

Engineering Countermeasures for Reducing Speeds: A Desktop Reference of Potential Effectiveness

May 2009

Countermeasure	Area	Road Environment	Reference # (Year)	Sample Size (# of Sites)	After Measurement	Average Daily Volumes		85 th Percentile Speeds			
						Before (veh)	After (veh)	Before (mph)	After (mph)	Change (mph)	%Change
GEOMETRIC FEATURES											
Speed Hump -rounded raised area across the road, typically 12 to 14 feet in length and 3 to 4 inches high	Urban	Local Street	1 (1999)	178		48 to 11544	46 to 11043	35 (4)	27 (4)	-8 (3)	-22% (9%)
		Local Street	2 (2005)	7		400 to 4362	401 to 3384	32 (3)	26 (2)	-6 (2)	-20% (6%)
		Local Street	4 (2000)	4		475 to 1506	433 to 1343	36 (2)	31 (2)	-5 (1)	-15% (3%)
Speed Cushion -speed hump typically 6 to 7 feet wide that allows most emergency vehicles to straddle the hump.	Urban		1 (1999)	1		3323	2321	35 (-)	28 (-)	-7 (-)	-20% (-)
			2 (2005)	2		1042 to 1556	693 to 1563	31 to 37	26 to 30	-5 to -7	-16% to 19%
Speed Table -a long speed hump typically 22 feet in length with a flat section in the middle and ramps on the ends	Urban		1 (1999)	72		198 to 14500	242 to 14400	37 (3)	31 (3)	-6 (3)	-16% (9%)
	Rural	Small town	3 (2008)	2	12 month	1480		33 (1)	29 (2)	-4 (1)	-14% (3%)
		Residential Streets	18 (2003)	19		198 to 2102	364 to 2061	38 (n/a)	29 (n/a)	-9 (n/a)	-24% (n/a)
Raised Intersection -a raised plateau, with ramps on all approaches, where roads intersect	Urban		1 (1999)	2				37 (1)	38 (4)	1 (4)	3% (11%)
	Urban	Local Street	5 (2004)	1				30 (-)	30 (-)	0 (-)	0% (-)
Choker -mid-block curb extensions that narrow a road by extending the sidewalk or widening the planting strip	Urban		1 (1999)	4		770 to 6150	331 to 5040	34 (2)	30 (2)	-4 (1)	-3% (3%)
	Urban	Residential Area	51 (1977)	6				30 (4) 95%tile	29 (3) 95%tile	-1 (2) 95%tile	-3% (7%) 95%tile

Countermeasure	Area	Road Environment	Reference # (Year)	Sample Size (# of Sites)	After Measurement	Average Daily Volumes		85 th Percentile Speeds			
						Before (veh)	After (veh)	Before (mph)	After (mph)	Change (mph)	%Change
Neckdown -intersection curb extensions that narrow a road by extending the width of a sidewalk	Urban		1 (1999)	3		2800 to 8110	4660 to 5660	29 (9)	30 (3)	1 (7)	3% (30%)
	Urban	Local Street	5 (2004)	2				28 (3)	31 (4)	3 (7)	12% (27%)
Chicane -curb extensions that alternate from one side of the street to the other, forming S-shaped curves.	Urban		1 (1999)	2		1380 to 3200	790 to 2400	33 (4)	27 (4)	-6 (1)	-16% (4%)
			4 (2000)	4	at least 4 years	1380 to 1965	790 to 1993	31 (6)	22 (4)	-9 (4)	-29% (8%)
	Urban	School Zone	42 (1998)	1		8000		31 (-)	28 (-)	-3 (-)	-10% (-)
Lateral Shift -curb extension that shifts travel lanes to one side of road for extended distance and then back to the other side	Urban	Local Street	5 (2004)	1				36 (-)	33 (-)	-3 (-)	-8% (-)
	Rural	At City Limits	19 (1999)	5				44 (4)	33 (4)	-11 (7)	-25% (9%)
Center Island -a raised island along the centerline of a street that narrows the travel lanes	Urban		1 (1999)	1		3500	2800	33 (-)	29 (-)	-4 (-)	-12% (-)
Traffic Circle -circular, raised island placed within the middle of an intersection	Urban		1 (1999)	45		240 to 10910	269 to 8280	34 (5)	30 (4)	-4 (3)	-11% (9%)
Roundabout -large, raised, circular islands at the middle of major intersections, around which all oncoming vehicles must travel until reaching their destination street, where they then turn off.		Transition from High to Low Speed	36 (2005)	1				48 (-)	28 (-)	-20 (-)	-42% (-)
	Suburban	Y Intersection of two-lane roads	37 (2005)	1				32 (-)	24 (-)	-8 (-)	-25% (-)
	Urban		38 (2004)	1				47 (-)	33 (-)	-14 (-)	-30% (-)
	Urban & Rural	Intersection entry	54 (2007)	55					20 (4)		
SURFACE TREATMENTS AND MARKINGS											
Transverse Rumble Strips -raised or grooved patterns installed on the roadway travel lane or shoulder pavements, perpendicular to the direction of travel.	Rural	Posted Speed Limit=70mph	17 (2007)	3	5 months					-0.6 (0.4)	
	Rural	Intersection	23 (2003)	11	At least 1 month					-1 to -2	

Countermeasure	Area	Road Environment	Reference # (Year)	Sample Size (# of Sites)	After Measurement	Average Daily Volumes		85 th Percentile Speeds			
						Before (veh)	After (veh)	Before (mph)	After (mph)	Change (mph)	%Change
Converging Chevron Marking Pattern -a type of transverse pavement markings forming chevron shape to create the illusion of traveling faster as well as the impression of narrower lanes.	Rural	Main Roads	3 (2008)	2	12 months	2300		36 (1)	33 (1)	-3 (2)	-7% (6%)
		Double S-Curve On A Two- Lane Roadway	7 (2006)	1	15 months			37 (-)	33 (-)	-4 (-)	-11% (-)
	Urban	Exit Ramps	12 (2003)	1	20 months			70 (-)	53 (-)	-17 (-)	-24% (-)
		Community Collector Street	13 (2001)	1	2 years			41 (-)	39 (-)	-2 (-)	-5% (-)
		Freeway-to-Freeway Connector Curve	48 (2008)	1	6 months	18000		53.4 (-)	52.8 (-)	-0.6 (-)	-1% (-)
Transverse Markings -a series of white lines placed across the center of the lane and spaced progressively closer to create the illusion of traveling faster	Rural	Horizontal Curves	20 (2005)	3	5 days			49 (3)	50 (3)	0.2 (1.7)	0.3% (3%)
	Rural	Interstate Work Zone	46 (2001)	1		18000		68 (-)	67 (-)	-1 (-)	-1% (-)
Optical Speed Bars -a series of white rectangular markings typically 1 foot wide placed just inside both edges of the lane and spaced progressively closer to create the illusion of traveling faster as well as the impression of narrower lane.	Rural	Main Roads	3 (2008)	1	12 months			46 (-)	45 (-)	-1 (-)	-2% (-)
	Rural	Main Roads	3 (2008)	2	3 months	1000		47 (8)	46 (-)	-1 (0)	-2% (0)
	Rural	Curve	11 (2004)	3				37 (6)	36 (10)	-1 (4)	-2% (8%)
	Rural	Two-Lane Highway; Tourist Traffic	45 (2009)	1	3 months			71 (-)	66 (-)	-5 (-)	-7% (-)
	Rural	Freeway Curves	53 (2008)	1	6 months	63,072	57,948	61 (-)	60 (-)	-1 (-)	-2% (-)
Speed Limit Pavement Legend	Rural	Main Roads	3 (2008)	4	12 months			34 (3)	33 (2)	-1 (1)	-1% (4%)
Enhanced Speed Limit Legend with Colored Surfacing	Rural	Main Roads	3 (2008)	3	12 months	1000		46 (6)	44 (6)	-2 (2)	-4% (4%)
In-Roadway Warning Lights	Urban	Residential Area; Pedestrian Crossing	15 (2000)	2	1 month	30,000		46 (0)	39 (1)	-7 (1)	-15% (1%)
		School Zone	33		1 year			58 (-)	53 (-)	-5 (-)	-9% (-)
	Urban	Central Business District; Pedestrian Crossing	34 (2004)	1	2 weeks	25,000		21 (-)	22 (-)	1 (-)	5% (-)
		Freeway Off-Ramp	39 (2008)	1	14 months			57 (-)	53 (-)	-4 (-)	-7% (-)
Delineator Post	Rural	Horizontal Curves	20 (2005)	3	5 days			49 (3)	50 (3)	0.5 (0.4)	1% (1%)

Countermeasure	Area	Road Environment	Reference # (Year)	Sample Size (# of Sites)	After Measurement	Average Daily Volumes		85 th Percentile Speeds			
						Before (veh)	After (veh)	Before (mph)	After (mph)	Change (mph)	%Change
"Slow" Pavement Legend	Rural	Main Roads	3 (2008)	3	9 months	2940		40 (6)	41 (8)	1 (2)	1% (4%)
	Suburban	Curve on Two-Lane Road	47 (1998)	1	2 weeks	5000		39 (-)	37 (-)	-2 (-)	-5% (-)
SIGNS											
Speed Feedback Sign -sign that dynamically displays speed of passing vehicles with the message "YOUR SPEED XX"	Rural	Main Roads	3 (2008)	1	3 months	2870		37 (-)	30 (-)	-7 (-)	-19% (-)
		15mph School Zone	8 (2002)	1				48 (-)	15 (-)	-33 (-)	-69% (-)
		School Zone	8 (2002)	1				32 (-)	25 (-)	-7 (-)	-22% (-)
		School Zone	14 (2005)	1	2 to 4 months			50 (-)	42 (-)	-8 (-)	-16% (-)
		Advance of School Zone	14 (2005)	2	2 to 4 months			57 (6)	56 (7)	-1 (1)	-2% (3%)
		Advance of Signalized Intersection	14 (2005)	2	2 to 4 months			57 (10)	56 (12)	-1 (2)	-3% (4%)
		Non-freeway	9 (2005)	20	6 to 39 months			35 (3)	32 (2)	-3 (2)	-7% (4%)
		Collector Street/Residential Cross Street	10 (2007)	6	3 years			37 (2)	33 (1)	-4 (2)	-11% (4%)
		School Zone	26 (2006)	8	6 months			25 (2)	24 (2)	-1 (2)	-5% (7%)
	Rural	Work Zone on Interstate Highway	27 (2001)	3	5 weeks	38000		65 (2)	60 (2)	-5 (1)	-8% (1%)
		School Zone	28 (2003)	2	2 months	8000 to 9200		30 (5)	28 (4)	-2 (1)	-7% (1%)
		School Zone	28 (2003)	2	2 months	11800 to 29200		43 (1)	34 (0)	-9 (1)	-22% (1%)
		Two-Lane Collector Arterial, Near to School Zone	29 (2005)	4	7 months	1486 to 2794	1270 to 2533	34 (2)	32 (3)	-2 (1)	-3% (4%)
	Rural	Interstate Highway Work Zone	32 (2006)	1	1 week			65 (-)	63 (-)	-2 (-)	-3% (-)

Countermeasure	Area	Road Environment	Reference # (Year)	Sample Size (# of Sites)	After Measurement	Average Daily Volumes		85 th Percentile Speeds			
						Before (veh)	After (veh)	Before (mph)	After (mph)	Change (mph)	%Change
Speed Activated Warning Sign -sign that displays warning messages to speeding drivers		Posted Speed Limit=50/55mph	17 (2007)	4	at least 3 months					-1.4 (0.1)	
		Work Zone at State Route	25 (2007)	3		122 to 250				-1 to -6.5	
		Multilane US Highway	25 (2007)	1						-1.6 to -4.7	
		Multilane Interstate	25 (2007)	2						-3.0 to -11.2	
	Urban	U.S. Highway Work Zone	32 (2006)	1	1 week			67 (-) PC; 65 (-) Truck	64 (-) PC; 63 (-) Truck	-3 (-) PC; -2 (-) Truck	-4% (-) PC; -3% (-) Truck
	Urban & Rural	Work Zone	35 (2007)	2				54 (4)	49 (6)	-5 (3)	-10% (5%)
	Rural	Four-Lane Divided Highway	43 (1999)	1		7000		73 (-)	69 (-)	-4 (-)	-5% (-)
		Curve on Interstate Freeway	44 (2003)	1		65000		63 (-)	62 (-)	-1 (-)	-2% (-)
Speed Activated Speed Limit Reminder Sign		Major Road	6 (2005)	1				42 (-)	37 (-)	-5 (-)	-12% (-)
		School Zone	24 (2001)	1	2 months			43 (-)	37 (-)	-6 (-)	-14% (-)
Variable Speed Limit Sign	Rural	Finland, weather-controlled	31 (1999)	3						-4.7 to -8	
	Rural	Freeway	40 (2005)	2				82 (1)	77 (6)	-5 (5)	-6% (6%)
Lower Speed Limit by 15+ mi/h	Urban & Rural	2 lane roads	21 (1997)	9	12-24 months			49 (5)	49 (4)	-0.1 (1)	-0.1% (3%)
Lower Speed Limit by 10 mi/h	Urban & Rural	2 & 4 lane roads	21 (1997)	34	12-24 months			50 (5)	50 (5)	-0.1 (1)	-0.6% (2%)
Lower Speed Limit by 5 mi/h	Urban & Rural	2 lane roads	21 (1997)	14	12-24 months			51 (6)	50 (6)	-0.3 (1)	-0.1% (2%)
Red Border Speed Limit Sign	Rural	Two-Lane highway	30 (2007)	3	8 to 14 months					-3 (4)	
One-Direction Large Arrow (W1-6) sign	Rural	Horizontal Curves	20 (2005)	1	5 days			47 (-)	47 (-)	0 (-)	0% (-)

Countermeasure	Area	Road Environment	Reference # (Year)	Sample Size (# of Sites)	After Measurement	Average Daily Volumes		85 th Percentile Speeds			
						Before (veh)	After (veh)	Before (mph)	After (mph)	Change (mph)	%Change
Add Flashers to Existing Curve Warning Sign	Rural	Horizontal Curves	20 (2005)	2	5 days			51 (2)	52 (3)	1 (1)	1% (1%)
Add Flags to Existing Curve Warning Sign	Rural	Horizontal Curves	20 (2005)	3	5 days			49 (3)	49 (3)	-0.3 (1.3)	-0.6% (3%)
Combinational Horizontal Alignment/Advisory Speed Sign	Rural	Horizontal Curves	20 (2005)	3	5 days			49 (3)	50 (2)	0.2 (1)	0.4% (2%)
Chevron Sign	Rural	Horizontal Curves	20 (2005)	1	5 days			52 (-)	52 (-)	0 (-)	0% (-)
NARROWING											
Add Shoulder Markings to narrow lane	Rural	Two-Lane Road Through Small Town	3 (2008)	2	12 months			33 (2)	33 (1)	0.5 (1)	2% (2%)
	Urban	Freeway Exit Ramp	49 (2000)	4	2 weeks			38 (10)	37 (9)	-1 (1)	-2% (2%)
Add Center Line and Edge Line	Rural	Main Roads	3 (2008)	2	12 months			34 (1)	35 (1)	1 (1)	2% (2%)
	Urban	Residential Area	50 (1984)	2	2 weeks			34 (2) Mean	34 (1) Mean	0 (0) Mean	1% (1%) Mean speed
	Rural	Two-Lane Road Day	52 (2006)	3				63 (2)	64 (3)	1 (4)	2% (7%)
	Rural	Two-Lane Road Night	52 (2006)	3				66 (4)	65 (3)	-1 (0)	-1% (0)
Longitudinal Rumble Strips -raised or grooved patterns installed on both inside edges of normal travel lane to narrow effective width	Rural	Rural High Speed Intersections on Two-lane Roadways	16 (2008)	9	at least 3 months					-4.5 (0.25)	
Road Diet -restripe road to reduce the number of lanes from 4 to 3	Urban	Arterial road	41 (1999)	1		24,000		51 (-)	47 (-)	-4 (-)	-8% (-)
Tubular Chanelizers -three foot high tubes used to create island in center of road	Rural	Main Roads	3 (2008)	3	12 months	2060		40 (5)	39 (4)	-1 (1)	-2% (2%)

Countermeasure	Area	Road Environment	Reference # (Year)	Sample Size (# of Sites)	After Measurement	Average Daily Volumes		85 th Percentile Speeds			
						Before (veh)	After (veh)	Before (mph)	After (mph)	Change (mph)	%Change
ACCESS CONTROLS											
Half Closure -Physical blockage of one direction of traffic for a short distance on a two-way street	Urban		1 (1999)	11		220 to 9540	151 to 9180	30 (4)	24 (5)	-6 (4)	-20% (12%)
Diagonal Diverter -a barrier placed diagonally across a four-legged intersection, preventing through movement	Urban		1 (1999)	7		474 to 2057	177 to 574	28 (5)	27 (5)	-1 (5)	-5% (17%)
Full Closure -physical street closure resulting in a dead-end	Urban		1 (1999)	2		1540 to 1980	850 to 1080	18 (3)	15 (3)	-3 (0)	-17% (3%)
COMBINATION MEASURES											
Gateway Treatment -the combined use of signs, textured pavements, name plates, monuments, landscaping, and/or others placed at the entrance to a neighborhood that helps to communicate a sense of neighborhood identity	Rural	Main Roads	3 (2008)	3	12 months			46 (6)	44 (6)	-2 (2)	-5% (4%)
	Urban		5 (2004)	1	9 months			30 (-)	28 (-)	-2 (-)	-7% (-)
Speed Hump + Speed Table	Urban		1 (1999)	4				36 (3)	29 (2)	-7 (4)	-17% (9%)
Speed Hump + Choker	Urban		1 (1999)	2		2456 to 3685	2593 to 2931	38 (2)	25 (0)	-13 (2)	-33% (3%)
Speed Table + Choker	Urban		1 (1999)	3				33 (1)	29 (1)	-4 (1)	-12% (3%)
Speed Table + Center Island	Urban		1 (1999)	2		6500 to 8440	6400 to 6780	37 (1)	29 (1)	-8 (3)	-22% (6%)
Half Closure + Median Barrier (-Median barriers are raised islands located along the centerline of a street and continuing through an intersection so as to block through movement at a cross street.)	Urban		1 (1999)	2		10160 to 10320	1120 to 2120	38 (2)	32 (4)	-6 (3)	-17% (8%)

Countermeasure	Area	Road Environment	Reference # (Year)	Sample Size (# of Sites)	After Measurement	Average Daily Volumes		85 th Percentile Speeds			
						Before (veh)	After (veh)	Before (mph)	After (mph)	Change (mph)	%Change
Transverse Bar + Speed Feedback Sign	Rural	Main Roads	3 (2008)	3	12 months	830 to 1680		47 (6)	43 (8)	-4 (3)	-8% (8%)
Speed Hump + Traffic Circle + Gateway Treatment			2 (2005)	2		2017 to 4213	1857 to 4635	32 (1)	25 (3)	-7 (2)	-22% (6%)
Textured Pavement + Neckdown + Pavement Marking			2 (2005)			3722 to 3792	3603	31 (-)	31 (-)	0 (-)	0% (-)
Edge Marking + Speed Limit Marking	Rural	Main Roads	3 (2008)	4	12 months			34 (3)	33 (2)	-1 (1)	-1% (4%)
Rubber Pedestrian Island + In-Roadway Yield to Pedestrian Crossing Sign (R1-6) (-Removable rubber curbing used to create island and concentrate pedestrian crossings at crosswalk.)	Rural Resort Area	High pedestrian crossing	22 (2002)	2	2 weeks			44 (2)	38 (1)	-6 (3)	-14% (6%)

Notes:

- 1) Reference table only includes U.S. studies, except where no U.S. studies on a treatment exist, then international studies are used.
- 2) Measures within parentheses in the "85th Speeds" columns represent the standard deviations from the average values.

References:

1. Ewing, Reid (1999), "Traffic Calming: State of the Practice", (FHWA-RD-99-135), ISBN 0-935403-36-1, ITE/FHWA. <http://www.ite.org/traffic/tcstate.asp#tcsop>
2. Arlington County, VA (2005), "Effectiveness of Traffic Calming Measures in Arlington County", Table 1. <http://www.arlingtonva.us/Departments/EnvironmentalServices/dot/planning/ntc/study/Study05.aspx>
3. FHWA (2008), "Traffic Calming on Main Roads Through Rural Communities", FHWA Publication No.: FHWA-HRT-08-067. <http://www.tfhrc.gov/safety/pubs/08067/index.htm>
4. Marek, John C. and Walgren, Shauna (2000), "Mid-Block Speed Control: Chicanes and Speed Humps", City of Seattle, WA. <http://www.seattle.gov/Transportation/docs/ITerevfin.pdf>
5. Arup Services New York Ltd (2004), "Downtown Brooklyn Traffic Calming Project", New York City Department of Transportation. http://home2.nyc.gov/html/dot/downloads/pdf/brooklyn_2.pdf
6. UK DFT (1999), "Traffic calming on major roads: a traffic calming scheme at Costessey, Norfolk", Traffic Advisory Leaflet 14/99, Department for Transport, UK. http://www.dft.gov.uk/adobepdf/165240/244921/244924/TAL_14-991.pdf

7. ATSSA (2006), "Low Cost Local Roads Safety Solutions", American Traffic Safety services Association (ATSSA), Fredericksburg, VA. <http://www.cmap.illinois.gov/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=14624>
8. Fors, C. (2002), "Controlling Community Speeds with Radar Displays", In Police and Security News, Vol. 18, No. 5.
9. Ray Godinez (2005), "Stationary Radar Sign Program, Transportation Department", City of Bellevue, Washington State. http://www.ci.bellevue.wa.us/pdf/Transportation/2005_Radar_Report.pdf
10. City of Englewood (2007), "Traffic Calming - Recent Accomplishments", Englewood, Colorado. <http://www.englewoodgov.org/Index.aspx?page=649> (accessed 2008).
11. Bryan J. Katz (2004), "Pavement Markings for Speed Reduction", Traffic Control Devices Pooled Fund Study (TPF-5-065). http://www.pooledfund.org/documents/TPF-5_065/speed_reduction.pdf
12. Drakopoulos, A. and Vergou, G. (2003), "Evaluation of the Converging Chevron Pavement Marking Pattern at one Wisconsin Location", AAA Foundation for Traffic Safety, Washington, D.C. <http://www.aaafoundation.org/pdf/chevrons.pdf>
13. Corkle, J., Giese, J.L., and Marti, M.M. (2001), "Investigating the Effectiveness of Traffic Calming Strategies on Driver Behavior, Traffic Flow and Speed", MN/RC-2002-02. Minnesota Department of Transportation, St. Paul, Minnesota. <http://www.lrrb.org/PDF/200202.pdf>
14. Ullman, G.L. and Rose, E.R. (2005), "Evaluation of Dynamic Speed Display Signs", Transportation Research Record 1918, TRB, pp. 92-97. <http://trb.metapress.com/content/3028rr500u381630>
15. Prevedouros, Panos (2000), "Evaluation of in-pavement Flashing Lights on a Six-lane Arterial Pedestrian Crossing", University of Hawaii at Manoa, Honolulu, HI. http://www.xwalk.com/images/Hawaii_Study.pdf
16. Vanasse Hangen Brustlin, Inc. (2008), "Two Low-Cost Safety Concepts for Two-Way STOP-Controlled, Rural Intersections on High-Speed Two Lane, Two-Way Roadways", FHWA Publication No. FHWA-HRT-08-063, Federal Highway Administration, Washington, D.C. <http://www.tfrc.gov/safety/pubs/08063/index.htm>
17. Kittelson & Associates, Inc., etc. (2007), "Guidelines for Selection of Speed Reduction Treatments at High-Speed Intersections", NCHRP web-only document 124, National Cooperative Highway Research Program, TRB, Washington, D.C. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_613.pdf
18. Bretherton Jr., W. M. (2003), "Do Speed Tables Improve Safety?", Paper presented at ITE 2003 Annual meeting, Seattle, WA. <http://www.ite.org/traffic/documents/AB03H5601.pdf>
19. Berger, Wolfgang J. and Martin Linauer (1999), "Speed Reduction At City Limits By Using Raised Traffic Islands", Proceedings from the 2nd KFB-Research Conference – Urban Transport Systems, Lund, Sweden. <http://www.lth.se/fileadmin/tft/dok/KFBkonf/6Bergerlinauer.PDF>.
20. Vest, Adam and Nikiforos Stamatiadis (2005), "Use Of Warning Signs and Markings to Reduce Speeds on Curves". The 3rd International Symposium on Highway Geometric Design, Chicago Illinois, United States. <http://pubsindex.trb.org/document/view/default.asp?lbid=760638>
21. Parker, Martin. R., Jr.(1997), "Effects of Raising and Lowering Speed Limits on Selected Roadway Sections", FHWA Publication No. FHWA-RD-97-084. <http://www.dot.state.oh.us/districts/D01/PlanningPrograms/trafficstudies/SpeedZones/Documents/2hj01!.pdf>
22. Kamyab, Ali, Steve Andrie, and Dennis Kroeger (2002), "Methods to Reduce Traffic Speed in High Pedestrian Areas", Minnesota Department of Transportation Report No. MN/RC – 2002-18. <http://www.lrrb.org/PDF/200218.pdf>
23. Fitzpatrick, Kay, Marcus A. Brewer, and Angelia H. Parham (2003), "Left-Turn and In-Lane Rumble Strip Treatments for Rural Intersections", Texas Department of Transportation Report No. FHWA/TX-04/0-4278-2. <http://tti.tamu.edu/documents/0-4278-2.pdf>
24. Taft, Russ (2001), "School Radar Speed Display Sign Effectiveness Report", San José Department of Transportation. <http://www.forteltraffic.com/uploaded/sanjosereport.pdf>

25. Mattox, James H., III, Wayne A. Sarasua, Jennifer H. Ogle, Ryan T. Eckenrode, and Anne Dunning (2007), "Development and Evaluation of a Speed-Activated Sign to Reduce Speeds in Work Zones", Transportation Research Board 2007 Annual Meeting CD-ROM.
http://www.workzonesafety.org/files/documents/database_documents/07-0015.pdf
26. Kelly Grant Ash (2006), "Increasing Speed Limit Compliance in Reduced-Speed School Zones", Master of Science thesis submitted to Brigham Young University. <http://contentdm.lib.byu.edu/ETD/image/etd1271.pdf>
27. Pesti, Geza, Patrick T. McCoy (2001), "Long-Term Effectiveness of Speed Monitoring Displays in Work Zones on Rural Interstate Highways", Transportation Research Board 2001 Annual Meeting. http://www.workzonesafety.org/files/documents/database_documents/00573.pdf
28. Garden Grove, City of. (2003). "Speed Radar Feedback Sign Study", City of Garden Grove, California. <http://www.forteltraffic.com/needs/download.php?id=205>
29. Chang, Kevin N., Matthew Nolan, and Nancy L. Nihan (2005), "Measuring Neighborhood Traffic Safety Benefits by Using Real-Time Driver Feedback Technology", Transportation Research Record No. 1922, pp. 44–51. <http://trb.metapress.com/content/10j8t56r40433j05>
30. Hawkins, H. Gene, Jr., Matthew A. Sneed, and Cameron L. Williams (2007), "Evaluation of Traffic Control Devices: Third-Year Activities", Texas Department of Transportation, Report No. FHWA/TX-07/0-4701-3. <http://tti.tamu.edu/documents/0-4701-3.pdf>
31. PIRKKO RÄMÄ (1999), "Effects of Weather-Controlled Variable Speed Limits and Warning Signs on Driver Behavior", Transportation Research Record 1689, pp. 53-59. <http://trb.metapress.com/content/t071x61532h5683r>
32. Brewer, Marcus A., Geza Pesti, and William Schneider IV (2006), "Improving Compliance with Work Zone Speed Limits Effectiveness of Selected Devices", Transportation Research Record No. 1948, pp. 67–76. <http://trb.metapress.com/content/q88303792um87557>
33. DeRobertis, Michelle and Raymond D. Chong, School Zone Improvements, Cupertino, CA.
http://www.walkinginfo.org/pedsafe/casestudy.cfm?CM_NUM=44&CS_NUM=27 (accessed May 2009)
34. Kannel, E.J. and W. Jansen (2004), "In-Pavement Pedestrian Flasher Evaluation: Cedar Rapids, Iowa", CTRE Project 03-145, Center for Transportation Research and Education, Ames, Iowa. http://www.intrans.iastate.edu/reports/ped_flasher.pdf
35. Sorrell, Mark T., Wayne A. Sarasua, William J. Davis, Jennifer H. Ogle, and Anne Dunning (2007), "Use of Radar Equipped Portable Changeable Message Sign to Reduce Vehicle Speed in South Carolina Work Zones", Transportation Research Board Annual Meeting CD-ROM.
https://www.workzonesafety.org/files/documents/database_documents/07-3159.pdf
36. Ritchie, Scott and Mark Lenters (2005), "High Speed Approaches At Roundabouts", Transportation Research Board National Roundabout Conference, Vail Colorado. <http://roadwaystandards.dot.wi.gov/standards/fdm/forms/11-26-030p01.pdf>
37. Waddell, Edmund and James Albertson (2005), "The Dimondale Mini: America's First Mini-Roundabout", Transportation Research Board National Roundabout Conference, Vail Colorado. http://onlinepubs.trb.org/Onlinepubs/circulars/ec083/28_Waddellpaper.pdf
38. Ariniello, Alex J.(2004), "Are Roundabouts Good for Business?", Transportation Research Board National Roundabout Conference, Vail Colorado.
<http://ci.golden.co.us/files/roundaboutpaper.pdf>
39. Reddy, Vivek, Tapan Datta, and Satya Pinapaka (2008), "Evaluation of Innovative Safety Treatments Volume 6: A Study of the Effectiveness of In-Roadway Lights", Florida Department of Transportation. <http://cdm266301.cdmhost.com/cgi-bin/showfile.exe?CISOROOT=/p266401coll4&CISOPTR=2489&filename=2490.pdf>
40. Ulfarsson, Gudmundur F., Venkataraman N. Shankar, and Patrick Vu (2005), "The Effect of Variable Message and Speed Limit Signs on Mean Speeds and Speed Deviations", International Journal of Vehicle Information and Communication Systems, Vol. 1, Nos. 1/2.
<http://www.inderscience.com/storage/f215111287310694.pdf>.
41. Skene, Michael (1999), "'Traffic Calming' On Arterial Roadways?", Institute of Transportation Engineers Compendium of Technical Papers.
<http://www.ite.org/traffic/documents/AHA99B08.pdf>

42. Macbeth, Andrew G. (1998), "Calming Arterials in Toronto", Institute of Transportation Engineers Compendium of Technical Papers. <http://www.ite.org/traffic/documents/AHA98C19.pdf>
43. Carlson, Paul J., Mike Fontaine, H. Gene Hawkins, Jr., Kimberly Murphy and Danny Brown (1999), "Evaluation of Speed Trailers at High-Speed Temporary Work Zones", Transportation Research Board 2000 Annual Meeting. https://tti.tamu.edu/publications/catalog/record_detail.htm?id=15302
44. Drakopoulos, Alex, Sharad Uprety and Georgia Vergou (2003), "I-43 Speed Warning Sign Evaluation", Wisconsin Department of Transportation Report. http://www.eng.mu.edu/~drakopoa/web_documents/I_43_sign/Fore_abstract.pdf
45. Latoski, Steven P.(2009), "Optical Speed Zone for Rural Two-Lane Highways", Institute of Transportation Engineers Journal, March 2009. <http://www.ite.org/membersonly/itejournal/pdf/2009/JB09CA30.pdf>
46. Meyer, Eric (2001), "A New Look at Optical Speed Bars", Institute of Transportation Engineers Journal, November 2001. <http://www.ite.org/membersonly/itejournal/pdf/2001/JB01KA44.pdf>
47. Retting, Richard A. and Charles M. Farmer (1998), "Use of Pavement Markings to Reduce Excessive Traffic Speeds on Hazardous Curves", Institute of Transportation Engineers Journal, September 1998. <http://www.ite.org/membersonly/itejournal/pdf/JIA98A30.pdf>
48. Voigt, Anthony P. and Shamanth P. Kuchangi (2008), "Evaluation Of Chevron Markings On Freeway-To Freeway Connector Ramps In Texas", Texas Department of Transportation Report No. FHWA/TX-08/0-4813-2. <http://tti.tamu.edu/documents/0-4813-2.pdf>
49. Retting, Richard A., Hugh W. McGee, and Charles M. Farmer (2000), "Influence of Experimental Pavement Markings on Urban Freeway Exit-Ramp Traffic Speeds", Transportation Research Record 1705 Paper No. 00-3272, pp. 116 – 121. <http://trb.metapress.com/content/j013k624063v38l8>
50. Lum, Harry S. (1984), "The Use of Road Markings to Narrow Lanes for Controlling Speed in Residential Areas", Institute of Transportation Engineers Journal, June 1984. <http://www.ite.org/traffic/documents/JFA84A50.pdf>
51. Marconi, William (1977), "Evaluation of Speed Control Measures in Residential Areas", Traffic Engineering, Institute of Transportation Engineers, March 1977. <http://www.ite.org/traffic/documents/JCA77A28.pdf>
52. Tsyganov, Alexei R., Randy B. Machemehl, Nicholas M. Warrenchuk, and Yue Wang (2006), "Before-After Comparison of Edgeline Effects on Rural Two-Lane Highways", Texas Department of Transportation Report No. FHWA/TX-07/0-5090-2. http://www.utexas.edu/research/ctr/pdf_reports/0_5090_2.pdf
53. Gates, Timothy J., Xiao Qin, and David A. Noyce (2008), "Effectiveness of Experimental Transverse-Bar Pavement Marking as Speed-Reduction Treatment on Freeway Curves", Transportation Research Record 2056, pp. 95–103. <http://trb.metapress.com/content/b01456n256661082>
54. Rodegerdts, Lee et al (2007), "Roundabouts in the United States", NCHRP Report 572, Transportation Research Board. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_572.pdf