

A Summary of the Use of Warrants for the Installation of Left-Turn Phasing at Signalized Intersections

by Nazir Lalani, Daniel Cronin, David Hattan, and Terence Searls

Members of the Colorado/Wyoming Section of the Institute of Transportation Engineers believed that a need existed to document current techniques being used by state and local agencies to determine when a left-turn phase should be installed at signalized intersections. A technical committee (composed of the authors) was formed to investigate this subject. No financial resources were available to undertake extensive new independent research. The committee wanted to assemble information on the subject from Institute members and publicize the information collected. The committee did not assume that at the end of its deliberations a particular technique would be recommended. The committee believed that the information collected would prove useful to traffic engineers evaluating their own agency's methods or establishing a new method for their particular agency. The committee also hoped the information collected could be used for future research by a national ITE committee or by the Federal Highway Administration to establish nationally recommended techniques.

Objectives

The objectives of the study, as identified by the committee, were to

1. Conduct a questionnaire-type survey of Institute members working for state and local agencies to determine techniques in current use by the agencies.
2. Summarize the responses from each agency as briefly and clearly as possible, and assemble comprehensive bibliographic information on this subject.

3. Draw reasonable conclusions from agency responses and other information made available to the committee.

Survey Methodology

The committee sent 1200 questionnaires to members of the Institute of Transportation Engineers identified as working for state and local agencies. Members in the United States, Canada, Australia, Europe, Africa, the Middle East, and Asia were included. Approximately 300 questionnaires were returned. The committee did not expect 100% return as they anticipated that many questionnaire recipients worked for the same agencies. Full details of each technique and comprehensive bibliography are available in the committee's full report.¹ This study was done in

conjunction with a study on the use of techniques for establishing left-turn phase change intervals.²

Results of the Study

Analysis of Agencies Currently Using Warrants/Techniques

To determine how many agencies were currently using a warrant or technique for left-turn phasing, the questionnaire asked, "Does your agency use warrants or techniques for installation of left-turn phase?"

One-hundred and sixty four respondents said yes, 50 said no, and 4 had no response.

The committee also analyzed all the responses (regardless of whether they contained useful information) to obtain a geographical breakdown (Tables 1 & 2).

Table 1. Number of Responses by State

State	Responses (No.)	State	Responses (No.)	State	Responses (No.)
Alabama	5	Louisiana	8	New York	8
Arizona	7	Massachusetts	2	Ohio	10
California	59	Maryland	3	Oklahoma	3
Colorado	7	Maine	2	Oregon	9
D.C.	1	Michigan	10	Pennsylvania	5
Florida	19	Minnesota	2	South Carolina	3
Georgia	6	Missouri	4	South Dakota	2
Iowa	3	Mississippi	2	Tennessee	9
Idaho	3	North Carolina	4	Texas	11
Illinois	7	North Dakota	2	Utah	3
Indiana	1	Nebraska	3	Virginia	5
Kansas	1	New Jersey	10	Vermont	1
Kentucky	2	Nevada	3	Washington	18
				Wyoming	2

Summary of Current Warrants

To determine details of warrants or techniques in current use by agencies that determine when installation of left-turn phasing was justified at a signalized intersection, the question was asked, "If you use left-turn phase warrants, are they based on delay, accidents, turning movement volume, or other?"

The responses to these questions are summarized in Table 3. Engineers interested in the detailed responses should refer to the full report.¹

Opinions on a National Technique

One of the questions on the survey form asked, "Do you feel that a nationally accepted warrant for left-turn

phases should be provided by ITE or the *Manual on Uniform Traffic Control Devices*?"

One-hundred and thirty-seven respondents were in favor of establishing a national warrant; 38 were against the establishment of a national warrant. Forty-three respondents were in favor of guidelines with provisions for variations in local conditions, engineering judgment, coordination systems, rural conditions, buses, and trucks.

Recommendations

The committee recommended that the findings summarized in the report be used by the Institute of Transportation Engineers and the National Committee on Uniform Traffic Control Devices for establishing nationally recommended techniques to determine when left-turn phasing is needed at signalized intersections.

Members interested in the Colorado/Wyoming Section's full reports^{1,2} should contact City of Lakewood, Traffic Engineering, 445 S. Allison Parkway, Lake-

wood, Colorado 80226-3105. A \$5.00 charge covers the cost of printing and mailing each Colorado/Wyoming Technical Committee Report. Checks should be made payable to ITE-Colorado/Wyoming Section.

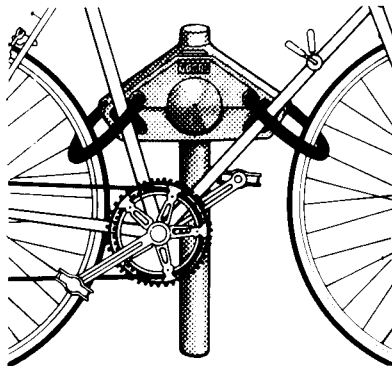
References

1. Lalani, Nazir; Cronin, Daniel; Hattan, David; et al. *A Study of the Use of Warrants for the Installation of Left-Turn Phasing at Signalized Intersections*. Colorado/Wyoming Section Technical Report, March, 1985.
2. Lalani, Nazir; Cronin, Daniel; Hattan, David; et al. *A Study of the Use of Techniques for Establishing Left-Turn Phase Change Intervals*. Colorado/Wyoming Section Technical Committee Report, March 1985.
3. Transportation Research Board. *Interim Materials on Highway Capacity*. Circular 212. Washington, D.C.: Transportation Research Board, January 1980.
4. *Traffic Manual*. State of California, Department of Transportation, pp. 9-15.
5. *The Canadian Manual on Uniform Traffic Control Devices*.
6. *Manual of Uniform Traffic Control Devices*. Province of Ontario, Ministry of Transportation and Communications of Ontario, February 1982, pp. B4-2, B4-5.
7. *Technical Notes*. 82-1 to 82-5. New York State, Department of Transportation, October 1982.
8. Leisch, Jack E. "Capacity Analysis Techniques for Design of Signal Intersections." *Public Roads*, Vol. 34, No. 9, 10. August 1967, October 1967.
9. Institute of Transportation Engineers. *Left-Turn Signal Warrants*. Technical Report 76-1. Wash-

Table 2. Foreign Responses

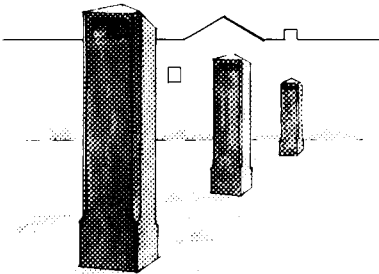
Country	Responses
Canada	14
China	1
South Africa	2

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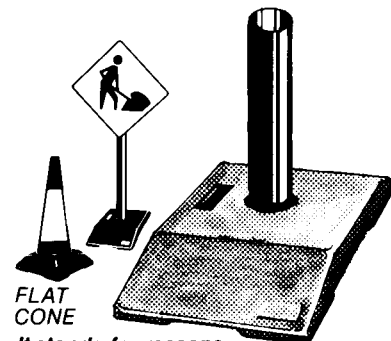
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Table 3. The Most Widely Used Techniques for Warranting Left-Turn Phasing at Signalized Intersections

Type of Warrant	Criteria	Agencies Using Warrant
Warrants Based on Accidents		
Accidents	3-5 Left-turn accidents/year	85
Warrants Based on Volumes		
Cross product of left turn \times opposing	2 lane exceeds 30,000-50,000 4 lane exceeds 50,000-100,000	43
Minimum left-turn hourly volumes	Exceeds 50-100 vehicles/hour	32
Minimum left-turn volume per cycle	Exceeds 2/cycle	26
Average daily or peak hour left-turn volume	Exceeds 10% of through volume	4
Level of service/capacity analysis	Soap, webster, critical lane	26
Left-turn check in TRB 212 ³	V_L exceeds 1200 G/C- V_O	12
Warrants Based on Delay/Queues		
Left-turn vehicle delay	Exceeds 2 vehicles/hour	13
Left-turn vehicle delay	Exceeds 35 seconds/cycle	5
Vehicle queue	More than 10% left at end of through phase	6
Vehicle delay	Exceeds 2-3 cycles	3
Left-turn storage	Exceeded by left-turn demand	2
Other Warrants		
Caltrans ⁴	Combination of accidents, delay volume, and speed criteria	20
Geometric design	Sight distance inadequate	16
Signal system	Progressive movement/adjacent intersection phasing	10
Number of opposing lanes	Exceeds 2	5
Gap analysis	—	2
Traffic conflicts	Exceeds 10-14/hour	4
Blanket policy	At all intersections with separate left-turn lanes	2
Street classifications	At all arterial/arterial, arterial/collector, and collector/collector intersections	3
Approach speed	Of opposing traffic exceeds 45 mph	11
Number of left-turn lanes	At all double left-turn lanes	3
Canadian MUTCD ⁵	(See reference for full details)	1
MUTCD of Province of Ontario ⁶	(See reference for full details)	4
New York State DOT policy ⁷	(See reference for full details)	1
Jack Leisch ⁸	Chart 17 (See reference for full details)	3
ITE Technical Committee Report 76-1 ⁹	(See reference for full details)	1
Tanner's curve ¹⁰	(See reference for full details)	2
Political	—	6
Public demand	—	4

ington, DC: Institute of Transportation Engineers, January 1978.

10. Tanner, J. C. "A Problem of Interface Between Two Queues." *Biometrika* Vol. 40, 1953. ■

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