Narrow Residential Streets: Do They Really Slow Down Speeds?

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Introduction

Transportation planners and traffic engineers are often asked to consider designing narrow residential streets or narrowing existing wide residential streets as a measure to reduce speeds. Only one of a litany of traffic calming measures, narrowing streets is almost taken for granted to be an effective method of slowing traffic. In addition to literally reducing the curb-to-curb width through design or retrofit, there are several common ways to physically narrow sections of streets including the installation of chicanes, necked curb returns, and tree planters in parking lanes. Some communities indicate success in "perceptive" narrowing of wide streets through painting edge lines or adding bicycle lanes.

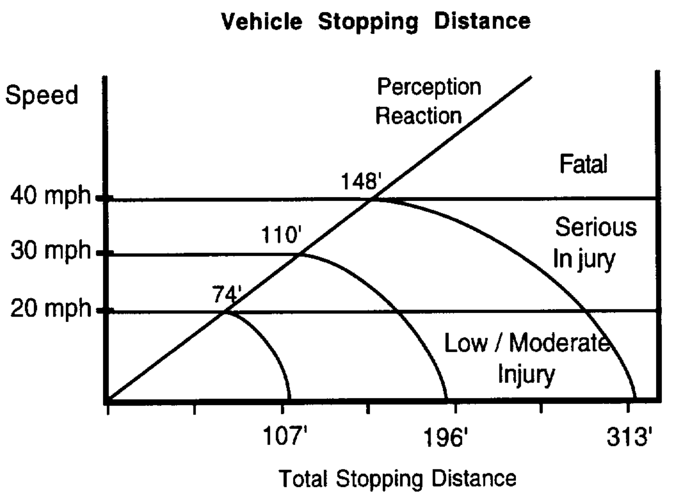


Figure 1. Pedestrian and Bicyclists Accident Severity with Vehicles at Various Speeds

There are clear and obvious benefits of slowing traffic on residential streets, primarily the improvement of pedestrian and bicyclist safety. Slower traffic reduces the severity of accidents, reduces noise, and generally improves the livability of residential streets. Figure 1 shows the relationship between vehicle speed and stopping distance, and pedestrian and bicycle accident severity. Attempting to achieve speeds in the low to moderate injury range (20 mph or less) along the entire length of a residential street is certainly desirable from a pedestrian and bicyclist safety perspective.

When considering narrowing residential streets as a traffic calming measure, it is reasonable to ask the following questions:

- Is street narrowing alone an effective calming measure?
- How narrow must the street be to dramatically reduce speeds?
- What other factors affect residential street speed, and what is their relationship?

Data Collection

This article presents research into the effect of width on residential street speeds in the San Francisco Bay Area. Speed data was collected on nearly 50 streets with curb-to-curb widths varying from 25 to 50 feet. In addition to speed and width, parking density was surveyed on a number of the streets. Selected street segments met specific criteria to ensure speed data was consistent and comparable. The criteria were:

- Meets California Vehicle Code definition of a residential district.
- Relatively straight and flat or with low grades.
- Provides for through traffic.
- No existing traffic calming devices such as speed humps, etc.
- Not within a school speed zone.
- Average daily traffic volumes less than 5,000.
- Parking permitted on both sides of the street.

Summary of Conclusions

The conclusions of the research are based on analysis of the collected data and observation of speed behavior on streets with various traffic volumes, headways, and parking densities. The key findings of the research are:

1) Wider residential streets experience higher speeds for both the average and 85th percentile speeds.
2) On-street parking density significantly affects speeds.
3) Traffic volume and vehicle headways affect speeds.
4) Significant reductions in "effective" street width are required to dramatically reduce speeds.

Speeds Versus Street Width

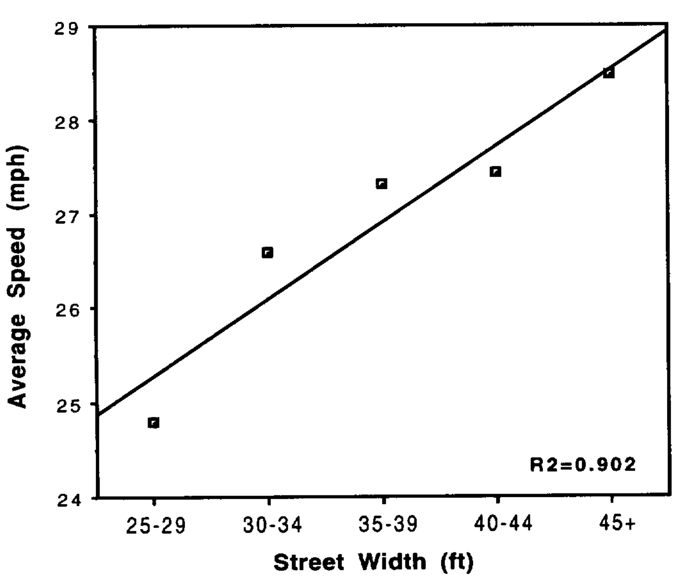


Figure 2. Average Speed vs. Street Width Group

Figure 2 presents average speed by street width groups. The points on the graph reflect the average of the speeds within each of the width groups. The data shows a slight increase in average speed as street width increases, about 4 mph between the narrowest and widest groups. While there is good correlation between average speed and width group, the individual speeds within the width groups form a broad range with little correlation to street width.

Figure 3 presents 85th percentile speed by street width group. Similar to average speeds, the 85th percentile speeds increase slightly with street width, about 3 mph between the narrowest and widest groups. The average 85th percentile speed levels off between 31 and 32 mph as street width exceeds 35 feet. While the data indicates that, in general, speed decreases slightly as street width decreases, there isn't a strong correlation between speed and street width alone. Other factors must affect speed as well.

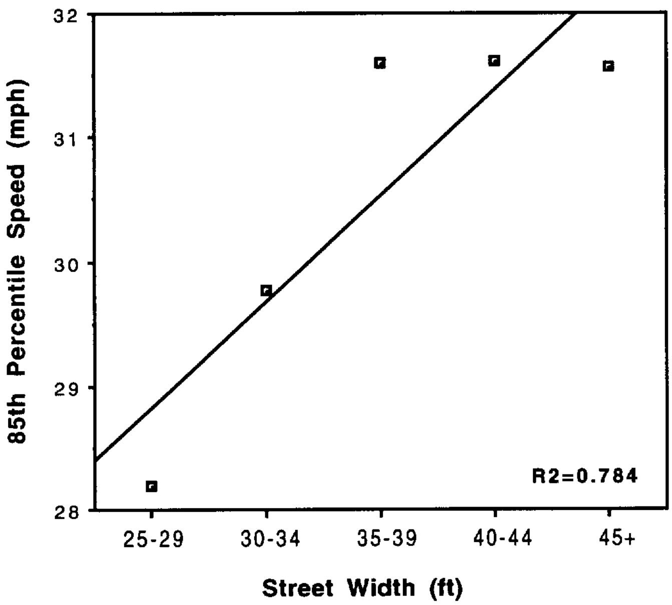


Figure 3. 85th Percentile Speed vs. Street Width Group

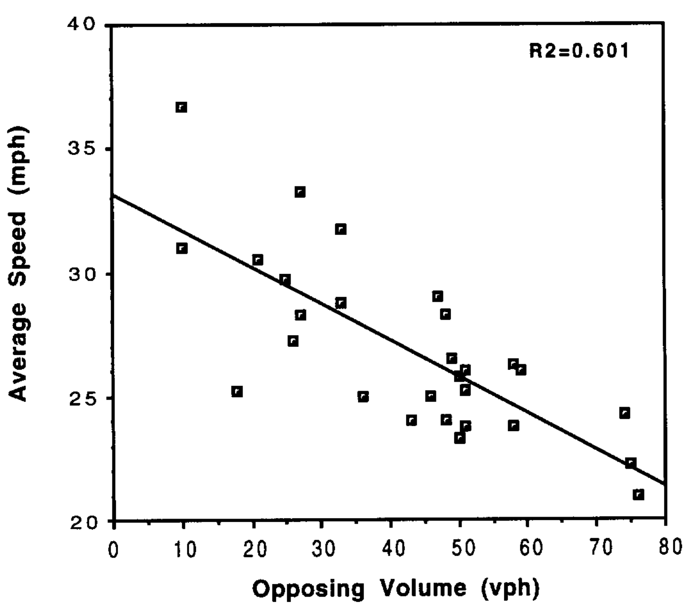


Figure 4. Average Speed vs. Opposing Traffic Volume

Speed Versus Opposing Traffic Volume

Figure 4 present average speed versus opposing hourly volume. The data points reflect streets of varying widths with the lowest speeds on the narrowest streets with the highest opposing volume.

There is a relatively strong correlation between average speed and opposing volume, particularly on narrow streets where drivers either must pull over and stop to let other vehicles pass or where the perception of street width is too narrow to judge accurately. In either case, on-street parking density plays an important role as it defines the effective width of the street. Related to the opposing volume is the headway between vehicles. Short headways mean that drivers encounter other vehicles more frequently and are thus required to slow down more often. Even in the same direction of travel, short headways influence the speed at which drivers travel. Observation has shown the situation which promotes the highest speeds on residential streets is a wide street with low parking density, low traffic volumes, and long headways between vehicles. This situation, which often occurs at night, minimizes the number of vehicles (parked or moving) which can influence a drivers perception of their own speed based on the proximity of other vehicles.

Speed Versus Parking Density

One of the most influential factors in residential street speed is the density of on-street parking, especially on narrow streets. On-street parking on both sides of the street defines the "effective" width of the street. On narrow streets with a relatively high density of parking, the effective width can be as narrow as a single lane forcing a driver to pull over and stop when an opposing vehicle is encountered. Figure 5 presents average speed versus on-street parking density. The points on the graph represent very low to moderately high parking densities on streets of varying widths, both during the day and at night. As stated above, high parking densities on narrow streets which reduce the effective width can dramatically slow speeds.

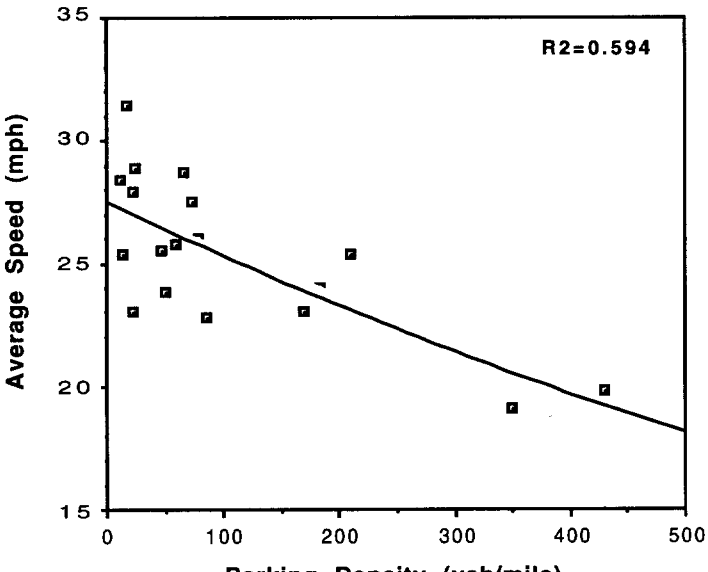


Figure 5. Average Speed vs. On-Street Parking Density

Effective Street Width and Parking Density

The following examples illustrate the calming effect of the "effective" street width as a function of curb-to-curb width and parking density. Traffic volumes and headways also contribute to the calming effect.

Wide streets with low parking density (Figure 6) have a wide effective width and virtually no calming effect. Without the influence of other moving or parked vehicles, this width of street promotes speed. Wide streets with high parking densities (Figure 7) provide a narrower effective width resulting in a low calming effect. Narrow streets with low parking density (Figure 8) have an effective width similar to wide streets with high parking density, but produce a moderate calming because off-set parked vehicles create a chicane effect.

Finally, narrow streets with high parking density (Figure 9) have the highest calming effect because it reduces the width of the street to a single lane. This forces drivers to pull over and stop to allow opposing traffic to pass. While this situation

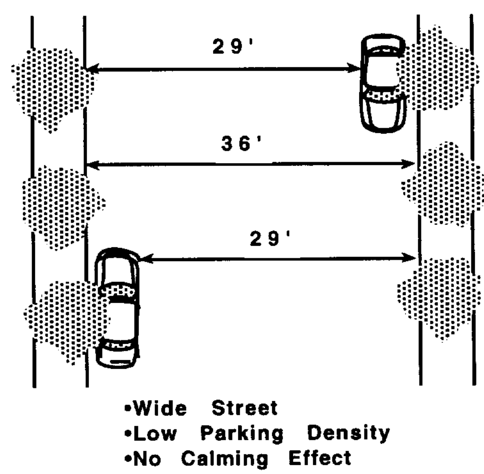
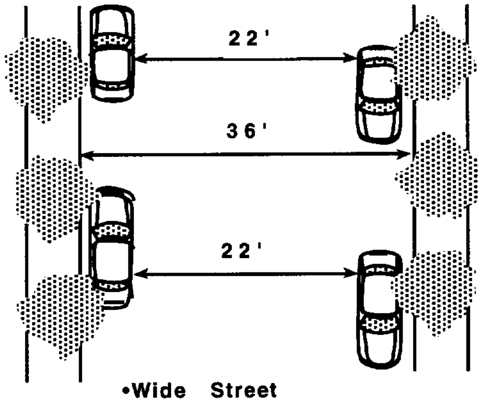
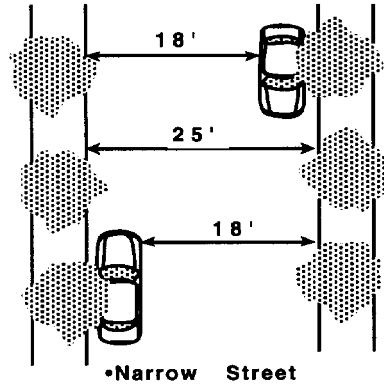


Figure 6. Effective Width of Wide Street with Low Parking Density



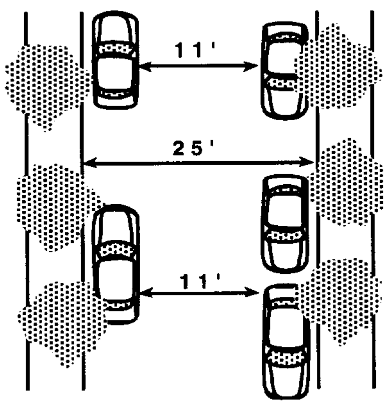
•Wide Street
•High Parking Density
•Low Calming Effect

Figure 7. Effective Width of Wide Street with High Parking Density



•Narrow Street
•Low Parking Density
•Moderate Calming Effect
(Chicane Effect)

Figure 8. Effective Width of Narrow Street with Low Parking Density



•Narrow Street
•High Parking Density
•High Calming Effect

Figure 9. Effective Width of Narrow Street with High Parking Density

creates an effective calming measure, it cannot be sustained over a long segment of street. Breaks in the parking density, or numerous driveway curb-cuts, are required to provide space for drivers to pull over to allow vehicles to pass.

Hypothesis of a Calmed Street

Analysis of the data presented above and observations of residential street speed characteristics leads to the formulation of a hypothesis for narrowing streets as a traffic calming measure. Figure 10 illustrates the relationship between street width, traffic volumes, and calmed streets. Relatively high parking density is assumed as a component of this relationship. Within a range of street widths and traffic volumes (or headway between vehicles) a street is calmed, as depicted by the shaded portion of the graph. The calmed street area is roughly bounded by widths less than 36 feet wide and headways less than 30 seconds in the peak hour (equivalent to about 1,500 to 1,600 vehicles per day). As width and headways increase drivers are not inhibited by width and speeds, therefore, become independant of width.

Since it is impractical and undesirable to decrease headways (by increasing volume), street width becomes the variable to work with. For streets to operate well within the calmed area the lower limit of volume is roughly 160 vehicles per hour (1,600 vehicles

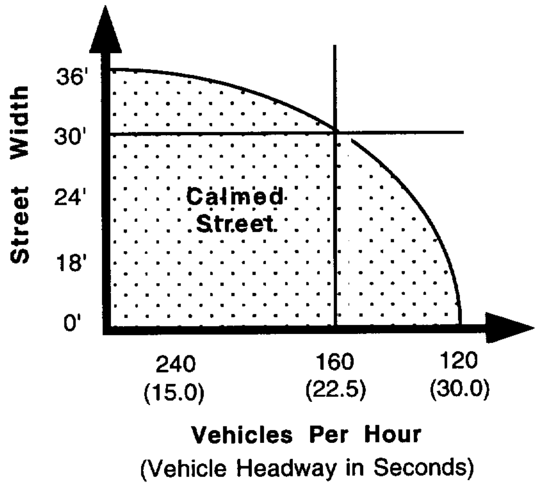


Figure 10. Calmed Street Hypothesis

per day) or headways between vehicles of 22.5 seconds, and the upper limit of the street width is about 28 to 30 feet (14 to 16 feet effective width). Further study is required to develop a mathematical model of speed as function of street width and volume which can be used by planners and engineers to design new streets and retrofit existing streets to the desired effect.

Methods to Reduce the Effective Width

The effective width of a residential street can be narrowed using several common techniques. Existing wide streets may be narrowed with tree planters in parking lanes, raised medians, curb bulb-outs at intersections and mid-block, chicanes, or slow points. These devices should be spaced appropriately to maintain low speeds along the entire length of a street. To effectively lower speeds in the design of new streets the curb-to-curb width should be 28 to 30 feet with parking allowed on both sides. Off-street parking requirements can be reduced to promote higher on-street parking densities.

Trade-Offs of Narrowing Residential Streets

The desire to reduce speeds on residential streets through narrowing effective width must be balanced with several disadvantages. Narrower streets are often discouraged for the accommodation of emergency vehicles, garbage trucks, and other large vehicles. Driver visibility of pedestrians may be reduced, especially with high parking densities where children may dash out from between parked vehicles. However, lower speeds reduce the required stopping distance. Sideswipe accidents with parked vehicles may increase. However, older neighborhoods with narrow streets have existed for many decades, generally without problems. Despite the disadvantages, many communities strive to reduce speeds, improve pedestrian and bicycle safety, and improve the livability of residential streets through traffic calming measures. Narrowing residential streets can be one of many effective measures to consider.

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