

Alternative Methods of Temporary Traffic Control on Rural Highways

Melisa D. Finley, P.E.
Texas A&M Transportation Institute

July 19, 2016



Acknowledgements

- Researchers

- Nada Trout (TTI)
- Praprut Songchitruksa (TTI)
- Sandra Stone (TTI)
- Gerald Ullman (TTI)
- Eun Sug Park (TTI)
- Jacqueline Jenkins (CSU)
- Graduate students
- Undergraduate students

- Sponsors



Rural One-Lane, Two-Way Operations

- Must alternate one-way movement of two lanes
- Flaggers typically used to control traffic flow
- Advantages
 - Typically available
 - Least amount of setup/removal time
- Disadvantages
 - Vehicle-flagger conflicts
 - Flagger fatigue and stress
 - Additional trained personnel for rotation
 - Cannot work if flaggers unavailable



Research Objective

Identify and evaluate cost effective and safer alternatives to current temporary traffic control (TTC) methods used by state agency maintenance forces without significantly increasing



TTC Alternatives Evaluated

Automated Flagger Assistance Devices (AFADs)



Pilot Vehicle (PV)



Portable Traffic Signals (PTSs)



How Do Red/Yellow AFADs work?

Stop



Proceed



Transition



How Do Stop/Slow AFADs work?



Stop



Proceed

AFADs

- Flagger must operate and not leave unattended
- Advantages
 - Flaggers located off roadway
 - One flagger can operate
 - Easier to setup and deploy than PTSs
- Disadvantages
 - More expensive if two flaggers retained
 - May result in increased intrusions
 - Potential for device malfunction
 - Device maintenance
 - Training in setup/operation



PTSs

- Replace flaggers
- Advantages
 - Vehicle-flagger conflicts removed
 - Reduces flagger stress
 - Removes need for flagger rotation
 - Flaggers can preform other work duties
 - Less potential to be obscured by vehicles
 - Clearer signal indications



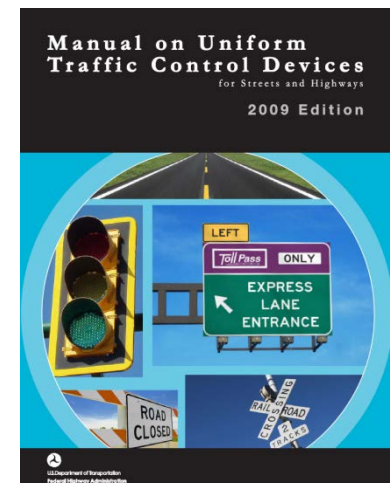
PTsS, cont.

- Disadvantages
 - More expensive
 - Work zone length limited to ≤ 1 mile
 - May result in increased intrusions
 - Longer setup time
 - Potential for device malfunction
 - Device maintenance
 - Training and expertise in setup/operation
 - May increase motorist delay



Pilot Vehicle with PTSs

- Advantages
 - Control operating speeds within work zone
 - Provide positive guidance regarding open travel lane
- 2009 MUTCD
 - Allows for a pilot vehicle to be used with PTS
 - Requires a flagger on each approach when a pilot vehicle is used



Overview of Field Studies

TTC	State	Sites	AADT (vpd)	Speed Limit (mph)	Lane Closure Length (ft)	# of Stop Periods	# of Vehicles
Flaggers	Ohio Texas	6 8	2390–5120 220–3650	55 45–70	830–3430 460–2570	913 294	3206 --
AFADs	Ohio Texas	6 16	520–1140 220–5100	55 35–70	700–1490 300–5280	733 1414	1442 --
PTSS	Ohio	3	7180–9230	55	1020–1630	497	5772
-- Unknown PV with PTSS	Texas	8	470–2800	55–70	2160–7480	661	3822

What We Did

- Observational data
 - Stop phase onset time
 - Arrival time of first vehicle
 - Proceed phase onset time
 - Total number of vehicles in queue
 - Whether or not the queue cleared
 - Total number of violations
 - Total number of vehicles through
- Documented site characteristics
- Surveyed ODOT & TxDOT personnel
- Motorist surveys in Texas only



Performance Measures

- Violation rates
- ODOT & TxDOT personnel opinions
- Implementation and use considerations
- Benefit-cost
- Motorist delay (simulation)
- Motorist comprehension










Motorist Surveys Main Findings

- Stop/slow AFADs
 - Current signs not well understood
 - Experimental symbol sign best understood
 - Need to require gate arm
- Red/yellow lens AFADs
 - Participants understood stop and proceed phases
 - Most participants did not understand difference between flashing and steady yellow signals
 - Gate arm critical to understanding



Texas Violation Rates

TTC	Supplemental Sign(s)	Gate Arm	Violations Per 100 Stop Cycles
Flagger	Not Applicable	Not Applicable	0.0
Red/Yellow Lens AFAD		Yes	2.2
Stop/Slow AFAD		No	6.7*
	 	Yes	4.0
	 	Yes	3.2
		Yes	3.8

Ohio Violation Rates

TTC	Violations Per 100 Stop Cycles
2 Flaggers	0.1
2 Flaggers with 2 Red/Yellow Lens AFADs	0.0
1 Flagger with 2 Red/Yellow Lens AFADs	0.5

***Significantly different from flagging operation.**

More Texas Violation Data

TTC	Violations Per 100 Stop Cycles		
	Followed Queue	Could Not See Queue	Total
PTSs With Flagger			14.9*
PTSs Without Flagger			13.9*
Total			14.4

***No significant difference between scenarios.**



More Texas Violation Data

TTC	Violations Per 100 Stop Cycles		
	Followed Queue	Could Not See Queue	Total
PTSs With Flagger	14.6	0.3	14.9*
PTSs Without Flagger	11.6	1.1	13.9*
Total	13.0	0.8	14.4

***No significant difference between scenarios.**



AFAD Lessons Learned

- Slight signal delay from remote to device
- Slower response to arriving vehicles
 - Adjusted minimum red times
 - May need shorter minimum green times
 - Leave direction 1 “green” if no traffic in direction 2
- STOP HERE ON RED signs mounted at 5 ft
 - Sometimes hard to setup due to terrain
 - Can block view of AFAD
 - Crew preferred sign on AFAD



PTS Lessons Learned

- Shoulder width and terrain limit locations where PTSs can be used
- May need to adjust green and/or red times in field
 - Requires training and some expertise



Pilot Vehicle Lessons Learned

- Need to select adequate green time to ensure all vehicles in queue clear
- Researchers developed quick and easy tool

Number of Commercial Vehicles	Number of Passenger Cars										
	0	1	2	3	4	5	6	7	8	9	10
0	4	6	8	10	12	14	16	18	20	22	24
1	9	11	13	15	17	19	21	23	25	27	29
2	14	16	18	20	22	24	26	28	30	32	34
3	19	21	23	25	27	29	31	33	35	37	39
4	24	26	28	30	32	34	36	38	40	42	44
5	29	31	33	35	37	39	41	43	45	47	49
6	34	36	38	40	42	44	46	48	50	52	54
7	39	41	43	45	47	49	51	53	55	57	59
8	44	46	48	50	52	54	56	58	60	62	64
9	49	51	53	55	57	59	61	63	65	67	69
10	54	56	58	60	62	64	66	68	70	72	74
<div><div></div> Use 30-second preset green time</div> <div><div></div> Use 60-second preset green time</div> <div><div></div> Use 90-second preset green time</div>											

Device Recommendations

- Use red/yellow lens AFADs and PTSs, when appropriate for conditions
 - Improves flagger safety
 - Increases work crew productivity
 - Does not significantly increase motorist delay
- Pilot vehicles with PTSs should be allowed
 - No need for flagger
- Traditional flagging should still be used where these devices are not suitable





Device Recommendations, cont.

- AFADs best suited for...
 - Short-term stationary operations lasting a few hours to 1 day
 - Narrow roadways with limited to no shoulders
- PTSs best suited for...
 - Activities that last at least half a day
 - Nighttime only work
 - Multiple day work
 - Higher volume roadway with shoulders and relatively flat side slopes

Report Information

- TxDOT Project 0-6407 (Flaggers & AFADs)
 - <http://tti.tamu.edu/documents/0-6407-1.pdf>
 - TRB Journal No. 2337, pp. 1-8
- TxDOT Project 9-1001-14 (PTSs & PVs)
 - <http://tti.tamu.edu/documents/9-1001-14-1.pdf>
- ODOT Project 134846 (Flaggers, AFADs, & PTSs)
 - <http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/reportsandplans/Pages/MaintenanceReports.aspx>

Contact Information

Melisa D. Finley, P.E.
TTI

Research Engineer
979-845-7596
m-finley@tti.tamu.edu

