A Verkehrsberuhigung Design for an American Road

BY KOPL HALPERIN AND ROBERT HUSTON

The appearance of the ITE guidebook Residential Street Design and Traffic Control in 1989 should have signaled the start of a new era for American city streets. Experiments had begun in the Netherlands in the late 1960s to make a more forgiving roadway out of what was known to be the most dangerous type of roads. The deadliest roads are "obsolete facilities where increasing traffic speeds, volumes and vehicle performance have exceeded the original design parameters."2 In the words of another author, these are "roads that were mostly built for horse traffic. It is not surprising that an accident problem has arisen."3

By 1976 systematic attempts to apply the Dutch experience had begun in Germany.4 These were called Verkehrsberuhigung, translated as "transportation calming." The first guide in English to the use of these techniques was Appleyard,5 followed by the ITE guidebook and more recently by Civilised Streets.6 Civilised Streets not only catalogs the techniques but charts their successes at reducing crash rates.

Now, after 15 years of European successes, Great Britain also has begun to apply Verkehrsberuhigung. It is interesting that the United States and Canada have not. Perhaps this is because the authors of these guides have used European models as illustrations. These European models appear foreign to American traffic planners and drivers. Native North American road elements that would achieve the same goals have been overlooked.

A design is presented here that uses American road elements for Verkehrsberuhigung. The primary aim is greater safety. It should also contribute to urban revitalization, as such designs have done in Europe.8

Site Selection

A preliminary work for site selection previously was published.7 Death rates on state traffic routes in Erie County, Pa., were found not to be a function of traffic volume, which supports earlier published work reviewed by Hauer.8

The highest fatality rate route was selected for redesign. It should be pointed out that any route can be made safer; limited resources should be spent on those routes that pose the greatest risk. The redesign shown is site specific, but similar use can be made of locally familiar elements on any route needing redesign. The highest fatality rate route in Erie County is S.R. 4018 or Alternate 5, a 9.6-mile collector or minor arterial entirely within the urban district. It carries up to 9,500 cars a day.9 This route had 52 fatalities between 1961 and 1990. Figure 1 maps these fatalities. The deaths are distributed over the entire length of the road; there are no black spots. A black spot is a particular high-crash location, for example, a single intersection.

Figure 1 also shows the remarkable number of schools along this route. Roads are a special hazard for 6- to 9-year-olds.9 Roughly 30 percent of childhood pedestrian traffic casualties are children going to or from school.6 Beginning in 1972, the Japanese government devoted considerable effort to improving safety in school zones. Within five years they had reduced childhood pedestrian casualties by half.10

The portion chosen for the redesign is segments 120 through 140 of S.R. 4018. It is a six-block (three-quarter mile) stretch of what local residents call W. Sixth Street, from Cranberry to Cherry streets. There are two elementary schools located right along the route in this one portion. In addition, children walk this route to four other schools.

Six blocks to the south is 12th Street, S.R. 5, a six-lane principal arterial and major truck route. This six-lane route carries 30,000 cars a day. Six blocks to the North is "0th" Street, the Bayfront Highway. The Bayfront Highway is a three-lane urban bypass, opened in October 1990. As Levinson states, the opening of urban bypasses often leads to excess capacity on existing city streets.11 This has certainly been the case in Erie. Figure 2 shows the capacity of 0th to 12th streets along with the total average daily traffic. It can be seen that even closing a street would not affect the level of service on any parallel route.

Conversion Factors

To convert from to multiply by

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The design in this article is not aimed at closing the road, but merely at lowering the crash rates by enforcing the speed limit. But the American Association of State Highway Transportation Officials' (AASHTO's) Green Book states that a minor arterial "ideally does not penetrate identifiable neighborhoods." To avoid conflict, through traffic can be routed to two nonresidential routes, the Bayfront Highway and S.R. 5 (12th Street).

S.R. 4018 is not used by emergency vehicles (as confirmed by ambulance, fire and police officials), and since the opening of the Bayfront Highway, S.R. 4018 is not used by truckers. Although 95 percent of the traffic is passenger car, it also is a bus route, because the design allows for the large turning radius of a bus.

The Design

A computer-aided design drawing of the basic design is shown in Figure 3. An artist's rendering of the design is shown in Figure 4. For comparison, a photograph of the existing route is shown in Figure 5. The existing route is 36-feet (ft) wide. It consists of two cartways, two bikeways and a parking lane. All are retained.

The techniques of Verkehrsberuhigung chosen for implementation and the elements of the design are given below. All of these techniques and design elements must be unified into one aesthetic whole.

Following are the elements examined in detail.

- Concrete pavers. Concrete pavers are the only element of the design to be somewhat new to Erie drivers. Their nearest use on a major street pavement project is in downtown New Castle, 60 miles to the south. Pavers are a proven part of European successes in traffic safety. Fink states that Americans like technological solutions to problems. Working with a Western Pennsylvania paver manufacturing firm helped get the right textures for the cartways, bikeways, parking and detail work.
- Clay-shale brick crosswalks. Red concrete pavers would work, but for aesthetics and continuity with American tradition, real red brick was chosen. The design combines the appeal of tradition and respect (brick) with the appeal of high technology (concrete pavers). Aesthetics are extremely important in gaining public acceptance.
- Central boulevard. Again, an American element is used. This boulevard style is quite familiar to local drivers. In fact, the redesign intersects two existing boulevards, at Cranberry Street and at Liberty Street. In 30 years there...
has never been a fatality on the boulevard part of either Cranberry or Liberty.

Recent work by the Florida Department of Transportation\textsuperscript{15} and the Georgia Department of Transportation\textsuperscript{16} has shown that a mountable curb median can have an enormous positive influence on traffic safety. In this design, a mountable median is used for those areas that cannot have a boulevard because of the turning radius of a bus. Neither mountable curb nor boulevard would interfere with the turning radius of a car. Otherwise, a boulevard is preferable to mountable curb, especially in a snowbelt region.

The boulevard provides refuge to pedestrians and greater visibility. It separates the traffic streams, and the boulevard lowers the lateral clearance, an essential component.\textsuperscript{17} Finally, the boulevard increases beauty and thus improves the respect drivers will pay to the district. Drivers will not be as likely to speed through a neighborhood they respect.

9-ft lanes. Both the AASHTO Green Book\textsuperscript{12} and ITE’s Traffic Engineering Handbook\textsuperscript{18} give 9-ft lanes as an acceptable standard. 9-ft lanes are certainly familiar to Erie drivers. There is a surprising lack of published research in North America on the effects of lane width on speed and safety on any roads other than interstates.\textsuperscript{19} But in Europe this is not the case. Hass-Klau et al.\textsuperscript{4} are adamant that lane widths greater than 3 meters (m) are detrimental to safety on older urban roads. Our own measurements of snow patterns revealed 7-ft 6-inches (in.) to 8-ft 6 in. as the widths created by drivers exercising caution.

Curb bulbs. Curb bulbs are an important part of Verkehrsberuhigung installations. Residents in Erie are familiar with curb bulbs, especially along Perry Square, a park that lies on S.R. 4018. The function of curb bulbs is to narrow the apparent horizontal alignment so as to induce the driver to choose lower speeds. Another function is to delineate the cartway, so that the driver cannot encroach on the bikeway or parking. Currently, drivers along S.R. 4018 use the parking lane as a second traffic lane, a dangerous practice. Curb bulbs would eliminate this. Finally, the curb bulb can be planted with flowers, enhancing respect for the district and thus lowering speeds.

There are three identical blocks in the project, the three blocks of segment 120. The number of midblock curb bulbs varies from one block to the next, for research purposes. It is hoped that the optimal spacing for desired speeds can

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Figure 2. Erie roadway capacity Bayfront to S.R. 5, east-west routes, Cranberry to Cherry.

Figure 3. Elements of Verkehrsberuhigung design.
be determined. It is known what spacing is needed between vertical realignments such as speed plateaus and pillows. If the same effects can be achieved with horizontal realignment, this would be more familiar to American drivers and thus a better choice, but this would require further research.

- Reflecting bollards. Reflecting bollards need no introduction to American traffic planners. They help delineate the roadway under conditions of limited visibility.

- Stop signs. Stop signs are one of the few proven methods to lower crash rates. This recently was confirmed by LaPlante and Kropidlowski. According to LaPlante and Kropidlowski, stop signs are ineffectual or even counterproductive on roads with greater than 12,000 cars a day. The present traffic volume in the redesign route section is 6,000 cars a day; the new bypass has removed 3,000 cars a day. The design volume is 2,000; it is expected that through traffic will re-route to the Bayfront Highway bypass.

Rerouting does not necessarily occur after a Verkehrsberuhigung installation; it depends on the availability of alternate routes. In a district with large numbers of faster parallel bypasses available and severe overcapacity, rerouting will probably occur. According to Appleyard, diverting traffic alone increases safety; according to Hauer, lowering traffic volume does not necessarily increase safety. Safety of a route does not appear to depend on the traffic volume. It should be pointed out that both the population and the traffic volume in Erie County, Erie City and in the immediate district have been declining for many years.

It is recommended that all intersections within the redesign district be redesigned to multiway stops. Currently, three intersections have traffic lights; it is not known what happens when traffic lights are replaced by stop signs. It is believed that multiway stop signs are of such known safety advantage that they should be specified whenever possible in urban residential districts. This is especially important in school zones.

- Lower posted speed. It is well known that drivers do not drive the posted speed. On the road in question, the posted speed is 25 miles per hour (mph), and the overall design is aimed at enforcing that speed limit. The current 85th percentile in the redesign area ranges from 34 mph to 38 mph depending on the segment. In order to convince the driver that the optimum speed has now changed, the design includes changing the posted speed from 25 mph to 20 mph. The entire district is a school zone, and in conjunction with school zone signs, this new posted limit should not meet with resistance and should aid the other design elements in convincing drivers to select speeds below 25 mph. Speed limits of 20 mph do not currently exist in Erie but are common in Chicago neighborhoods.

From Smeed in 1960 to Evans in 1991, the evidence shows that lowering speed limits does lower the average speed of the road and does lower the crash rates. The success of this project does not depend, however, on the effects of speed limits. The redesign instead depends on engineering techniques.
Angle-in parking in some places. It was feared that the redesign would eliminate essential parking spaces. A parking survey was done and found that the parking along the route was utilized less than 10 percent at all times of the day and night. There were two exceptions to this, one was in front of Emerson-Gridley Elementary School in segment 131.

The other location in need of greater parking is the strip of small shops at the corner of Cascade Street in segment 120. The redesign includes eight angle-in spaces, where currently there is concrete pavement at sidewalk grade. The shops will thus take on the aspect of a small-town downtown. This should increase trade, and shopkeepers are uniformly supportive of this project.

**Expected Crash Reduction**

The crash reduction calculations are complicated. They involve comparing the route to existing routes in the Erie urban district and comparing the extent data to data predicted from Nilsson's equations on crash rates and severity rates as a function of route speed.25

In Pennsylvania, a reportable crash is one in which either the vehicle was towed or a person was treated for injury, or both. The design should be able to reduce the number of reportable crashes by 34 percent and the number of injuries by 57 percent.

The fatality prediction is more striking. Fatalities increase much more rapidly with increasing route speed than do overall crashes. The current expected value is one fatality on this route section every 10 years. The redesign should reduce this to one every 70 years, and childhood pedestrian fatalities should fall from one every 30 years to one every 200 years. If the redesign were applied to the entire length of S.R. 4018, the number of fatalities would fall from 14 a decade to between two and three. That is, 11 or 12 deaths a decade that currently occur could be prevented.

**Prospects**

The proposed design is, like any road design, site specific. Whether it gets built at the particular site is a political decision. Unfortunately, as Kraay states, transportation safety has a low political priority.6

The basic elements of the analysis and of the design shown here can be adapted to any urban route. Identifying a high death rate location on an old horse road probably means finding a place needing redesign.

For more than 20 years, successful overseas experimentation with road redesign has lowered crash rates. If American road design elements are used, many American urban districts could rapidly duplicate these successes. This design, it is hoped, could be adapt-

![Figure 4. Artist's rendering of Verkehrsberuhigung design.](image-url)
ed elsewhere. Locally familiar elements should be used wherever possible. It is a fertile area for further research, but more importantly, lives can be saved.

Finally, Wilde states that the success of any transportation safety improvement depends on its being “psychologically invisible.” Evans arrives at the same conclusion: “Safety may best be advanced by drivers not having to choose between driving habits more likely to lead to crashes than those less likely to lead to crashes.”

Verkehrsberuhigung, when properly done with an eye for aesthetics and neighborhood improvement, leads to a safer transportation system without drivers feeling restrained.

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References

Optimization and Simulation Made Easy for Actuated Controlled Intersections

**EVIPAS and EZVIPAS**

- Optimized settings for max. green, min. green, unit extension, added initial, max. initial, time before reduction, time to reduce, min. gap and more
- Prettimed, semi-actuated, fully-actuated, and volume-density
- MOEs include delay, operating costs, fuel consumption and emissions
- Dual-ring eight phases including pedestrian
- Output summary of delays
- Stochastic, microscopic and event-based

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