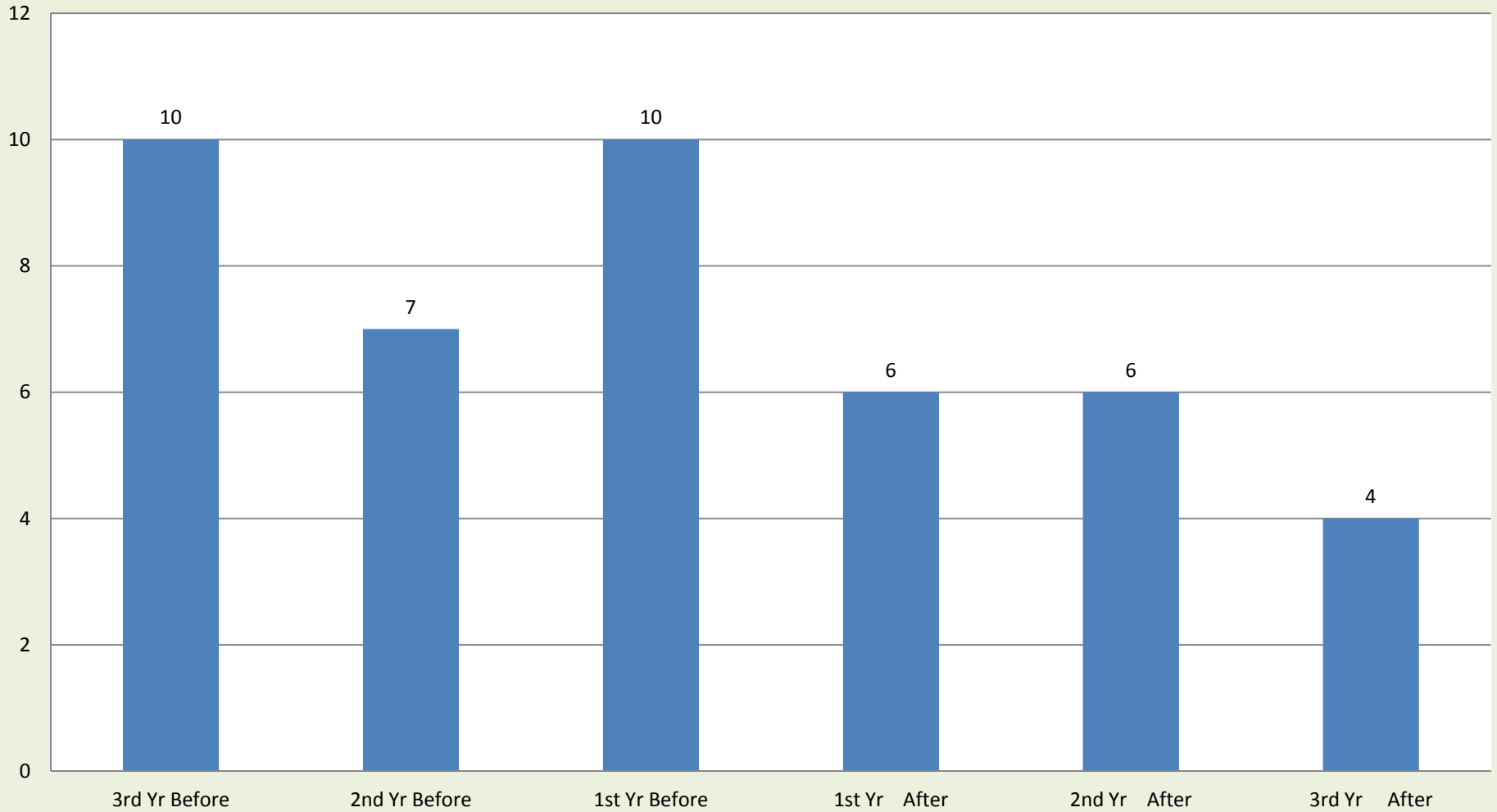
Section	AADT Before	AADT After	Counted Accidents During After Period with Treatment		Expected Accidents During After Period in case of no Treatment		Reduction	
			Total	HO + OPP SW	Total (σ)	HO + OPP SW (σ)	Total (95% CI)	HO + OPP SW (95% CI)
A on US-50	5524	5036	38	1	53.93 (6.23)	4.22 (1.74)	30.47% (27.93% - 33.01%)	79.75% (68.03% - 91.46%)
B on US-40	4255	4465	52	0	83.83 (5.86)	3.65 (1.22)	62.01% (61.44% - 62.58%)	100.00%
Overall			90	1	137.76 (8.55)	8.68 (2.21)	49.38% (47.58% - 51.18%)	89.18% (66.70% - 111.67%)

Total Accidents



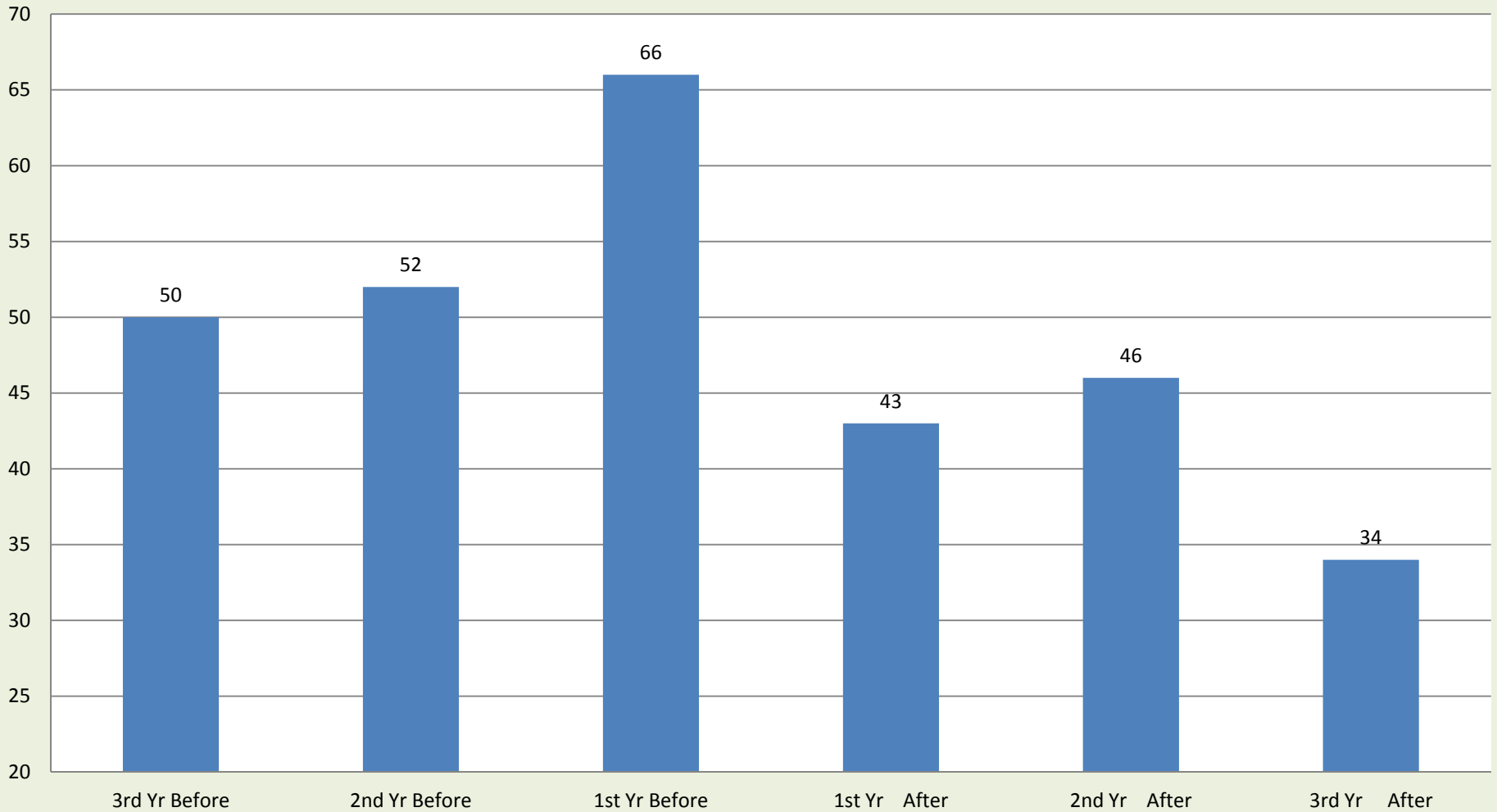
Total Accidents

Fatality Accidents



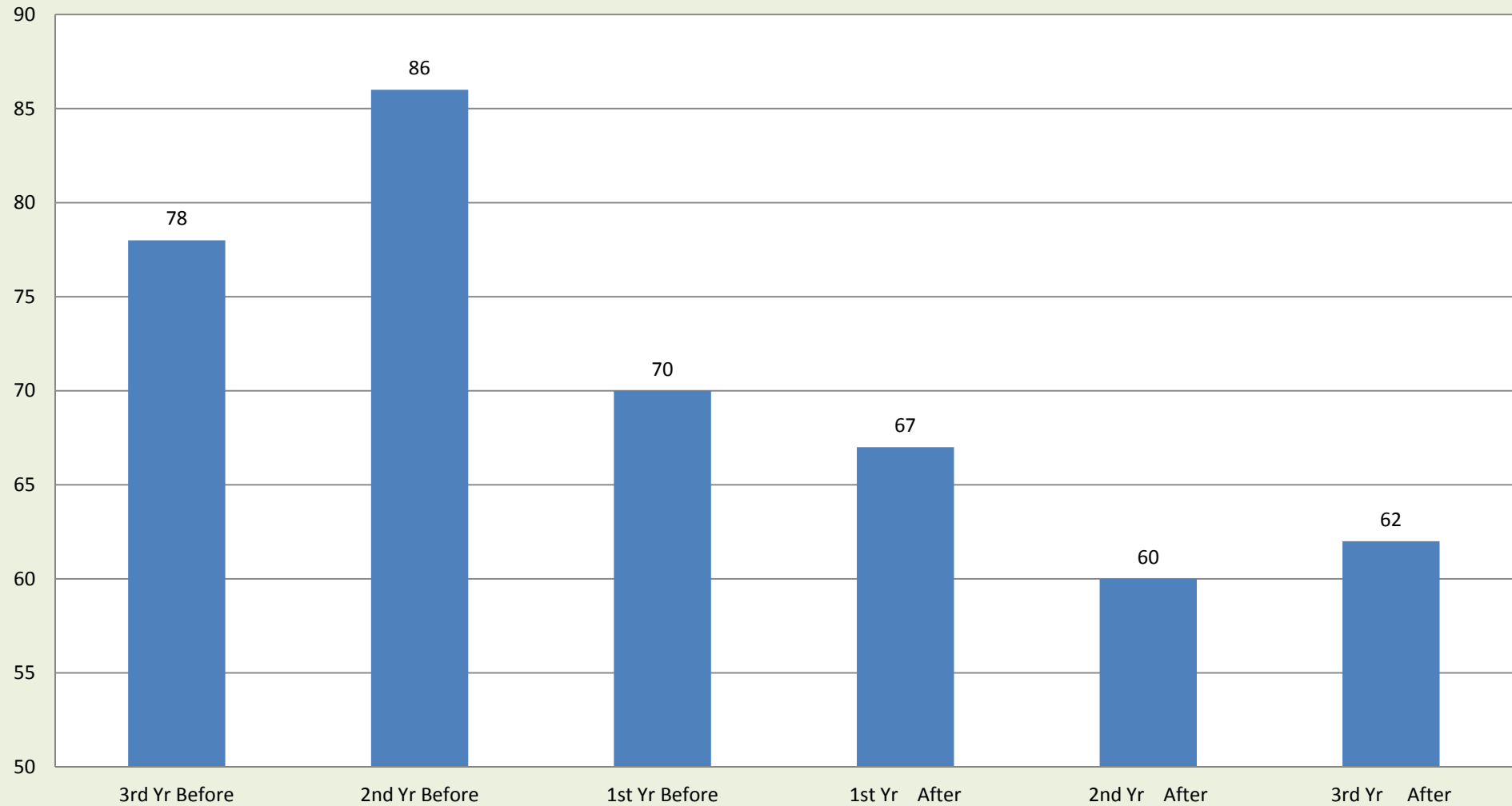
Total Accidents

Injury Accidents



Total Accidents

Property Damage Only



















Questions?

