

## II. The History and Development of Traffic Calming

*I think, though others may not agree with me, that the term "traffic calming" was originated by me in the mid-1980s when making a direct translation from the German "verkehrsberuhigung." Traffic calming as a device may have originated in the Netherlands, where the concepts of "woonerven" (living yards) and "winkelerven" (shopping yards) were applied respectively to residential and shopping areas.<sup>5</sup>*

In a report for the United Kingdom environmental group, Friends of the Earth, Hass Klau traces the roots of traffic calming back to three sources. In addition to the Dutch "woonerven," she identifies Buchanan's "Traffic in Towns," in which he described the importance of having environmental areas, and pedestrianization as being the major influences.<sup>6</sup>

Few would argue that the development of traffic calming has been led by European countries such as the Netherlands, Germany, and Denmark. Although many of the engineering techniques and facilities used in traffic calming have always been a small part of the United States traffic engineers toolkit, they have not been utilized in quite the same way and not to nearly the same extent as in Europe or, more recently, in Japan and Australia.

Much of the reason for this is purely practical. European cities tend to be more compact than United States cities and cannot cope with the volume of traffic experienced in the United States. Car ownership is still higher in the United States than in most European countries. European cities tend to have better public transport services already in place and local governments have much greater control over land use planning and development than their counterparts in the United States

However, these differences should not mask the real reason for the much wider acceptance and implementation of traffic calming in Europe than in the United States. As a matter of policy, the overwhelming majority of European cities have determined they do not want

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<sup>5</sup> Roberts, John, "Traffic Calming," *Pro Bike '90 Proceedings*, Bicycle Federation of America, Washington, D.C.

<sup>6</sup> Hass Klau, *An Illustrated Guide to Traffic Calming*, Friends of the Earth, 1990, London.

to accommodate the level of car use experienced in the United States as the economic, social, cultural, and environmental cost of doing so would be unacceptably high.

A study into the likely economic impact of increasing car use from 36 percent of trips to 76 percent of trips in the Dutch city of Groningen—and a fall in bicycle use from 50 percent to just 5 percent—estimated an annual cost per car of approximately \$250 to make up for the increased air pollution, noise nuisance, parking costs, and energy consumption. Traffic accidents, congestion and health impacts were not quantified. The additional parking required for the increase in traffic represented one quarter of the entire downtown area of Groningen.<sup>7</sup>

Buchanan warned in 1963:

*The briefest acquaintance with the conditions that now prevail in towns makes it clear that traffic congestion has already placed in jeopardy the well being of many of the inhabitants and the efficiency of many of the activities. Unless something is done about the potential increase in the number of vehicles that come together in neighborhoods the conditions are bound to become extremely serious within a comparatively short period of years. Either the utility of vehicles in towns will decline rapidly, or the pleasantness and safety of the surroundings will deteriorate catastrophically—in all probability both will happen together.*<sup>8</sup>

Countries such as Germany paid heed to these warnings. While they developed the most extensive freeway system in Europe they also invested heavily in public transport, bicycling, and walking facilities. According to Hall, “German cities have led and the rest of the world—including Britain—have followed at a distance.”<sup>9</sup>

## 1. Pedestrianization

Throughout the 1960’s pedestrianization of downtown shopping streets was undertaken across Germany. Streets were reserved exclusively for use by pedestrians. Initially, pedestrian streets were provided as part of a general re-design of city centers to make way for the automobile—including central city ring-roads, multi-story car parking garages, and rear access streets for delivery vehicles. However, as a result of their economic success and changes in attitude towards historic preservation, the environment, safety, and pedestrianization of large areas of downtowns became a symbol of enlightened town planning. In western Germany alone, there

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<sup>7</sup> Kromendijk, Erma, *Policy and Provision for Cyclist in Europe*, Commission of the European Community, 1989, Brussels.

<sup>8</sup> Buchanan, *Traffic in Towns*, HMSO, 1963, London.

<sup>9</sup> Hall, Peter. *New Life for City Centers: Planning, Transport and Conservation in British and German Cities*, Anglo-German Foundation, 1988, London.

are over 1,000 pedestrian areas and traffic-calmed town centers. All cities and almost all towns with a population of over 50,000 have central pedestrian areas. Almost three-quarters of towns with populations of 20,000–50,000 have a pedestrian area or a traffic-calmed shopping area.<sup>10</sup>

Most pedestrian areas in Germany began as short stretches of street, typically quite narrow and with a high density of pedestrians. Newly established pedestrian areas usually cover 100-300 meters (300-1,000 feet) and most are subsequently extended. In the older and larger cities such as Munich, Frankfurt and Hanover networks of pedestrian streets and arcades extend from 4 to 7 kilometers (2.5 to 4.5 miles). Similar development is evident in eastern Germany as well.

Pedestrianization is now a feature of most European cities, to the extent that cities without them are considered backwards. In 1975 Monheim surveyed 120 German towns to determine why they had implemented pedestrianization. He found the most important reason was “to have an up-to-date town layout and attractive image.” Other popular answers were:

- Improvements for traffic and safety
- Leisure use of the center, especially for evening use
- Attracting shoppers from surrounding countryside
- Less noise and pollution
- Preservation of historic townscape
- Prevent loss of trade to competing towns<sup>11</sup>

Discussion of the success or desirability of pedestrian areas focuses not on safety but economics. Roberts sums up the argument:

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<sup>10</sup> Monheim, H., “The Evolution and Impact of Pedestrian Areas in the Federal Republic of Germany,” *The Greening of Urban Transport*, Belhaven Press, U.K. 1990.

<sup>11</sup> Ibid.

*There is now a wealth of evidence to show that pedestrianization, unless it is mis-designed or located, benefits retail turnover. This is probably attributable to three phenomena: pedestrian flows increase by at least 50 percent; pedestrians are more relaxed when freed from the hassles of vehicular traffic; they can more easily compare what is on offer and, in fact, see things they probably would have missed in a traffic congested street.<sup>12</sup>*

As evidence of this, Roberts cites a 1978 study by the Organization for Economic Cooperation and Development (OCED). More than 100 cities with pedestrian areas responded and, worldwide, turnover in city centers with pedestrian areas increased in 49 percent of cities, remained stable in 25 percent, decreased by 10 percent in 18 percent of the cities, and by 25 percent in the remainder. Cities in Austria, Germany, and Scandinavia experienced increases in turnover of more than 60 percent.<sup>13</sup>

Roberts warns of the mis-design and location of pedestrian streets, while Monheim details the possible negative effects of pedestrian areas. Some of the issues that arise in their discussions include:

- Streets should already have significant pedestrian activity before motor vehicle traffic is removed.
- Pedestrian areas should not usually be introduced as isolated measures, but as part of a package designed improve the whole downtown area. For example, the extensive pedestrianization in Munich was complemented by construction of the very successful U-bahn and S-bahn rail systems, which feed directly into the pedestrian areas.
- The increased attractiveness of pedestrian areas can significantly increase shop rents. For example, the pedestrianization of Stonegate in York, England led to rent increases from \$400 to \$1500 per square meter. While this demonstrates success, it can lead to “nightmare pedestrian areas” where only nationally franchised chain stores can afford to remain, leaving every pedestrian area looking exactly the same.
- The type of shopping found in pedestrian streets tends to be comparison shopping rather than convenience shopping, as shoppers feel more comfortable browsing in the unhurried auto-free atmosphere.

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<sup>12</sup> Roberts, John, “The Economic Case for Green Modes,” *The Greening of Urban Transport*, Belhaven Press, 1990, U.K.

<sup>13</sup> *Results of Questionnaire Survey on Pedestrian Zones*, Organization of Economic Cooperation and Development (OCED), 1978, Paris.

- Other locations, especially those on the periphery, do less well after pedestrianization. Competing town and city centers may also suffer a loss of business. In some locations traffic calming, rather than full pedestrianization, has been introduced in the peripheral areas to make them more attractive.<sup>14</sup>

Despite these potential problems, both Monheim and Roberts speak in glowing terms of the importance of traffic free downtown areas, and the way in which pedestrian activity builds on itself to create an attractive place to be.

*The sheer attractiveness of a reborn city center, resulting from less vehicular traffic and concomitant environmental improvements, can introduce less tangible benefits. It will become a magnet for tourists. It will be a better place for working, so employees and employers will have greater satisfaction. It will permit on-street entertainment, political meetings, concerts—all contributing not only to a better quality of life but also to economic enhancement. New buildings will arise and old ones will be renovated, shop fronts will be renewed or repainted. And it will become a mecca for green travelers—a good place to walk, cycle and perhaps tour around in a minibus. There is an interactiveness about all these events, one stimulating another.<sup>15</sup>*

## 2. Woonerven

In the 1970's the focus shifted from city centers to residential streets and neighborhoods, where traffic was becoming a significant nuisance and threat to residents. The Dutch, and in particular the city of Delft, were at the forefront. According to Tolley:

*Planners there began to ask why it was that their residential streets were so dull and so unsafe, and why was it impossible to do anything else there except drive cars—even though most of the time there were no moving cars. Traffic was seen as one of the greatest sources of blight, causing unsafety, discomfort and taking most of the space.<sup>16</sup>*

The result of their thinking was development of a new concept in traffic management: the woonerf, or living yard. Experiments with these new street designs, in which there was no segregation between motorized and nonmotorized traffic and in which pedestrians have priority

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<sup>14</sup> Roberts, J., and Monheim, H., "The Economic Case for Green Modes" and "The Evolution and Impact of Pedestrian Areas in the Federal Republic of Germany," *The Greening of Urban Transport*, Belhaven Press, 1990, U.K.

<sup>15</sup> Roberts, John, "The Economic Case for Green Modes," *The Greening of Urban Transport*, Belhaven Press, 1990, U.K.

<sup>16</sup> Tolley, Rodney, Chapter 4, *Calming Traffic in Residential Areas*, Brefi Press, 1990, Wales.

in the whole street area, became Dutch law in 1976. In the 7 years after the new traffic law defining woonerven was passed a total of 2,700 such features (average size: two streets of approximately 200 meters (600 feet) in length) were built.<sup>17</sup>

The 1976 law lists some important characteristics of a woonerf (pl. woonerven) that differentiate it from any other type of street. These include some very specific design requirements such as:

- The impression that the highway is divided into a separate roadway for motor vehicles and a footpath must be avoided. There should, therefore, be no continuous difference in cross-sectional elements along the length of the road. Breaks should therefore occur in features which can give the impression of the existence of a footpath and should be at intervals of approximately 25 meters (75 feet); this should be quite clear to the motorist.
- On those parts of the highway intended for motor vehicle use, features must be introduced which will restrict the speed of all types of vehicles. These features should not be more than 50 meters (150 feet) apart.
- These features should not be located so as to cause vehicles to pass too close to housing which fronts directly onto the road.
- Adequate street lighting must be provided to ensure that all features, especially those referred to above, are fully visible at night.<sup>18</sup>

These main features, along with 10 others, were required in every woonerf. As a result, it was also felt necessary to publish a new set of traffic regulations especially for the woonerf. Five basic principles were outlined:

- Pedestrians may use the full width of the roads within a woonerf which is designated as such; playing is also permitted on the roadway.
- Drivers within a woonerf may not drive faster than at walking pace. They must make allowance for the possible presence of pedestrians, including children at play, unmarked objects, and irregularities in the road surface, and the alignment of the roadway.
- Traffic from the right has priority over traffic from the left in a woonerf. (Normally, fast traffic has priority over slow traffic.)

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<sup>17</sup> Ministerie van Verkeer en Waterstaat, *Residential Neighborhoods and Traffic Zones*, The Hague, 1986.

<sup>18</sup> ANWB (The Royal Dutch Automobile Club), "Woonerf," The Hague, 1980.

- Drivers may not hinder pedestrians within a woonerf. Pedestrians shall not unnecessarily hamper the progress of drivers in a woonerf.
- Drivers of motor vehicles with more than two wheels are not permitted to park in a woonerf except at places which are identified by the appropriate traffic sign or the letter P marked on the pavement.<sup>19</sup>

The biggest change, of course, was the notion that all road users should be integrated, not separated, for their mutual safety and benefit. The legal change was backed up with quite radical new street designs and layouts and every feature of the woonerf encourages drivers to drive at walking pace.

Figure 1 on the next page shows the typical features of a woonerf.

Drivers entering a woonerf must pass by a sign indicating the new rules that apply. No sidewalks are provided—the whole street is on the same level. Regular shifts in the vertical and horizontal alignment, street furniture, play areas, designated parking spots and different surface materials all contribute to the feeling that priority rests not with the motor vehicle, but with residents on foot, children playing, and nonmotorized users.

Other important principles inherent in the original woonerf design included:

- Woonerven were only appropriate for streets with an already low flow of through traffic.
- Woonerven should always be two-way streets, with passing places where necessary.
- Access for emergency and service vehicles is always maintained.<sup>20</sup> Planners, engineers, and residents alike clamored for the introduction of woonerven. Indeed, one problem experienced with their use was that residents living on the streets wholly inappropriate for implementation of a woonerven, pressured their governments to have their street changed.

The widespread introduction of woonerven was closely evaluated:

- Nationally, 70 percent of the Dutch population thought woonerven attractive or highly attractive.
- Nonmotorized users assessed them more positively than motorized users.

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<sup>19</sup> Ibid.

<sup>20</sup> Ibid.

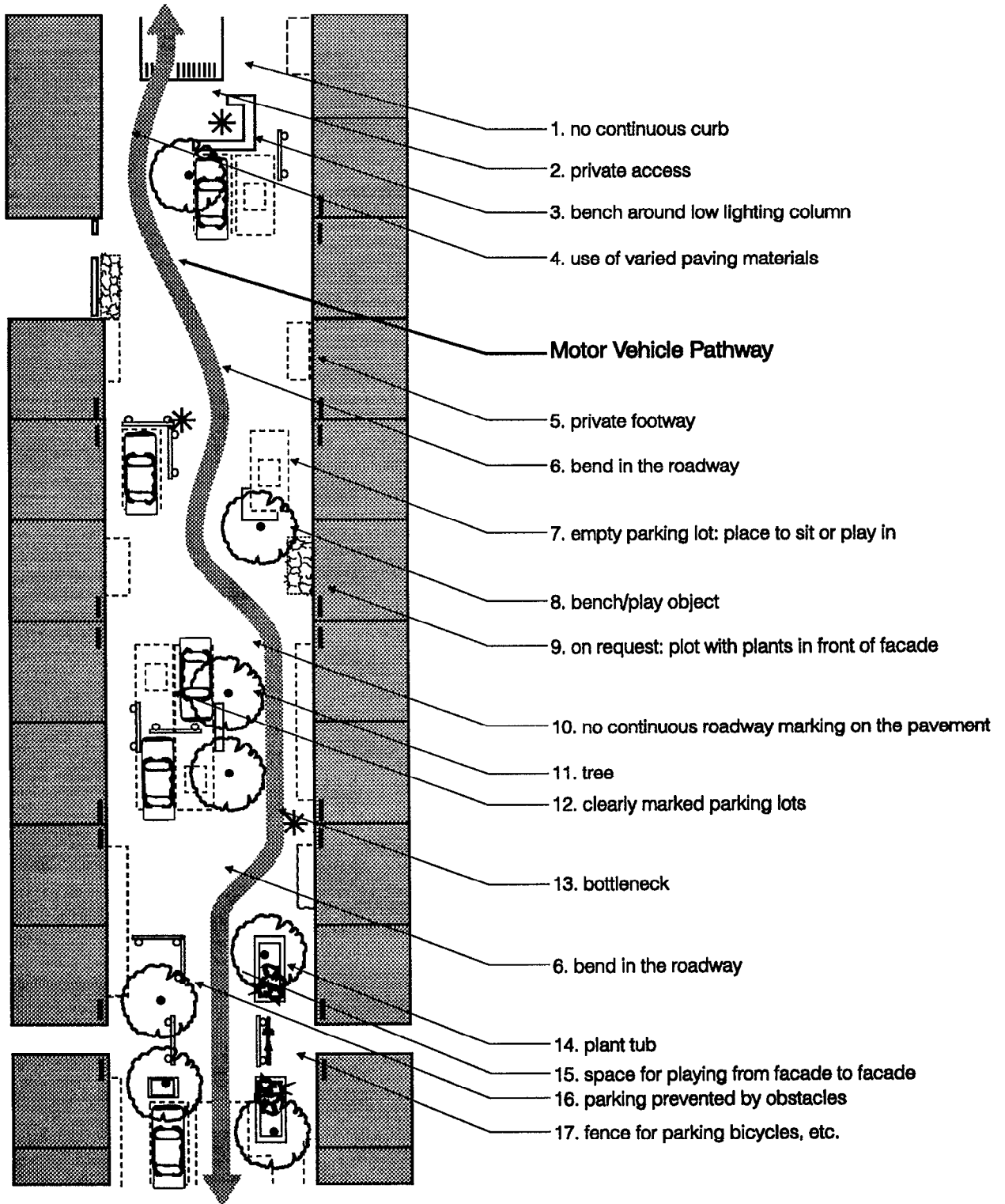


Figure 1. A Model "Woonerf"

- Residents appreciated the low traffic volumes and absence of through traffic, but the bigger play areas and environmental improvements were even more of a benefit.
- Injury accidents were reduced by 50 percent.
- Vehicle speeds were reported to average 13-25 km/hour (8-15 mi/hr.).

As a result of this success, woonerven have become a routine feature of new residential area design. However, there have also been a number of problems identified with woonerven. Retrofitting existing neighborhoods to become woonerven was prohibitively expensive. The very strict design requirements of woonerven often could not be met. For example, traffic flows in inner city neighborhoods might exceed the low volume required for a woonerf and cause an overflow of traffic onto neighboring streets. Pedestrians complained that there was no designated or protected space for them without raised sidewalks. Finally, the principles of woonerven could not legally be extended to shopping streets or village centers (*winkelerven* and *dorpserven*).

Thus, in 1984, a Review Panel established by the Dutch Government reviewed the woonerf law and made a number of substantial changes. The 14 strict design rules were reduced to just six basic principles, close to the original concept of the woonerf, but allowing more flexibility.

1. The main function of the “erf” shall be for residential purposes. Thus, roads within the “erf” area may only be geared to traffic terminating or originating from it. The intensity of traffic should not conflict with the character of the “erf.” In practical terms, conditions should be optimal for walking, playing, shopping, etc. Motorists are guests. Within woonerven, traffic flows below 100 vehicles per hour should be maintained (300 vehicles per hour for *winkelerven*).
2. To slow traffic, the nature and condition of the roads and road segment must stress the need to drive slowly. Particular speed reducing features are no longer mandated, so planners can utilize the most effective and appropriate facilities.
3. The impression shall not be created that the road is divided into a carriageway and sidewalk. Therefore, there shall be no continuous height differences in the cross-section of a road within an “erf.” Provided this condition is met, a facility for pedestrians may be realized. Thus, space can be designated for pedestrians and a measure of protection offered, for example, by use of bollards or trees.
4. The entrances and exits of “erven” shall be recognizable as such from their construction. They may be located at an intersection with a major road (preferable) or at least 20 meters (60 feet) from such an intersection.
5. The area of a section of the road surface intended for parking one or more vehicles shall be marked at least at the corners. The marking, and the letter P

shall be clearly distinguishable from the rest of the road surface. In winkelerven special loading spaces can be provided, as can short term parking with time limits.

6. Informational signs may be placed under the international "erf" traffic sign to denote which type of "erf" is present.

These new laws were effective July 16, 1988. In the 12 years between the first "woonerf" law and the revised version, Dutch traffic engineers were busy with much more than just woonerven. In addition to the problems identified above, woonerven were only applicable in a particular type of low-volume street. The need to tame traffic was far more widespread, and many of the techniques used in woonerven could readily be applied to other residential streets without some of the substantial costs involved in implementing full-scale woonerven.

Two demonstration projects were established in 1977 in residential areas of Eindhoven and Rijswijk to compare the costs and benefits of a full-blown woonerven with Buchanan-style one-way street systems. In between was a third trial area: streets with many woonerf style treatments such as speed humps, carriageway narrowing and parking management. The woonerven was effective but expensive. The simple traffic diversion method was cheap and largely ineffectual. In between came what is now known as the 30 km/hr zone (18 mi/hr) where significant speed and accident reductions could be achieved without the high costs of a woonerven.

### **3. Verkehrsberuhigung**

The Netherlands and their North European neighbors watched the development of the woonerf and learned from the shortcomings of the concept. The Eindhoven and Rijswijk experiments prompted the Dutch to create regulations for 30 km (18 mi/hr) zones such that the character of the street dictated a maximum speed of 30 km/hour (18 mi/hr).

As with woonerven, Dutch local authorities greeted this opportunity to calm traffic with enthusiasm. Close to two hundred 30 km/hr (18 mi/hr) zones were created in the first 3 years and a series of evaluation studies was set in motion. In one such area in 's-Hertogenbosch results show:

- 33 percent reduction in through traffic
- 85 percent of vehicle speeds between 20 and 30 km/hr (12-18 mi/hr) at speed humps, rising to 30 and 35 km/hr (18-21 mi/hr) between the humps.

Tolley reports this level of success has been repeated in the first 10 studies completed. Mean speeds have fallen from 27 to 22 km/hr (16 to 13 mi/hr) with speed humps (less than 60 meters apart (180 feet)) and mini-roundabouts being the most effective measures.<sup>21</sup>

German traffic planners and engineers took up the lead from the Dutch and quickly developed their equivalent of the woonerf: wohnstrasse. The province of North-Rhine Westphalia asked for neighborhoods to volunteer, and 130 responded. Thirty areas were eventually selected. Three years later an evaluation reported that injuries had been reduced by 44 percent and serious injuries and deaths by 53 percent.<sup>22</sup>

Keeping in step with the Dutch, the Germans then developed their version of the 30 km/hr (18 mi/hr), or Tempo 30, zone: area-wide traffic calming, or "verkehrsberuhigung." As with the 30 km/zones (18 mi/hr), they combined the best features of the woonerven with Buchanan's concept of environmental areas. The road system remained fully connected—unlike in Buchanan's model, where road closures, diversions and one-way streets kept unwanted traffic away—but traffic speeds throughout the system were to be significantly decreased.

*Short-cut traffic would be deterred, yet residents could still reach their homes directly. There would be a more uniform distribution of traffic across the area and traffic volumes would be brought into line with area functions and land use policies. The speed reductions would be achieved by applying at critical areas in the network some of the same sort of [traffic-calming measures].<sup>23</sup>*

The results of Verkehrsberuhigung in Berlin:

**Table 1. Injury Accidents per 1000 Children**

LOCATION	1977-79 (before)	1982-84 (after)
Berlin-Charlottenburg (with VB)	11.2	4.0
Berlin-Moabit (without VB)	7.6	11.3
Berlin West (Total)	8.6	7.1

VB = Verkehrsberuhigung

<sup>21</sup> Tolley, Rodney, Chapter 5, *Calming Traffic in Residential Areas*, Brefi Press, 1990, Wales.

<sup>22</sup> Citizens Against Route Twenty, *Traffic Calming*, 1989, Queensland, Aus.

<sup>23</sup> Tolley, Rodney, Chapter 5, *Calming Traffic in Residential Areas*, Brefi Press, 1990, Wales.

The importance of reducing traffic speed cannot be overemphasized. While the overall goals of traffic calming may include environmental improvements, better conditions for bicyclists and pedestrians, accident reductions, and more space for children to play—the reduction of vehicle speeds is crucial to each.

When the European Commission surveyed the attitudes of bicyclists in 11 countries, the strongest and closest agreement came for the statement “Most cars drive too fast.”<sup>24</sup>

Clearly details 15 specific speed reducing “techniques” in the Cyclists’ Touring Club’s (CTC) excellent guide to traffic calming.

1. Road Humps and Speed Tables

Raising the surface of the road over a short distance, generally to the height of the adjacent curb. Humps can be round or flat-topped—the latter being known as speed tables, which can extend over many meters.

2. Chicanes

Physical obstacles or parking bays, staggered on alternate sides of the highway so that the route for vehicles is tortuous.

3. Traffic Throttles (pinch points)

The narrowing of a two-way road over a short distance to a single lane. Sometimes these are used in conjunction with a speed table and coincident with a pedestrian crossing.

4. Curb extension (sidewalk widening)

The sidewalk on one or both sides of the road is extended to reduce the highway to a single lane or minimum width for two-lane traffic. This reduces crossing distances and discourages parking close to intersections and crosswalks.

5. Central refuges (medians)

Islands situated in the middle of the road to reduce lane widths and provide a refuge for pedestrians and bicyclists crossing major roads.

6. Mini-roundabout (traffic circle)

Small roundabouts situated at an intersection. Some have raised centers, others are just painted circles on the road.

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<sup>24</sup> Commission of the European Communities, *Policy and Provision for Cyclists in Europe*, 1989, Brussels.

7. Raised Intersections

The highway is raised at an intersection, usually by brickwork or a plateau with a ramp on each approach. The platform is a curb level and may well have distinctive surfacing.

8. Entry Treatment Across Intersections

Surface alterations at side road intersections, generally using brickwork, setts or other textured surface materials. Level of the road may be raised to the level of the sidewalk.

9. Environmental Road Closure

Road closures, generally in residential streets, designed to remove through traffic or prevent undesirable turns.

10. No Entry—with “cycle-slip”

Access to a road is barred in one direction by a No-entry sign. The rest of the road remains two-way, and bicyclists and pedestrians can pass the No-entry sign.

11. Textured Surface

The use of nonasphalt surface such as setts, brickwork, paving or cobbles to reinforce the concept of a traffic restricted area.

12. Shared Surfaces

The traditional distinction between sidewalk and pavement is removed, leaving pedestrians, bicyclists and motor vehicles to share a common space.

13. Tortuous Roads

Roads are designed to meander, occasionally quite sharply, reducing the view of any stretch of “open road” and thereby encouraging lower vehicle speeds.

14. Rumble Strips

Lines of cobbles or other raised surfacing designed to warn drivers of excessive speed or of the proximity of a hazard area where lower speeds are desirable.

15. Transverse Bands

Painted lines oriented as transverse bands across the highway at decreasing intervals. They are intended to give drivers the impression they are traveling with increasing speed, so they will react and slow down.<sup>25</sup>

The CTC technical note provides considerably more details, discusses the advantages and disadvantages of each measure, and addresses ways of ensuring each one benefits bicyclists and does not make the street more complicated, unsafe, or unattractive.

All of these features are used to some extent in the examples of traffic calming cited in this report, and there are a number of other good sources of technical information on the design and implementation of these features.<sup>26</sup>

One important feature of traffic calming not mentioned by Cleary in the CTC guide are, in fact, special bicycle facilities. In many traffic-calming projects road space is reallocated to provide bicyclists and pedestrians more and/or dedicated space.

The Germans began to treat the urban street system according to a new kind of hierarchy:

- Arterials and major routes should have a maximum speed of 50 km/hr (33 mi/hr), synchronized traffic lights, bike lanes, marked crosswalks, medians and attractive sidewalk areas for people to linger.
- Collector/distributor streets should have a maximum speed of 30 km/hr (18 mi/hr) with design features—such as narrower lanes, bike lanes, wider sidewalks, speed tables—to make this limit self-enforcing.
- Residential streets should be woonerf-type streets with carefully managed parking, very slow speeds (walking pace), chicanes, play areas, speed humps, and environmental road closures to deter through traffic.

Adopting an approach dealing with the whole street system has helped avoid some of the pitfalls of just concentrating on woonerven and residential streets. Accident problems and excess traffic cannot simply be shunted off to another street. Traffic calming has truly become area-wide in scope.

In the early 1980's German planners and traffic engineers started to develop Tempo 30 zones: Areas where traffic signs and minimal changes to the infrastructure sought to reduce traffic speeds. In 1983, a 5-year experiment with Tempo 30 zones prompted work in more than 5,000 areas. In Hamburg, 30–40 percent of the highway system is designated 50 km/hr (30 mi/hr) and the remainder is—or will become—Tempo 30 areas (18 mi/hr).

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<sup>25</sup> Cleary, *Cyclists and Traffic Calming*, Cyclists Touring Club, 1991, Godalming, U.K.

<sup>26</sup> Tolley, Rodney, *Calming Traffic in Residential Areas*, 1990, Brefi Press, Wales.

As experience grew, however, it became clear that physical changes to the street were needed to really control vehicle speeds. All of the features listed above have been used in thousands of areas where traffic calming has been implemented in recent years. Monheim estimated that in 1987 there were 4,000 traffic-calming areas in North-Rhein Westphalia alone. A 1989 study puts that figure at 8,147. The province has an ambitious, ongoing program featuring 126 projects in 94 cities and towns with a total investment level of close to \$100 million.<sup>27</sup>

The Federal Government was anxious to know how these different approaches were working and in 1981 set up a major research project to study traffic-calming projects in six very different settings. Communities in one major city (Berlin), three medium sized cities (Mainz, Ingolstadt and Esslingen), a small town (Buxtehude) and a village (Borgentreich) were selected.

Initial results of the project were very encouraging. Monheim provides an overview:

- Little change in overall traffic volumes.
- Average vehicle speeds fell from 39 km/hr to 20 km/hr (25 to 12 mi/hr).
- Average journey time for motorists increased 33 seconds.
- Fatalities fell by 43-53 percent and injuries by 60 percent. The total number of accidents remained the same.
- Air pollution decreased by between 10 and 50 percent; noise levels fell by 14 decibels; fuel use was cut by as much as 10 percent (depending on driving style and behavior).
- 67 percent of motorists and 75 percent of residents approved of the changes (an improvement from 27 percent and 39 percent respectively prior to the work.)<sup>28</sup>

Since then, more specific results have appeared from the different areas involved in the experiment.

Bicycle use has doubled in Buxtehude in the 4 years since the traffic-calming project was finished. Bicycle accidents have also risen—but primarily noninjury accidents.<sup>29</sup>

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<sup>27</sup> Whitelegg, John, "The Principle of Environmental Traffic Management," *The Greening of Urban Transport*, Belhaven Press, 1990, London.

<sup>28</sup> Citizens Against Route Twenty, *Traffic Calming*, 1989, Queensland, Aus.

<sup>29</sup> Doldissen and Draeger, "Environmental Traffic Management Strategies," *The Greening of Urban Transport*, Belhaven Press, 1990, London.

## 6. Other Traffic-Reduction Strategies

The three philosophies of pedestrianization, woonerven, and verkeersberuhigung have dominated urban traffic management for the last 30 years in Europe. However, they are far from the only innovative and successful transportation initiatives that have taken place during this time.

### Traffic Cells

Traffic chaos during the 1969 Christmas season was, apparently, the inspiration for the city of Gothenburg in Sweden to restrain traffic for the economic survival of the city. The downtown area of the city was divided into five "cells" and cars were prevented from crossing the boundaries between these cells. Instead, to move from one to another drivers have to return to an inner ring-road and circle around to the entrance to the next cell. Public transport vehicles, bicycles and pedestrians are allowed to cross the cell boundaries.

In addition to the traffic cells, public transport was improved, parking spaces were reduced and made more expensive and an extensive public information system was put in place. The combination of measures worked well with results including:

- 45 percent reduction in traffic entering the central area between 1970 and 1982.<sup>36</sup>
- 50 percent reduction in injury accidents inside the ring road and a 25 percent cut on the ring-road in the first 5 years. This freed up 20-30 policemen for other work.
- 8 percent increase in transit ridership, 1970-75.
- Increase in travel speeds on the ring-road from 16 to 23 km/hr (10 to 14 mi/hr)—reduced radial traffic meant longer green times for the orbital route.
- A markedly improved environment for people living, working or walking in the central district. Noise levels fell from 74 to 67 decibels and carbon monoxide from 65 to 5 parts per million in the traffic-free area.<sup>37</sup>

The Dutch city of Groningen introduced a similar traffic circulation plan in 1977 and achieved a 44 percent reduction in the number of cars and vans in the central area in the first

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<sup>36</sup> Mathew, D., "Calming the Traffic—Exciting the Cyclist," *Cycletouring and Campaigning*, Feb/March, 1989, Godalming.

<sup>37</sup> "Center City Environment and Transportation: Transportation Innovations in Five European Cities," United States Department of Transportation, 1980, Washington, D.C.

year. Bus travel rose 12 percent and bicycling and walking increased substantially. Bicycle use in Groningen is now well over 50 percent of all trips.<sup>38</sup>

In each of these cities, cars can still reach all parts of the city center—if they need to. For most people it makes more sense and is more convenient to go by some other means. Once in the center, the absence of traffic has made the shopping and working environment very attractive.

### Italian Auto-free Zones

Motor vehicle traffic in many Italian cities has become unbearable for residents and visitors alike in the last decade. The impact of traffic accidents, congestion and extremely destructive air pollution has prompted a number of cities to close off large downtown areas to all but essential traffic—i.e. noncommuters and those with a final destination in the downtown such as residents and merchants.

Both Florence and Milan introduced such measures, usually involving complete closure of the central area to all but those with permits, after citizen referenda confirmed popular support for them. Even the chaotic Milan experiment cut motor vehicle travel to the central area by half.<sup>39</sup>

The most successful of the Italian cities to introduce this kind of area-wide traffic restraint is Bologna. Under a slogan of “A City for Living” authorities have tightened access restrictions to streets in the historic central district while improving bus, trolley, and metro services.

Many other cities in Europe have taken quite remarkable steps to reduce the impact of cars in their central areas. For example:

- The city of Freiburg, Germany (pop. 175,000) has 5 kms (3 miles) of pedestrianized streets, 125 kms (78 miles) of quiet traffic-calmed streets, 135 kms (84 miles) of bike paths and an efficient tram and bus system. Bicycle use doubled between 1976 and 1986 and with the introduction of a cheap, integrated transit pass, transit use rose 20 percent and 18 percent of car users switched to transit.<sup>40</sup>

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<sup>38</sup> Clarke, A., *Bicycles Bulletin*, July–December 1987, Friends of the Earth, London.

<sup>39</sup> Roberts, John. “Traffic Calming,” *Pro Bike '90 Proceedings*, Bicycle Federation of America, Washington, D.C.

<sup>40</sup> Roberts, J., and Monheim, H., “The Economic Case for Green Modes” and “The Evolution and Impact of Pedestrian Areas in the Federal Republic of Germany,” *The Greening of Urban Transport*, Belhaven Press, 1990, U.K.

- In 1989, the Mayor of Paris (pop. 2.3 million) announced plans to ban on-street parking from 200 miles of central city streets—close to 100,000 spaces—and to use the additional space for transit lanes and pedestrian facilities.<sup>41</sup>
- Residents of Amsterdam, Netherlands voted by a narrow majority in 1992 to severely restrict car access to the central area and to reduce the number of car parking spaces by half.

### **Traffic Calming Through Roads**

In addition to causing problems in large urban areas, motor vehicle traffic, especially through traffic, is a significant problem in many small towns and villages sitting astride major roads. For decades the solution to this problem has been to build costly by-passes around the affected area. In Denmark and France, however, traffic engineers and planners have successfully adapted the principles of traffic calming to major routes.

As with traffic calming in residential streets, a key objective is the reduction of vehicle speeds. Once again, the results are quite impressive.

- France: “A general speed reduction in a number of such small towns has been observed to be between 10 and 20 km/hr (7-13 mi/hr). So the average speed and especially excessively high speeds have been decreased, while free-flowing traffic conditions have been preserved at moderated speeds. In most cases, capacity and average travel time were maintained in these small towns.”
- The average number of accidents dropped by over 60 percent in the 10 towns studied.
- Denmark: A general speed reduction of between 8 and 10 km/hr (5-6 mi/hr) was achieved. Both the total number of accidents and injury accidents were reduced in the three experimental towns by 50 percent, and the number of injuries by one third.

Estimates suggest that a traffic-calmed street costs 10 percent more than regular reconstruction of a street and three to four times less than a by-pass. In addition, maintenance costs on the by-pass are likely to be 50-70 percent greater than on the reconstructed through road.<sup>42</sup>

Bracher reports on the impact of these projects on bicyclists. In Vinderup, Denmark the speed limit was lowered to 40 km/hr and cycle paths were constructed along the road. Seventy-five percent of bicyclists said they felt safe riding on the street after the changes, compared to

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<sup>41</sup> “Paris Pushes out the Motorists,” *Manchester Guardian*, October 22, 1989.

<sup>42</sup> Djurhuus, “Through Traffic in Small Towns,” *Permanent International Association of Road Congresses*, 1991, Paris.

just 17 percent before. In addition, 54 percent felt it had become easier to cross the road, compared to 9 percent previously.<sup>43</sup>

In another Danish town, Skaerbaek, cyclepaths were also included in a package of measures to reduce the speed of through traffic on the main road. Car speeds fell from 58 to 51 km/hr (36 to 31 mi/hr) small truck speeds fell from 60 to 49 km/hr (37.5 to 30 mi/hr) and large trucks from 55 to 46 km/hr (34 to 28.5 mi/hr). A total of 68 percent of people find it easier to move around town, including the majority of car drivers.

Although bicyclists actually now take longer to get across the main road, they approve of the measures. Almost half (47 percent) actually think it is easier for bicyclists to cross the road and 17 percent say it is more difficult. Only 6 percent (compared to 38 percent previously) are impeded by parked cars and 90 percent (compared to 37 percent) feel safe as bicyclists.<sup>44</sup>

## 7. Summary

Controlling and managing traffic has been the challenge of traffic engineers and planners throughout Europe for the last 30 years. The fact that Germany, the Netherlands, Denmark, and Scandinavian countries were first to grapple with the issue reflects the higher levels of car ownership and use experienced in those countries. As these levels have risen in other countries, so they too have had to rise to the challenge and determine how to manage cars in cities.

Five key themes have emerged. First and foremost has been the acceptance that cars must have a limited place in the life of cities—and this is often contrasted with the experience of cities in the United States, where the car has been accommodated at all costs.

Second, a new hierarchy of roads and streets has emerged. Major roads (nonfreeways) should have speed limits of 50 km/hr (31 mi/hr) with priority given to public transport and dedicated space given over to pedestrians and bicyclists. On collector and distributor roads, speeds should be limited to 30 km/hr (18 mi/hr) and speed reducing designs such as speed tables, crosswalks, bike lanes, sidewalks, and controlled parking methods should be utilized. Pedestrian areas, woonerven and very low speed routes complete the hierarchy in purely residential low-volume streets and shopping streets.

Third, this reflects a new paradigm: pedestrians, bicyclists and public transport are prioritized. Motor vehicles are the least desirable means of transport for most journeys in urban areas and should be discouraged at the expense of these other alternatives.

Fourth, all the modes, together with land-use planning are completely inter-connected and must be integrated. Implementing special bicyclists networks or pedestrian areas on their own

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<sup>43</sup> Commission of the European Communities, *Policy and Provision for Cyclists in Europe*, 1989, Brussels.

<sup>44</sup> *Ibid.*

will have limited overall impacts—a combination of measures is required to reduce the impact of motor vehicles in particular and transport in general.

Finally, the spirit of innovation is alive and well in the planning and engineering disciplines in Europe. Coupled with a willingness to involve the public in the process of determining the future shape of their neighborhoods, this willingness to experiment has been quite remarkable.