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Simplified spot speed studies

Spot speed studies are used primarily to determine the distribution of traffic speeds, or vehicle speed percentiles, at a specific location.

These data help traffic engineers determine and/or evaluate traffic operations and traffic control practices at specific locations; establish design elements for roadways, pedestrian walkways, and bikeways; assess roadway safety questions; and make other traffic safety-related analyses.

Editor's note

This article is the first of five summaries of traffic studies described in the Handbook of Simplified Practice for Traffic Studies: (1) spot speeds, (2) traffic volumes, (3) sight distances, (4) crash analyses, and (5) school zone programs. The handbook was developed by CTRE and funded by the Iowa Highway Research Board (TR-455).

The handbook describes straightforward traffic-study procedures to help local agencies "get their arms" around specific traffic-related questions or potential problems. Data collected from these studies can be critical to decision making and can help agencies communicate more effectively with community members and local officials.

All procedures outlined in the handbook and described below follow national standards.

Rules of thumb

For spot speed studies, a sample size of at least 50 and preferably 100 vehicles should be obtained. (Using multiples of 100 for the sample size simplifies calculations.)

Data for weekday speeds should be not be collected on Mondays or Fridays because of potential differences in traffic patterns on those days (unless, of course, an agency wants to conduct a spot speed study during a special event or other activity occurring on either Monday or Friday).

The site to be observed should be documented with an accurate sketch (see figures 1 and 2), and local law enforcement and other officials should be contacted if staff will be on location collecting data or installing equipment.

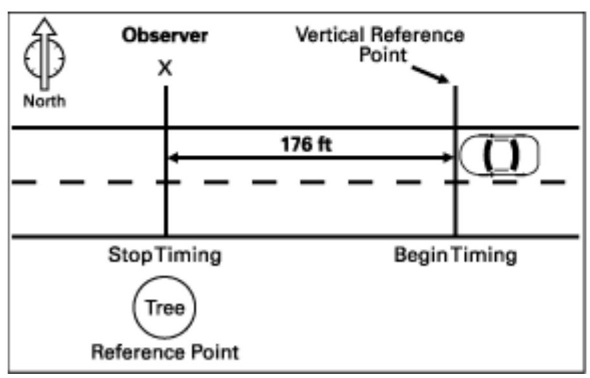

Figure 1. Example stopwatch spot speed study layout

Three spot speed study methods

Spot speed data can be gathered by any of three methods:

- stopwatch (least expensive)
- radar meter
- pneumatic road tubes (most expensive)

Stopwatch method

This method consists of timing vehicles with a hand-held stop watch as they travel between two predetermined reference points that are a specific distance apart. Using the distance between reference points and the recorded times, staff can calculate each vehicle's speed.

Calculating miles per hour is easier if the following recommended distances between reference points are used: If the average speed is below 25 mph, 88 feet; 25–40 mph, 176 feet; above 40 mph, 264 feet.
The stop watch method is the quickest and easiest but also the least accurate data collection method. Speeds must be calculated manually, and staff must be physically present to collect data.

Timers will need two stopwatches (one for backup), manual data collection forms (samples are included in handbook), measuring tape, two brightly colored reference posts, and a hardhat and safety vest.

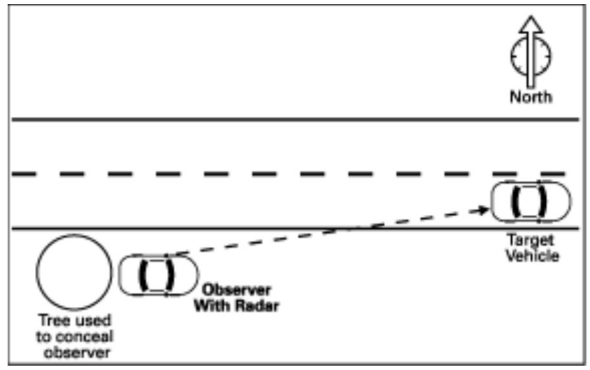

Figure 2. Example radar meter spot speed study layout

Staff should select the appropriate time of day for collecting data. For analyzing peak traffic flows, of course, speeds should be measured during peak traffic times. For assessing general speed trends or setting speed limits, off-peak measurements are more appropriate.

The reference posts should be set up according to the layout sketch. Staff need to select an observation point, according to the layout sketch, that provides a clear view of the reference posts and traffic.

Radar meter method

This method uses a radar meter that can be hand-held or mounted on a vehicle or tripod. The meter is easily operated by one person and automatically displays vehicle speed. A staff member simply pulls the trigger or points the meter at a vehicle and, as the meter displays the vehicle's speed, records the speed on the data collection sheet.

Agency staff must be physically on site to collect data. They will need a radar meter, backup batteries, a tripod (optional), manual data collection forms (again, sample forms are included in the handbook), and a hardhat and safety vest.

Again, staff should select the appropriate time of day for collecting data. They will also need to determine a strategy for targeting vehicles randomly (for example, every fifth vehicle).

The traffic observation location should be out of sight of motorists; if drivers see the radar meter, they may slow down, skewing study results.

Pneumatic road tube method

This method is normally used for more extensive, long-term data collection. Pneumatic tubes are placed in the travel lanes, attached to the pavement, and connected to recorders on the side of the road. As vehicles pass over the tubes, the recorders gather vehicle data that is used to calculate vehicle speeds. The automatic recorders can collect large amounts of data, which can be downloaded to a disk or computer.

For this type of study, agency staff do not have to be on location during data collection.

However, the pneumatic equipment is more expensive and the setup more extensive.

The recorders cannot automatically collect vehicle classification data, so that information, if needed, has to be collected by other means.

Most jurisdictions require assistance from the Iowa DOT or from a consulting firm to use this method.

Traffic speed percentiles

Two important vehicle speed percentiles calculated from spot speed study data sets are the 50th and the 85th percentiles.

The 50th percentile is the median speed of vehicles at the study location (the observed data set). That is, half of the vehicles observed are going faster than the 50th percentile speed, and half are going slower.

The 85th percentile represents the speed at or below which 85 percent of the observed motorists are traveling. It is normally considered to be the highest safe speed for a roadway section, and speed limits are generally set using the 85th percentile speed.

Calculating traffic speed percentiles

A convenient tool for determining traffic speed percentiles is a frequency distribution table. See the following example:

Table 1. Frequency Distribution Table

Speed (mph)	Frequency of Vehicles	Cumulative Frequency	Cumulative Percent	Percentile
15	1	1	1%	
18	2	3	3%	
21	6	9	9%	
24	12	21	21%	
27	13	23	23%	
				50th
30	20	54	54%	
33	18	72	72%	
				85th
36	14	86	86%	
39	6	92	92%	
42	6	98	98%	
45	1	99	99%	
45	1	99	99%	

“Frequency” is the number of vehicles recorded at each speed during the observation period. “Cumulative frequency” is a running total of vehicles. “Cumulative percent” is the cumulative frequency divided by total number of vehicles observed.

In our example, the cumulative frequency and cumulative percent are the same because the observed data set was 100. (As mentioned earlier, sample sizes in multiples of 100 are recommended.)

Note that the 50th percentile falls somewhere between 27 and 30 mph, and the 85th percentile falls between 33 and 36 mph. By interpolating between 27 and 30 mph, the exact 50th percentile speed is calculated to be 29.6 mph; between 33 and 36, the exact 85th percentile speed is 35.8 mph.

For more information

The *Handbook of Simplified Practice for Traffic Studies* includes sample data collection forms, information about contracting for spot speed studies, and additional study details.

You can also contact Duane Smith, LTAP director, 515-294-8103, desmith@iastate.edu.