TRAFFIC CALMING MEASURES AS AN AID TO URBAN REGENERATION

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CONTENTS

Abstract

Acknowledgements

1. Introduction

2. What is Traffic Calming?

3. Traffic Calming policy in the Netherlands

4. Traffic Calming Policy in West Germany

5. Finance and Implementation
   - Who initiates schemes?
   - Which bodies are involved?
   - Who pays?
   - Maintenance costs and procedures

6. Public Involvement

7. Evaluation

8. Conclusions

Appendices

A. Study visit itinerary

B. References

C. Financial Statement

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ABSTRACT

The report is based on information obtained during a study visit to Holland and Germany undertaken in autumn 1988 and funded by the Nuffield Foundation. It describes the purpose and practice of traffic calming in these countries, concentrating in particular on the policy context, finance, implementation and evaluation aspects.

It concludes that traffic calming is widespread, popular, and effective in reducing the harmful effects of road traffic on urban communities. Furthermore, the safety and environmental improvements associated with traffic calming are seen to be part of wider urban planning policies, notably the regeneration of run-down inner city areas, housing renewal and the conservation of historic centres.

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1. INTRODUCTION

Since the early 1970's attempts have been made in various countries to redesign roads in built-up areas to reduce danger to pedestrians and cyclists, and to improve the local environment. The best known and earliest examples were the Dutch “residential yards”, or “Woonerf” schemes, where traffic speeds were forced to walking pace and pedestrians were given equal priority over the whole of the street surface. A range of physical and legal measures were incorporated into the reconstructed streets to tip the balance in favour of the residential function of the street, and to reduce the domination of motor vehicles. These measures included speed humps, ramps, continuous footways, twists and turns, narrowed sections, designated parking spaces, planting, and various other means of visually reinforcing the message that the street is a “home” area where the motorist is allowed as a guest.

In the fifteen years or so since the birth of the Woonerf, the techniques have been developed to apply not just to individual residential streets, but to whole areas of towns, to main traffic arteries, to villages, shopping streets and town centres. This aspect of urban planning is fundamentally concerned with reducing the adverse impact of motor traffic on built up areas, usually involving a three sided approach of speed reduction, more space for pedestrians and cyclists, and environmental improvements. In some cases these policies have been part of wider policies of traffic restraint and urban regeneration. The totality of the movement is referred to in this report as “Traffic Calming”.

With a grant from the Nuffield Foundation, the author undertook a tour of West Germany and the Netherlands to study traffic calming practice. The study itinerary is shown at Appendix A. A large quantity of information was collected on the specific techniques used for traffic calming. A full distillation of this material would be beyond the scope of this report. Instead, we concentrate on the policy context of traffic calming, the financial and implementation aspects, and evaluation.

The work reported here deals exclusively with practice in continental Europe. Practice in the UK is by comparison rudimentary and undeveloped, as shown in the author's earlier publications on the subject (“Improving the Safety of Local Streets” 1983, and “Adapting Residential Roads for Safety and Amenity”, with Liz Beth, 1988). However, countries that have not yet embarked on a widespread programme of adapting streets to make them safer and more attractive have the potentially valuable advantage of being able to learn from the considerable wealth of experience that has been gained in the Netherlands, West Germany, Denmark, and other European and Scandinavian countries over the past fifteen years.

There is a danger, however, that particular examples of practice will be either misunderstood (and applied in inappropriate locations) or dismissed as being “unsuited to conditions in this country”. Misunderstanding of practice can only be overcome by thorough study and exchange of views, as attempted in this study. The latter problem is largely illusory. Of course conditions vary from place to place, but so they do within the countries that have adopted widespread traffic calming. More importantly, the problems which traffic calming aims to alleviate are experienced universally, namely the danger, intimidation, severance, noise, pollution, dirt and visual degradation caused by high levels of motor traffic in urban streets.

It is therefore useful to present the policy framework within which traffic calming schemes have been implemented, and the financial and practical means by which they have been achieved.

2. WHAT IS TRAFFIC CALMING?

Traffic Policy in Transition

Although transport and traffic policies vary widely between the different European countries and regions, and even between different cities, there is a common theme which has led to the “traffic calming” approach.

During the 1970's there was a growing realisation that policies aimed at providing roads and parking for fully motorised towns and cities had failed to produce a transport solution within the limits of environmental and financial acceptability. Indeed, the problems of accommodating motor traffic in established communities had been graphically demonstrated in Buchanan’s “Traffic in Towns” as early as 1963. But the real turning point in most countries followed the oil crisis in the mid-1970's, when growing concern for the environment and doubts about the future of oil supply led to the abandonment of literally hundreds of major urban road projects, and to the emergence of various counter-initiatives.

A whole battery of measures have been developed and applied to limit the demands of motor traffic, and to minimise its negative impact on the urban environment. Such measures include parking controls, waiting restrictions, bus priorities, provisions for cyclists, pedestrian shopping streets and malls, and major investment in new or upgraded public transport services.

Many of these measures fall into the category of what is usually termed “traffic restraint”, though this is a term which has an unfortunate negative ring. The aim after all is not to restrain traffic for its own sake, nor to prevent people from undertaking reasonable travel by car. Extreme anti-car views have become as unpopular as extreme pro-road views.

The aim is to influence or manage demand for travel to produce a better balance between the desires of people to use their cars, and the desires of people to live in towns and cities which are attractive, safe, and accessible to everyone (including non-car users).

The abandonment of wholesale attempts to adapt the city to the car, and the acceptance of motor traffic as an inevitable feature of urban life, has allowed the growth of policies designed to influence the behaviour of traffic and its distribution on the road network. To a considerable extent these measures can be pursued without necessarily reducing the overall volume of traffic.
It is this approach, and its associated measures to reduce speeds, improve safety, cut accidents and improve the surroundings in which we live, which is referred to throughout this document as “traffic calming”.

Before leaving this general look at transport policy, it needs to be hastily added that although there has been a major shift in the approach to traffic in towns, a powerful debate continues in most countries. This debate reflects two fundamentally opposed views. One is that towns and cities will whither and die if people cannot gain access to them in their cars. The other view is that towns and cities will whither and die if access by car is allowed to create an intolerable environment.

Traffic calming is clearly aligned to the latter view, but is nevertheless practised even within a political climate that that is generally “car friendly”. There are a number of ways in which this apparent paradox may be explained.

Firstly, “traffic calming” perhaps needs to be more closely defined as being concerned with traffic behaviour, and not directly with deliberate reductions of traffic volume. It is thus distinguished from “traffic restraint”.

Secondly, confusion can arise because traffic calming measures may lead to local reductions in traffic. For example, measures to reduce speed within a residential area may divert traffic onto alternative routes, or may even reduce total traffic. This may be accepted as an aspect of local improvement, but could give rise to strong opposition if it were promoted as a means of reducing car traffic.

Thirdly, it is possible to reduce car traffic (or limit its growth) by investing in new railways and other non-car alternatives. Such policies which “attract” people towards alternative forms of transport tend to meet less resistance than policies designed to “push” people out of their cars. Thus the presentation of policy is a factor in its political acceptability, and examples of this are given later in this report.

Policy Context in Holland and Germany

In both Holland and Germany (hereafter used to refer to The Netherlands and the Federal Republic of West Germany), local authorities enjoy a large degree of autonomy from their respective state, federal or national governments, and freedom to implement their own local policies and schemes. Conformity to nationally devised norms cannot often be enforced, though there are often incentives in the form of financial and other assistance. Moreover, advice from national agencies is needed (and often sought) to help local authorities to avoid mistakes and to benefit from each other's experience. The advice itself, however, is based on research programmes linked to schemes implemented at the local level.

Traffic calming in both countries is promoted at the National and Federal level as part of an integrated transport policy, and specifically as a means of improving road safety and improving the urban environment. The aim of reducing the total volume of traffic is less clearly stated, especially in Germany, except as a desired consequence of investment programmes in public transport and cycle facilities. Some individual city governments do, however, regard traffic calming as part of an explicit policy of traffic reduction.

We now look more closely at the policy framework for roads and traffic in Holland and Germany. The late Dr Klaus Turke of the German Federal Research Institute for Regional Geography and Planning once acknowledged to the author that “Holland is

the mother of traffic calming". It is therefore logical to begin with the evolution of policy in Holland.

3. TRAFFIC CALMING POLICY IN HOLLAND

In Holland, where there is no significant motor manufacturing lobby, national policy openly promotes public transport, pedestrians and cyclists at the expense of the car. For example, "Henceforth other functions will be given priority over motor traffic" and "the car's dominance should be diminished by deliberately increasing travel times, by creating a less dense network of main roads, and by reducing speeds" (see reference NL029).

The ANWB (Royal Dutch Touring Club), the equivalent of the AA or RAC, is broadly in favour of traffic calming policy, and indeed has done much to promote the Woonerf and subsequent initiatives (NL032, 033, 034, 036).

To be effective, however, national policies depend on the active involvement of the municipalities, some of which are more enthusiastic than others. Groningen, Den Haag, Delft and Tilburg are examples of cities that have an explicit policy of promoting public transport and non-motorised transport at the expense of the car. Groningen, where 50% of all journeys are made by bicycle, has achieved a 25% reduction of car traffic in the city centre. In Delft, the provisions for cyclists are held to be responsible for halting the growth of motor traffic. With car traffic in Holland generally increasing, a static trend in Delft may be regarded as a successful example of "traffic avoidance".

The Dutch "integrated transport policy" which has evolved since the mid-1970s includes the following features:
- Selective use of cars
- Emphasis on public transport, cycles and pedestrians
- Canalisation of traffic in urban areas (see below)
- Reducing speeds in residential areas
- Encourage cycling with the provision of better facilities
- Rail improvements and new lines
- Bus and tram priority at lights
- Abandonment (1977) of many inter-city road schemes after public consultation.

Although policy initiatives by the municipalities are important, the Ministries of Transport & Public Works and Housing & Physical Planning have directly promoted the integrated approach through a range of demonstration schemes and incentive grants. The main ones relating to traffic calming are:

- Area-wide traffic calming demonstration projects in Eindhoven and Rijswijk (Den Haag);
- Cycle demonstration projects in Tilburg, Den Haag, Delft;
- Parking demonstration project in Utrecht;
- Facilities for the handicapped demonstration project in Gouda;
- 15 demonstration projects for 30 kmph residential zones;
- "Action 25%" campaign including funding for road safety projects and special scheme awards, to reduce accidents by 25% by the year 2000.

In addition the Government plays a key role in providing grants and subsidies for public transport, still in the region of 50-80% of operating costs and 80-100% of capital investment.

These wide-ranging but integrated policies have evolved as a product of many influences over a period of fifteen or twenty years. There is general agreement as to the origins of the movement for converting residential streets to make them more "livable". Planners and engineers in the city of Delft in the early 1970s recognised the inherently dangerous layout of traditional streets, where people walk and children play within feet of solid objects travelling, quite legally, at 50 kilometres per hour, or illegally at even greater speeds. It was felt that "where frequent near-contact situations cannot be avoided (ie. where pedestrians and vehicles must share the same street) then the circumstances under which these contacts take place must be altered" (NL031). This was the beginning of the "Woonerf" concept.

In those early years, the policy was to identify streets with low traffic volumes and a purely residential function, and to redesign them so as to make driving at more than walking pace impossible, and to ensure that "traffic is not allowed to dominate", and to "emphasise their function as a place in which people live and have their home" (Minister for Transport & Public Works in NL032).

An area-wide approach in Eindhoven and Rijswijk (Den Haag)

The Woonerf solution spread rapidly and many streets were converted in almost every Dutch town. It was soon recognised, however, that the problem of traffic domination of urban areas needed to be tackled on a wider scale than just individual streets. In 1974 the Ministries of Housing and Transport published a policy document which laid down a principle for urban traffic which has continued to be a foundation stone of Dutch traffic planning. This principle is that public areas of towns and villages should be divided into two zones, namely ***living areas and traffic areas***. This principle has since been elaborated in regional, structure and traffic plans, including the structure scheme for traffic and transport, which set out the integrated transport policies already quoted.

In order to gain experience of this reclassification of urban space into living and traffic zones, the Government set up two large-scale demonstration schemes. Areas of about 100 hectares were selected in Eindoven and Rijswijk (a district of Den Haag). The aims of these demonstration projects were to:

- Investigate the possibility of dividing urban areas into living and traffic areas, using various measures (see below);
- Carry out before and after studies into the effects;
- Make recommendations on the restructuring and costs;
- Gain practical experience with the statutory minimum requirements for pedestrian priority areas.

The measures used in the "living areas" were grouped into three "Options".

Option 1 - Very simple measures (e.g. one-way streets) to exclude through traffic from residential streets

Option 2 - More extensive measures to exclude non-local traffic and to limit the speed of the remaining traffic, (e.g. using ramps and narrowings)

Option 3 - Complete reconstruction as pedestrian priority areas (on the Woonerf model)

These three options applied to the “living areas”. The projects also included measures in the “traffic areas” (main roads) to ameliorate the effects of motor traffic on vulnerable road users and the environment.

The demonstration projects began in 1977 and were mostly complete by 1985. Interim results had shown that the Option 1 measures had succeeded in reducing traffic volumes, but had done little to improve the “livability” of the streets concerned. Consequently the Option 1 areas subsequently have been upgraded to Option 2 areas with the provision of speed tables, ramps, humps, narrowings, chicanes and other measures. This upgrading was complete by summer 1988, so no Option 1 areas could be viewed during the author’s study visit.

The Option 3 (Woonerf model) areas created some problems, especially in Eindhoven. Prior to the announcement of the demonstration project, an area of housing within the selected 100 hectares had already been converted to Woonerf. This area was one of relatively poor families living in mainly rented housing. Residents in the adjacent areas proposed for reconstruction to Option 3 standards were strongly opposed to having their streets converted to Woonerven, mainly because they had come to identify the Woonerf with poor areas. This reaction “was a new and unexpected element in the discussion” (NL029 p19). The commonly held view based on earlier research (by ITS in Nijmegan) that Woonerven were universally popular had thus to be modified.

From Woonerf to Erf

From the mid 1970s onwards the Woonerf concept, originally confined to residential streets, was extended to shopping streets (Winkelerf) and village centres (Dorpserf). There was, however, no legal status for such schemes until July 1988 when new regulations became effective for all “Erf” areas, regardless of the function of the street. (NL001 p104 refers to “van Woonerf naar erf”; Min. van Verkeer en Waterstaat 1985) Thus new “Erven” can be created not only in residential, shopping and village streets, but also around schools, hospitals, commercial areas or railway stations. Anywhere, in fact, where it is decided that pedestrians should be given priority over motor traffic. The new Erf regulations are also much simpler and are based on the principle that the design and layout of the street must reasonably ensure that drivers proceed at walking pace. The 14 Woonerf regulations have been replaced by 6 Erf regulations. This gives more freedom to local authorities who have sometimes opted for less drastic measures (such as 30kmph zones) to avoid the strict Woonerf regulations. The agreed international sign will be used at all Erven, and will replace the original Woonerf sign. (NL001 p620)

The Woonerf has been a great success, and by 1985 there were estimated to be 4,000 Woonerven involving 7,400 streets (NL024).

In the development of a general policy for “living areas”, the Erf solution is recognised at all levels of government as valuable but too costly and too drastic to provide a universal solution. At the other end of the spectrum, the simple removal of through traffic without supporting measures does not bring about significant improvements in living quality. A middle-ground of traffic calming was therefore needed which was both effective and cheap enough to be applied on a wide scale.

30 kmph Zones

These general considerations, supported by the findings from the area-wide demonstration projects, led to the introduction of a new 30 kilometre per hour speed limit in 1983. Streets and areas can be designated as 30kmph zones only if self-enforcing measures are in place to ensure that this speed is not normally exceeded. Especially since the publication in 1983 of a handbook of available techniques, (NL003) municipalities throughout Holland have been implementing 30 kmph zones in living areas.

This policy was promoted at Government level also with the setting up of 15 demonstration projects in a variety of areas throughout the country, the full evaluation of which will be ready in 1989. Meanwhile the handbook of measures is in its third edition (NL001, 1988) and has been expanded to include all traffic engineering techniques. Although its recommended standards cannot be enforced, the handbook is regarded by municipal engineers and planners as a “reliable source of information”.

FIGURE 1 DUTCH LIVING AND TRAFFIC AREAS POLICY IN RELATION TO SPEED LIMITS

“Living Areas” (Verblijfs-gebeiden)	a.	“Erven” (pedestrian priority, no through traffic, traffic at walking pace)
	b.	30 km/h zones (with self-enforcing measures)
“Traffic Areas” (Verkeersruimten)	c.	50 km/h major roads (general built up area speed limit)
	d.	70 kmph through roads (general non-urban limit)
Non-urban area	e.	100 & 120 kmph limited access motorways

Traffic Area Policy

Policy development now focuses on how to improve conditions on through roads (i.e. the “traffic areas”). A start has been made with the introduction of measures to slow traffic on through roads where they pass through smaller towns and villages. In some

cases the speed limit has been reduced to 30 kmph. The next step will be to develop techniques for speed reduction and reducing space for vehicles on the main urban road network. Some experience has already been gained from the Eindhoven and Rijswijk demonstration projects, which included main roads.

Action 25%

A further road safety initiative, launched in 1988 by the Government's Road Safety Directorate, is "Action 25%, which aims at a 25% reduction of road casualties by the year 2000. The "Through Roads in Small Centres" programme referred to above is part of Action 25%, which also focuses on the following:

- Drinking and driving
- Safety features
- Traffic speeds
- Dangerous situations
- Elderly road users
- Young road users

A controversial incentive scheme has been set up by the Minister whereby municipalities agreeing to improve road safety will receive an initial payment of one guilder (about 30 pence) for each resident in its area, and further payments for schemes which succeed in reducing accidents. Other organisations that work hardest to improve road safety will receive a prize of 50,000 Dfl (about £15.000).

Traffic Calming and Urban Regeneration

Traffic calming is not simply an element of Dutch transport policy, it is also an important element of a policy to regenerate the older parts of towns and cities, and to make them once again attractive places in which to live. Amsterdam, for example, has a "compact city" strategy which emphasises traffic restraint, public transport and high density inner city living, and discourages further "out of city" development. Housing rehabilitation is taking place in the older areas of most towns, many of which are of great architectural or historic interest. Between 30 and 40% of the housing budget for such work is devoted to street improvements. A large portion of this is accounted for by the relaying of utility services (underground pipes, cables etc.) but as the street surfaces are re-laid the opportunity is taken to build in traffic calming measures - either "erf" or "3Okmph" measures - and to introduce attractive street furniture, paving and planting. As one Ministry official explained: "once the services have been laid, the cost of some bricks and trees is not so much".

An example is Leiden which has the largest old central city after Amsterdam with about 3,000 listed buildings, of which about 80 are restored each year at a cost of over £2 million via Government grants. This renovation is usually done street by street, and involves complete reconstruction of both underground services and street surface. The short distances between buildings in the older streets limits the extent of traffic calming measures, however, particularly because of the shortage of parking space.

The problem of over-intensive on-street parking in the older Dutch cities may be tackled in a new National Plan for Traffic in the year 2010. This includes a scheme to

precept each street to the extent of 3,500 DFl (about £1,000) for each parking place, to pay for off-street garages, usually in under-used backlands.

An important feature of Dutch cities which needs to be emphasised is that many of them, especially in West Holland, are built on peat. The instability of this sub-soil requires the carriageways in urban streets to be re-laid every 10-15 years, and in very old quarters at even more frequent intervals. Thus within the space of, say, 20 years the Dutch can re-lay an entire network of urban streets. This certainly helps to explain how the Woonerf and 30kmph zones have spread so rapidly. Also, the fact that residents of Dutch towns are more accustomed to having their streets torn up and re-laid may have meant less public resistance to changes in the street design. The official view, however, is that high living densities and the widespread concern about road accidents and environmental quality are the main factors which put Holland in the lead in calming urban traffic.

4. TRAFFIC CALMING POLICY IN WEST GERMANY

It may seem surprising that a policy of traffic calming should have arisen at all in such a car-orientated country as West Germany. It manufactures more (and faster?) cars than any other European nation, has the highest car ownership rate this side of the Atlantic, has built a comprehensive network of motorways - most of which operate without speed limits, and has invested huge sums on major urban roads and ring roads since the last war.

Yet the German Federal ministries in Bonn have since the early 1980s been promoting integrated transport policies which favour public transport, pedestrians and cyclists rather than the private car, albeit with a less united voice than in Holland. It is probably wrong to seek a simple explanation. On the one hand there are strong voices in Germany for stricter environmental controls, on the other hand there are those who fight any policy which they consider to be a threat to Europe's largest motor industry. But these opposing voices are not consistently aligned.

The principal German motoring organisation (ADAC) appears to support traffic calming and, like its Dutch counterpart (ANWB), has produced documents on the subject (e.g. D031, D007 p56). The private chamber of trade and commerce in Cologne has published an attack on traffic calming as vitriolic as it is glossy (D060). Some cities still have no explicit policy of taming the car, whilst Berlin has a deliberate policy of not taming the car. As in Britain and other countries, traders are typically conservative and often resist changes such as pedestrianisation and other traffic calming measures. Yet there are places where traders are asking for such measures, and are willing to pay for them. Estate agents often emphasise a property's location in a "traffic calmed" street as a selling point.

Thus there are trends and counter-trends and many apparent inconsistencies. John Ardagh in his book "Germany and the Germans" has this to say:

> "... if most Germans love their trees, a potent minority love their cars even more. The average German driver is highly disciplined and prudent in town, keeping carefully to the traffic lanes, and braking at lights even where there is no pedestrian in sight; but behind the wheel on an open autobahn, where there are no speed limits to hold him back, he becomes like a creature possessed, especially if he is in a fast car, tearing down the outside lane, lights flashing, at 200kph or more." (D061 p126)

Nevertheless, German cities have been leaders in pedestrianizing shopping streets, developing policies that began in Essen and Cologne during the inter-war period (D062 p86). Since about 1975 traffic calming measures have been taken in virtually all German cities, even in "car friendly" Berlin *. And in 1988 the first general autobahn

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* An article in a West Berlin newspaper headed "VORRANG FUR'S AUTO" began "Dass Berlin eine autofreundliche Stadt ist, ist allseits bekannt" - Berlin, as everyone knows, is a city that is friendly to the car. "Schoneberger Stichel" No. 45, September 1988.

speed limit (120 kmph) was imposed on the A45 Dortmund-Frankfurt. It is clear that the (high) accident rate and environmental damage caused by motor traffic has compelled the “Länder” and municipalities to act. This is true even in cities with influential motor lobbies such as Ingolstadt and Stuttgart (where, respectively Audi and Mercedes Benz plus Porsche cars are made). Some cities actively promote public transport as a means of reducing car traffic, and there is evidence of reductions having been achieved (Hannover and Nurnberg for example). (EC004 p133)

Several documents promoting traffic calming policy have been produced since the late 1970s by the Ministry of Regional Planning, Building and Urban Development. Some of these have been lavishly produced in colour in an attempt to reach a wide audience.

As in Holland, the policy began with “spot treatments” of residential streets from which through traffic was excluded (D002). The early schemes were based on the Dutch Woonerf and were labelled “Verkehrsberuhigung”, which means “traffic pacification” or “traffic calming”. The term is now applied to the wide range of policies and measures designed to slow traffic down, to achieve a calmer style of driving, and to improve the livability of streets. It is applied also to measures not just in residential streets, but to whole areas of cities, complete villages, and to major thoroughfares.

The transition of the traffic calming concept from a local traffic management technique to a major element of urban planning policy is clear from a document published by the Federal Ministry entitled (literally) “Town Traffic in Changeover” (D001). This argues the case that accessibility can be just as good with slower traffic speeds, while slower speeds enable carriageway space to be given over to public transport, pedestrians, cyclists, and green space. The theme that “less speed equals less space” is given practical interpretation, of which we will explore examples in later sections. The term “Verkehrsberuhigung” (traffic calming) is said (D001 p14) to embrace the following:

- Improvements for pedestrians and cyclists
- More traffic safety
- Improvement of the environment
- Promoting inner city living and shopping
- Less noise and fumes
- Nicer appearance, fewer traffic signs
- More green
- Less comfort and lower speeds for private motorised traffic

As part of the move away from the “spot treatment” approach, the Government set up six major demonstration projects for area-wide traffic calming. The associated before and after studies are particularly interesting covering as they do a wide variety of urban and village situations, and main roads as well as residential areas (see Table 1 below).

Other policy developments follow a sequence similar to that in Holland. The “Woonerf” model is also now thought to be too expensive, and in some ways too drastic an alteration to traditional townscape, to be the universal solution to residential areas. A provision was therefore drawn up for the creation of areas with speed limits below the traditional 50 km/h. These were based particularly on experience in Hamburg which had “jumped the gun”, and introduced 30 kmph limits ahead of the legality of the

30kmph sign! More than half of Hamburg's residential street network was covered by the 30kmph provision by 1986. This approach has been implemented on a wide scale in many other cities and by 1988 there were over 2,000 known 30kmph zones. These “Tempo 30” regulations expire, however, in 1989, and a decision will then have to be made about the future of the 30kmph limit.

TABLE 1
FEDERAL AREA-WIDE TRAFFIC CALMING DEMONSTRATION PROJECTS

TOWN (pop)	STATE	TYPE OF AREA	KM_2	POP	COST (Mio DM)
Berlin (1,900,000)	Berlin	19^{th} C Inner City “Moabit”	1.2	30,000	5.1 *
Borgentreich (2,300)	Nordrhein/ Westfalen	Village (whole area)	2.5	2,300	6.5
Buxtehude (33,000)	Neidersachsen	Historic core and surroundings	2.5	10,000	5.0
Esslingen (87,000)	Baden/ Wurttemberg	Medium-sized town, edge of central area	1.5	11,000	15.0 **
Ingolstadt (91,000)	Bayern	Central area of medium-size town	1.2	5,500	18.0 **
Mainz (105,000)	Rheinland/ Pfalz	Suburbs and old village within large town	2.5	12,000	3.2 **

* Excluding main roads
** Estimated
Source: A. Doldissen “Environmental Traffic Management - German Interministerial Research Programme” PTRC 1988 (D032c)

There is pressure on Bonn particularly from Nordrhein-Westfalen and the Deutscher Städtetag (an association of larger municipalities) to make 30kmph the general urban speed limit, with 50kmph roads being specially signed, rather than the reverse as at present. (There are similar calls from pressure groups in Holland.)

The principle that 30kmph zones should only be designated where physical measures have been taken to make the limit self-enforcing, is less strictly adhered to than in Holland. Indeed, some speed reduction has been achieved merely with the placing of 30kmph signs - for example in Nurnberg and Hannover - an experience not generally shared with other countries.

Calming measures have also been applied on some through roads in villages and some major roads in cities since the early 1980s. The aims and techniques in these situations are concerned more with reclaiming traffic space for the benefit of non-motor traffic, and speed reduction is less easily achieved than in residential areas. As in Holland, it is on these roads that the main work of policy development remains.

Efforts have been made to reverse the decline in bicycle use that occurred up to the 1970s. The Environment Ministry funded projects in two towns (Detmold and Rosenheim) in the early 1980s, which succeeded in increasing cycle traffic to 20% of all travel by 1983, and causing a 2% drop in car and public transport traffic. The decline in car traffic is a significant achievement when compared to an overall national growth of 3% per annum between 1976 and 1982.

As in Holland, there are more bicycles than cars in Germany and (according to TEST, 1987 [EC004]) the provision of bicycle facilities has become "the only activity which is not politically controversial. Everybody is in favour of bikes."

There are five main tiers in the urban road hierarchy and traffic calming policy becomes more tentative the "higher" the category of road.

"Fussgangerzonen" (pedestrian zones) usually shopping areas are removed from the traffic network.

In **"Wohnstrassen"** (residential streets) traffic calming is relatively easy and widely applied, especially where through traffic is removed.

In **"Sammelstrassen"** (collector roads) traffic calming can be achieved by reducing the space for motor vehicles. This achieves a more livable environment, but the effects on speed reduction and accidents are not yet fully researched.

In **"Hauptstrassen"** (main roads) there also are traffic calming possibilities. The conflicts to be resolved are usually greater (because of the need to provide for through traffic, bus routes, shopping, servicing etc.) but the benefits to be gained can also be greater.

"Autobahnen" (limited access roads) have speed limits only in urban areas.

The approach of the Federal Research Institute for Regional Geography and Planning is to "get the techniques and guidelines for traffic calming into the consciousness of all road and traffic planners and engineers in the Länder and communities" (meeting with the late Dr Klaus Turke, 1987). But apart from the six Federal area-wide demonstration projects, the Länder have their own programmes. The Nordrhein-Westfalen Land is by far the most active in the traffic calming field. Its Ministry of Urban Development, Housing and Traffic estimates that 70% of all German traffic calming schemes are to be found within its region. Of course, it is the Land with the largest population (17 million - 27% of the West German total), but it is by no means the richest region, nor the region with the most beautiful cities. A large programme of traffic calming research has been undertaken in Nordrhein-Westfalen, much of it by the Ministry's own research institute in Dortmund (ILS).

The leading position held by Nordrhein-Westfalen is almost certainly connected with its unique organisational structure, namely a combined Ministry of Urban Development, Housing and Traffic. Other Länder, like the Federal Government, have separate traffic ministries, often (as in Bavaria and Baden-Wurttemberg) closely linked with the motor industry. This serves to highlight an important feature of German traffic calming practice, namely the variations of approach between the Länder, and their relatively high degree of independence from Bonn. Thus Nordrhein-Westfalen has the most radical and comprehensive approach; Hamburg (a city-state) has concentrated on 30kmph zones; Berlin (also a city-state) denies any traffic calming policy yet allows its planning ministry to implement one of Germany's most successful schemes (Moabit); and in Bayern concern for transport centres on its role in expanding the economy, and traffic calming is promoted mainly as an aspect of beautifying its already-beautiful cities.

These are generalisations of course, but they illustrate the point. Moreover, the cities and smaller communities also enjoy a large degree of autonomy, so neither Federal nor Länder policies can convey a complete picture of traffic calming (or indeed other) policies throughout the Federal Republic, and there are exceptions to whichever general approach one describes. Dortmund, for example, is considered more resistant to traffic calming than other Nordrhein-Westfalen cities, while Nürnberg (Nuremburg) has pursued policies that seem radical compared to other Bavarian cities.

Urban renewal schemes in city centres, and in older inner-city housing areas, frequently provide an opportunity and finance for traffic calming measures. In German cities it is noticeable that a high proportion of schemes are to be found in areas housing low-income families, often with a high proportion of immigrants. This seems to be a direct result of the link between street improvements and housing renewal programmes. A city planner from Nürnberg suggested that the poorer sections of the community are in fact more interested in traffic calming than middle-class Germans because they make more use of their streets. This is partly a cultural difference and partly due to the fact that poorer housing areas often have little open space other than the street itself. Schemes are funded not only from the city housing budget, but also by contributions from property owners.

Measures to reduce traffic speeds and volumes can thus be identified with broader planning policies to make the inner cities more livable, and thus to enable them to compete more effectively with suburban developments, in terms of both living quality and economic strength.

5. FINANCE AND IMPLEMENTATION

The object of this section is to answer five questions about the finance and implementation of traffic calming schemes in Holland, Germany and other European countries. Firstly, who initiates the schemes? Secondly, which bodies are involved in carrying them out? Thirdly, what are the sources of finance for the street works and the associated evaluation research? Fourthly, What is the rough order of magnitude of the costs involved? Fifthly, how are schemes maintained?

Who initiates traffic calming measures?

We have already seen that schemes may be initiated in a variety of ways. In both Holland and Germany, early initiatives tended to be in individual cities, for example Delft as the pioneer of the Woonerf, and Hamburg as the frontrunner for the “Tempo 30” developments. But the widespread application of traffic calming techniques throughout these two countries cannot be attributed to multiple individual local authority initiatives. The involvement of regional and central government has encouraged local authorities to implement schemes. Such involvement has been particularly important when promoting policies (like traffic calming) which run against the grain of traditional or mainstream local practice. Central government involvement is regarded as crucial for at least four reasons.

1. It provides a source of reliable information, based on research beyond the scope of local authorities.
2. It provides advice on techniques, procedures and regulations, which can help avoid costly mistakes.
3. It provides a framework into which can fit research efforts by other agencies, such as universities and private consultancies.
1. It provides incentives to local authorities to act, especially through the provision of special grants.

It is important to recognise that initiatives are invariably a response to public pressure, either at the local or broader level. Most observers acknowledge the impact of the mid-1970s oil crises on the shift towards traffic restraint policies. At the city level, local groups often pressure their council to take action in their areas to reduce traffic speeds and accidents. The civic autonomy already discussed often produces powerful mayors who can have a major influence. A senior planner in Nürnberg claimed that “no mayor in Germany can afford to ignore the public pressure for reduction in traffic speed in towns”.

But it is the task of government bodies to translate the (often rather vague) public demands into specific and practical schemes. In this respect the true initiators of particular concepts or designs are more likely to be local authority officers, or their specialist consultants.

There is thus a distinction to be drawn between the political origins of a scheme, and the initiator of its design. The transfer of knowledge from one authority to another (encouraged in both Holland and Germany through central government action) means that schemes may be implemented even where there is no direct public pressure for action.

Which bodies are involved in traffic calming measures?

Most, if not all, schemes in Holland and Germany have been designed and implemented by the local authority. The involvement of other parties is common but may be regarded as an input to the process. Higher levels of government may often be involved in the financing of schemes and may impose conditions. For example, Government grants in Holland for Woonerf and 30kmph schemes are conditional upon the local authority having adequately consulted local opinion. Private or independent research consultants are frequently brought in (by all levels of government) to carry out specialist design work, or to undertake evaluation studies. At the local level, organised groups are often formally involved in the planning and implementation stages.

The restructuring of through roads in small communities in Holland provides an example which is fairly typical (NL020). Three groups of people are identified:

1. An official working party which carries out the planning and design, and coordinates implementation of the scheme. This will include professionals from the local authority, and representatives of the police and other services.
2. The local, county and Government authorities upon whom financial decisions rest.
3. Interested parties such as residents and shopkeepers who, if organised, may participate in the working party (as in 1).

The various national demonstration projects have involved a wider range of people. The six German area-wide demonstration projects were initiated at a conference in 1980 organised by the research institutes of three Federal ministries (the conference attracted 400 local authority delegates), and the work was funded by the local authorities with substantial grants from the Land and Federal governments. The extensive array of before and after studies of these 6 projects were carried out by about 20 independent research agencies (mostly private), and coordinated by the three Federal research institutes, who also met most of the costs. The research was directed initially at demonstrating the available techniques for area-wide traffic calming, and later at describing their effects.

The role of research institutes in developing traffic calming techniques and promoting good practice throughout the country needs to be emphasised. There are several such institutes in Holland and Germany, many of which cover several policy areas, not just transport. These are funded by collections of local authorities (such as the 100 or so authorities in the Deutsche Städtetag which fund the Berlin Planning Institute [DIFU]) or directly from central government or (in Germany) the Länder ministries. Some research institutes rely on project contracts - such as the Institute for Applied Sociology (ITS) in Nijmegan. The "HUK Verband" in Cologne is funded by the association of motor insurers, and investigates road accidents and road safety. In addition there are many research organisations both private and within universities that undertake projects for government agencies, and sub-contracts from the research institutes. Most of the work undertaken by, for example, the CROW institute in Holland and the German Federal institutes is actually parcelled out to independent research bodies.

The research effort is thus spread between a variety of civil servants, professional engineers and planners, academics, private consultants, and interest groups such as the motor insurers, motoring organisations, chambers of commerce, pedestrian and cycling organisations. These bodies together have generated a large quantity of research literature on traffic calming. The DIFU in Berlin, for example, holds more than 1,100 titles on the subject.

The most interesting traffic calming schemes are those which tackle multiple objectives - a combination of, say, reducing accidents, improving safety and providing a more attractive environment. There is a lot of evidence to suggest that such schemes are most effective when they are the product of multiple-interest organisations or teams. In particular, traffic and transport functions need to be combined with urban planning functions, either within joint departments, or in multi-disciplinary working arrangements. Some examples will highlight the point.

In Germany, the initiatives for traffic calming at the Federal level have come mostly from the Ministry of Town Planning and its associated research institute, but the six major Federal demonstration projects were the product of collaboration between three ministries (Town Planning, Transport, Interior) and their research institutes (D030).

In Nordrhein-Westfalen the successful widespread application of traffic calming has been attributed to the fact that it is the only Land with a joint ministry of planning, housing and transport.

At the local level, too, the point is clear. In Berlin the Town Planning and Environment ministry wishes to promote traffic calming in the city-state of Berlin, and has succeeded in implementing one of the best area-wide examples available (the Moabit scheme). But the separate and more powerful Transport ministry is actively opposed to traffic calming and has brought further development virtually to a halt.

In Nuremberg, the Director of Town Planning oversees three departments - housing, transport and general planning - and has the support of the Mayor in promoting a vigorous policy of 30kmph zones, pedestrianisation, and capacity reduction on the main radial roads, all in the context of wider policies of car restraint, improved public transport and inner city housing renewal.

The multi-objective approach is equally a feature of Dutch practice, and this has been achieved through inter-disciplinary working, especially at local government level. There are separate planning, housing and transport ministries in The Hague, all of which have contributed to the national initiatives, though the transport ministry is criticised by some as having become less enthusiastic, apparently following a political shift to the right.

In Groningen the planning and building department of 700 staff is organised in multi-disciplinary teams, deliberately (according to one senior official) “to break down professional barriers and especially the blinkered approach of some traffic engineers”. The process appears to have been aided by a political secondment from the department of a personal advisor to the Alderman in overall charge of planning, building and traffic.

The Public Works department in Delft, which pioneered the Woonerf, is now split into two sections, but between new projects and maintenance, rather than on professional boundaries.

The Eindhoven demonstration project was carried out by a specially constituted multi-disciplinary team which proved effective in reconciling different approaches to the work.

At local authority level generally, planning, housing and traffic are often conducted by separate departments, and although projects are coordinated at chief officer and council level, problems have arisen. For example, some early Woonerven carried out solely as engineering projects were less attractive and less popular than those with an urban design input.

The conclusion must be that traffic calming measures to be fully effective in tackling environmental, traffic and urban development objectives must be implemented by multi-disciplinary teams. This point has been underscored by Beth and Pharoah with regard to experience in the UK (UK002).

Who pays for traffic calming?

Grants from the National government in Holland and the Federal government in Germany have provided a major but not the only source of finance. Important though these have been in promoting policies and developing techniques, they are not regarded as a permanent feature of funding for local schemes. Government grants have been limited either to specific areas (e.g. the 6 German area-wide demonstrations, and the 2 Dutch ones) or to fixed periods of time (e.g. the 80% grant in Holland for cycle facilities 1975-l985). Moreover, much of the money from central sources has been used to pay for associated research rather than for the street works themselves. The German Federal government has sometimes found it difficult to fund local schemes because of friction between the Länder and the local communities, or because of obstruction by the anti-traffic calming lobby (e.g. Berlin).

Where grants for local schemes are provided centrally, they usually have conditions attached, for example that schemes form part of an approved traffic and transport plan, or that a particular design is used, or that public consultation has been carried out. In both countries there are non-specific grants from central to local government, and a proportion of this also may be used to finance local traffic calming schemes.

The Dutch Provinces and the German Länder also play a part in funding not least because they are responsible for the construction and maintenance of major road networks. The most adventurous is the Nordrhein-Westfalen Land which pays a large contribution towards local authority traffic calming expenditure, between 60 and 80% of total cost depending on the type of road and the size of the council (meeting at ministry, 1988).

While attention is inevitably focussed on the special projects and demonstration schemes, it is important to recognise that much traffic calming work has been carried out as part of ongoing programmes of maintenance and renewal. Such work is often

financed from housing, urban renewal, conservation, and highway maintenance budgets.

The process of implementing Woonerven, 30kmph zones and other measures has been especially rapid where street reconstruction is necessary at frequent intervals due to unstable sub-soil conditions. As a result, it would in theory be possible to “calm” the entire Dutch urban street network in 20-30 years, and for highway maintenance budgets to meet the bulk of the cost. The contribution of road maintenance budgets to traffic calming schemes is substantial, though difficult to quantify since the distinction between “improvements” and pure “maintenance” is blurred, perhaps deliberately so. Increasingly, cities have adopted a policy of introducing speed reduction and other traffic calming measures whenever a street is dug up. This now seems to apply to a majority of cities in Germany and Holland. As a consequence, it is common to find at least 50% of a city’s streets covered by the 30kmph speed limit, supported by self-enforcing speed reduction measures.

Housing and urban renewal budgets often provide for associated street reconstruction and improvement. In Holland this is usually 30-40% of the total budget. Of this sum, most goes on the reconstruction of underground utility services and road sub-structure. Redesigning the actual surface layout and paving may account for a relatively small proportion of the overall cost.

In Germany housing renewal budgets also provide for street improvement works, and most of the traffic calming grants in Nordrhein-Westfalen are linked to urban renewal objectives. In addition, a Federal law dictates that property owners contribute towards the cost of street works, though each town decides what proportion this is to be. In Ingolstadt (Bavaria) for example it is usually 30-40% of costs, though this was reduced to 5% for the area-wide traffic calming demonstration project in view of its experimental nature, and Federal contributions.

In Ingolstadt and other cities it has been found that property owners are more likely to inject private money into renovation work when street reconstruction takes place. Thus publicly funded traffic calming measures can raise confidence in an area and thus stimulate private investment.

In summary, local authorities have used a variety of sources of funding to implement traffic calming schemes, and have taken the opportunity to redesign streets to meet this objective as part of maintenance programmes. Local budgets have been supported by (often substantial) contributions from regional and central governments.

How much does traffic calming cost?

The early "spot treatment" street reconstructions (Woonerf and similar schemes) were expensive, and often very expensive, typically over £25 per square metre of road and in some cases as much as £150 per square metre.

Simple traffic calming measures using cheap materials such as temporary signs and planters and prefabricated humps and ramps can produce effective speed reduction at a cost of about £1,500 per hectare of housing, though such schemes can be unsightly and unpopular with residents.

More permanent and attractive 30kmph zones can be achieved including ramps, chicanes, plateau and planting for around £2,500 per hectare. This was achieved in 5 of the 15 demonstration zones in Holland, the remainder spending more either to achieve a better environment or to cope with special constructional problems (NL017). The Moabit area scheme in Berlin demonstrates that safe and attractive streets can be created for around £10 per square metre of street space, including a third for planting.

The differences in cost have a number of explanations. For example, costs can be minimised where traffic calming is achieved by inserting measures at intervals along a street. If total reconstruction of the street surface is undertaken total costs will be much higher. On the other hand costs attributed to traffic calming will be reduced if the reconstruction was needed anyway to maintain engineering standards. The quality of materials used also has an impact on overall costs, but again it is difficult to lay down rules of thumb. For example the Moabit scheme used granite setts which would normally be expensive, but which in this case were already available from the existing street paving.

Where schemes have been implemented to meet a “city beautification” objective, costs have been much higher, for example in Ingolstadt where the overall cost was three times the Berlin Moabit figure for a similar sized area. This was the result of using granite setts and other expensive materials, most of which had to be purchased specially for the project. (Granite was insisted upon by Bavaria and Bonn, despite the fact that Ingolstadt is a producer of concrete!)

To provide an indication of the rough order of magnitude of overall costs, Figure 2 shows in diagrammatic form the costs in relation to some of the factors discussed, with actual schemes mentioned by way of example. It must be stressed, however, that a variety of budgets can be involved, and the costs do not necessarily have to be attributed entirely to traffic calming.

How are traffic calming schemes maintained?

Keeping traffic calming schemes up to standard requires, firstly, the maintenance of paving, humps, ramps, bollards, seating, greenery and other features introduced to achieve the “calming” effect. Secondly, such features need to be properly reinstated following repair of underground utility services.

Consideration of how this work is to be carried out, and by whom, is an important consideration at the planning stage, and indeed has helped to shape traffic calming policy in both Holland and Germany. Generally speaking, the more elaborate schemes involve higher maintenance and reinstatement costs. It is partly for this reason that many cities have curtailed their programme of creating Woonerven. For example Groningen and even Delft no longer convert streets to full Woonerf standard, although new housing may be laid out on the Woonerf model. German cities also have now abandoned the creation of Woonerven-type schemes as a general policy.

To some extent the use of high quality materials can reduce maintenance costs, and this has been adopted especially where grants are available to meet the higher initial cost. An example of this is the use of granite setts in the Ingolstadt demonstration project. Street furniture needs not only to be strong, but also well placed. Maintenance

costs rise dramatically where poor design leads to bollards, trees etc. being damaged by vehicles. Simple design is usually cheaper and aesthetically more pleasing, but enough needs to be built to achieve a traffic calming effect. A balance thus needs to be struck between the objectives of economy and effectiveness.

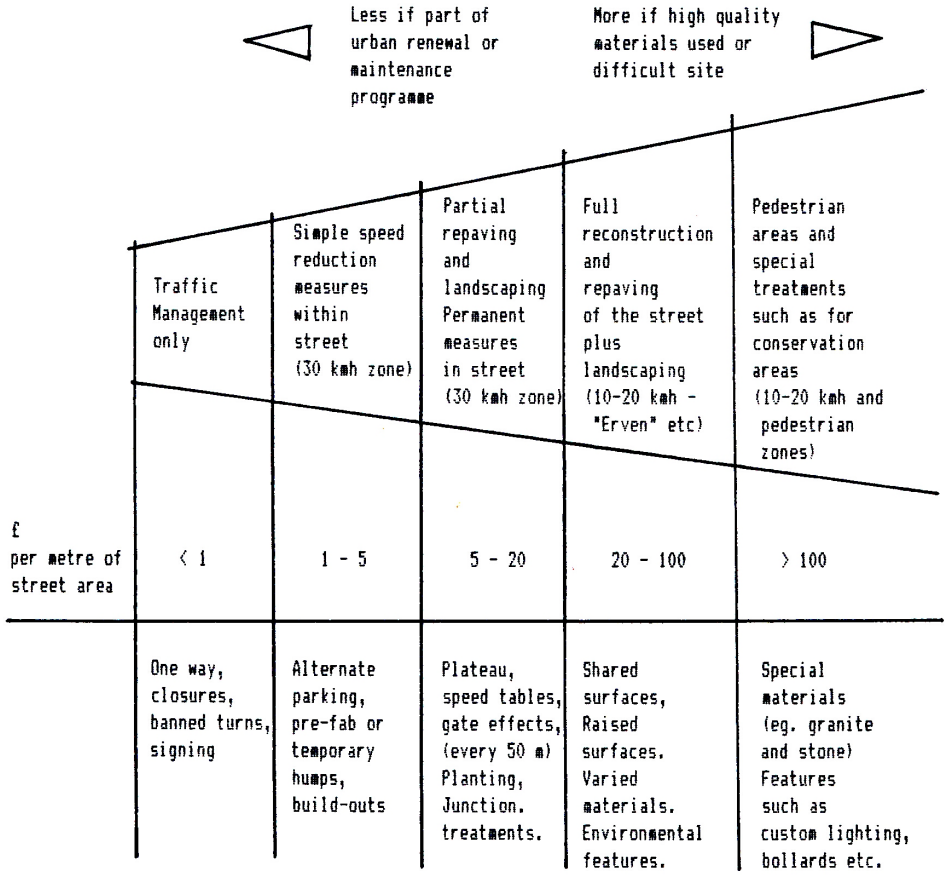
Reinstatement is also affected by the design of the scheme. Problems can arise if non-standard features are used, or where those carrying out the reinstatement work may be unaware of, or not properly briefed about the design required. An example of this was the use of coloured aggregate at some road junctions in the Eindhoven demonstration area; the effect had been destroyed by reinstatement work using grey asphalt. With traffic calming becoming more widespread, however, an ever larger range of materials and street furniture is becoming readily available, making the tasks of reinstatement and repair easier.

The problem of reinstatement works is greatly reduced by coordinating traffic calming works with the renewal of underground pipes and cables. Where it is proposed to reconstruct a street, the local council discusses with the public utility authorities the possibility of renewing sewers, pipes and cables at the same time. Very often a programme of priorities for street reconstruction can be designed to coincide with priorities for utility renewal. It is in the interests of the utilities to cooperate because they can avoid the cost of pulling up and relaying the street. If they do not take the opportunity to relay services when the street is reconstructed, they are more likely to face ad-hoc repairs, and the consequent costs of reinstatement. In some places (Groningen for example), the problems are minimised by the fact that the local council is responsible for sewerage and water supply, as well as street maintenance.

Schemes which involve inserting measures at intervals along the street (e.g. most 30kmph zones) rather than total street reconstruction are cheaper to maintain, but a judgement still needs to be made about whether to renew services and street surfaces at the same time. Measures can often be designed which do not alter the existing pattern of surface water drainage (e.g. Berlin Moabit) and this helps to keep costs to a minimum.

Maintenance of greenery can be a problem, especially if the scheme introduces greenery to the street for the first time and extra gardeners need to be employed. Sometimes the design can incorporate greenery in such a way that residents take on responsibility for maintenance. In Ingolstadt, for example, the provision of small front gardens was popular, and helped public acceptability of the traffic calming scheme.

FIGURE 2 AN INDICATION OF TRAFFIC CALMING COSTS (mid 1980s prices)



6. PUBLIC INVOLVEMENT

Public involvement in the planning process is an important aspect of traffic calming practice in both Holland and Germany. Unlike many municipal affairs which to many citizens often seem rather remote or abstract, traffic calming measures involve changes in the immediate environment of people's homes and often directly affect their daily lives. The route by which drivers reach their home, the safety with which the children can play in the street, the convenience of parking places; these and many other issues are raised whenever traffic calming measures are proposed. Involving the public at an early stage can ensure that problems are properly defined, and that a satisfactory design is achieved, This is vital if the measures are to receive support and acceptance. The lesson has been learnt in Dutch and German towns that without that general support, schemes can be severely delayed or blocked completely by organised public opposition. No matter how experienced a council may be in matters of street design, public reactions are often unpredictable. Indeed, even the feeling of having change thrust upon them can lead residents or shopkeepers to reject even the best schemes.

In Holland, government grants for traffic calming schemes are usually conditional upon adequate public consultation. For locally funded schemes there are no statutorily defined consultation procedures but preferred methods are laid down in a “Municipal Consultation Order” (NL011, p23) which applies in many municipalities. This Order includes the following provisions:

- The project team may include representatives from local organised groups such as residents’ associations.
- Advisory organisations may be consulted, for example the national organisations for motorists (ANWB), pedestrians (VBV), and cyclists (ENFB).
- The municipal traffic committee should be involved before and after public consultation.
- Individuals may participate in public inquiries and hearings, consultation meetings and information meetings.
- Public hearings should be held only as a last resort.
- Consultation meetings are preferred, where members of the public can react to specific plans, and be guaranteed the possibility of influencing them.
- Information meetings must be supplemented by other media, in order to reach as wide an audience as possible.

The area-wide demonstration project in Eindhoven serves to illustrate a number of important points. There were initially problems with public acceptance of the traffic calming proposals. When an outline plan of the proposals was presented, local people and the community council thought the city was imposing a solution. As a result a two-stage consultation procedure was developed.

Stage 1 dealt with the specific problems in the area and the possible means of tackling them. This allowed people in the community to describe the problems as they perceived them. In this way agreement was reached with the Council as to what the problems were before design work began.
Stage 2 took place after the production of the draft design, and was confined to discussion of how well the design met the problems already identified. For example

residents who complained that a junction design removed parking spaces were reminded that they had previously identified parking at junctions as a main source of danger. Thus the safer junction was accepted, despite the reduced convenience for parking.

The Eindhoven demonstration project team were often surprised by views expressed by residents. For example it was initially feared that expensive designs in some streets would be resented by residents in other areas. In the event the reverse was often the case. Architect's designs for the reconstruction of a public square in front of a church were rejected in favour of simple and uniform paving with no planting; residents in streets earmarked for expensive Woonerf treatment insisted on simpler measures being used to reduce traffic speed; and residents along part of the outer ring road insisted that the dual-carriageway should be retained in front of their homes, despite the fact that the adjoining section of the road had been converted to a single carriageway and moved well away from the houses. No planner, however experienced, could predict reactions of this sort and the only way of avoiding hostility to proposals is to involve the people who will have to live with them.

Similar lessons have been learnt in Germany, and concern now focuses on finding the best way of encouraging public participation. As in Holland, competitions and cash prizes are sometimes offered to groups who promote road safety schemes. It is also considered important to seek the views of residents after the implementation of schemes, as well as before. This is true especially of the major demonstration projects. Through careful monitoring of the effectiveness and popularity of various measures, future designs are improved and mistakes avoided. This may seem a simple point, but it is one that is often missed in the UK.

In Germany it has been found that public involvement needs to be more intensive in rural communities, where one needs to speak to everyone. Designs must also be different from those used in towns. For example consultation in Borgentreich (one of the area-wide demonstration areas) found strong opposition to road narrowings because of the need to accommodate oversize farm machinery, and to extra trees in the street because they would entail farmers in extra leaf-sweeping in the Autumn. The latter is particularly interesting because in towns it has often been found that extra planting greatly increases the popularity of traffic calming measures.

It has sometimes been harder to get public acceptance of traffic reduction on main roads than on purely residential roads, particularly when shopkeepers' interests are affected. Yet the difficulties are as likely to be between rival local authority departments as between the public and the council. This is true in Berlin, for example, where a majority of shopkeepers in Buessel Strasse (Moabit) want traffic calming measures, but the city's traffic ministry has blocked the scheme.

The two-stage approach adopted in Eindhoven has also found favour in Germany (Keller in D030), with consultation on the problems before design work is undertaken, and public involvement in the design work itself.

In Ingolstadt, consultation started late in the process, indeed after the first street had been reconstructed. The first publicity leaflets were rather diagrammatic and were misunderstood by some. Shopkeepers in particular mounted a campaign of opposition,

and got a 15,000 signature petition within two weeks. This rather poor start led to considerable delays in the implementation of the area-wide measures to the extent that at one point the Federal government threatened to withhold grants. Later consultation leaflets were redesigned to include detailed plans which allowed residents to identify their own properties, and eventually a more constructive dialogue was achieved. Local groups, especially those representing traders, exerted a lot of influence on the eventual designs. This led to more parking provision in the town centre than desired by the scheme's designers and this, in this author's view, has compromised environmental quality to a considerable extent.

The Ingolstadt city council has learnt these lessons, and now finds it very much easier to "sell" traffic calming schemes to the public. This is helped by being able to show residents successful schemes elsewhere in the town, and indeed coach visits to these have been organised as part of more recent public participation exercises. Hostility in the beginning was perhaps due to a fear of the unknown, and public attitudes have become more favourable to traffic calming as more schemes have been introduced. In a few streets where persistent opposition has been encountered, plans have been put on ice and priority transferred to other streets where residents are more enthusiastic. Public consultation has had a considerable influence on the design of schemes in Ingolstadt. One example was the removal of "rumble strips" designed to reduce traffic speed on the inner ring road, which proved very noisy for nearby residents. Another example was the provision of smooth paving footways in mixed precinct schemes: separate footways are not strictly part of the shared surface principle, but many residents complained that the surface of granite setts was difficult to walk on.

The difficulties with public opposition in Ingolstadt were compounded, at least until 1986, by the anti-traffic calming views of the local newspaper, which did much to inhibit progress of the scheme. It is sometimes said that the editor of the town's only newspaper is more powerful than the mayor. The mayor himself is powerful, directly elected (as in all Bavarian and Baden-Wurttemberg cities) with 70% of the votes. He had to tread a fine line between support for the Federal experiment, and concern for those who felt that their interests were threatened by it. The senior planner in charge of the scheme quoted a German saying which sums up the dual thinking of those who appreciated the principle of traffic calming, but who did not like the measures needed to achieve it: "Wash my fur, but don't make me wet"!

Opposition by traders also created problems in another of the Federal demonstration projects in Esslingen. The proposed measures had to be substantially redesigned to meet traders' objections, resulting in a delay of more than two years. Indeed the measures were still being installed in the Autumn of 1988.

These problems underline the importance of involving the public at the earliest stage, before there is any substantial commitment to a particular design. This was the approach in the Berlin Moabit scheme, which proceeded on target with public support. Provision in the traffic calming scheme for the introduction of greenery to the streets proved particularly popular, and residents have become involved in maintenance of the new trees and plants.

In undertaking the Gostenhof area-wide traffic calming project (a city project), Nuremberg city council encouraged public involvement by opening a cafe in the area

to act as an advice centre and meeting place. Planners, architects and politicians were available to answer questions every day, and the cafe remained open throughout the three years of the urban renewal programme. Most of the problems dealt with related to the housing improvements, but residents' comments also led to design modifications of the traffic scheme.

Most German cities have produced publicity documents on traffic calming, most dealing with local projects but some with a broader educational or promotional purpose. A report by Cologne city council includes examples of bad as well as good traffic calming practice within the city (D046).

7. EVALUATION

Many of the early traffic calming schemes were experimental or “acts of faith”, but as the effects of schemes have been investigated the ability to predict the effects of various measures has greatly improved. An attempt is made in this section to summarise the more robust findings of the major research projects in Holland and Germany, notably the various area-wide demonstration projects and the large scale evaluations of individual measures carried out in the Nordrhein-Westfalen Land. It should be noted that a great deal of additional research has been carried out by individual municipalities, or by independent consultants, but collation of this additional material (most of which is not available in English) is not included here.

The results of evaluation studies are valuable to those introducing traffic calming measures, but they need to be properly interpreted.

Firstly, the effects of individual measures (such as a speed hump or a chicane) cannot easily be evaluated in isolation. The particular combination of measures in a street have a powerful influence on the behaviour of drivers and others, and on the perception of safety and other aspects. Thus an individual measure may be ineffective when implemented in isolation, but both effective and popular when used in conjunction with other measures.

Secondly, if a wider evaluation is undertaken (e.g. a whole street) then the contribution of individual measures is difficult to isolate.

Thirdly, intervention in one street may affect conditions in neighbouring streets, especially if traffic is diverted. Consequently, and quite rightly, most evaluations have been carried out for whole areas, including surrounding roads. This helps to spot any migration of problems from one place to another, but the larger the area under evaluation, the less homogeneous it is likely to be.

Thus in all three ways it may become difficult to say what precisely is being evaluated! A pragmatic approach is to rely on the skill and experience of the designer to produce a scheme which addresses the stated traffic calming objectives. Information on other schemes thus becomes part of the designer’s “toolkit” rather than a set of prescriptive rules.

Monitoring of aspects that are crucial to a scheme’s acceptability is nevertheless required. Increases in accidents, noise and pollution must be avoided, and monitoring is needed to check on these aspects in particular so that remedial action can be taken if necessary. For example, a chicane of a particular design put into a distributor road in the Eindhoven demonstration area was observed to have created potentially dangerous conflicts between vehicles and cyclists, and was reconstructed prior to the full area-wide evaluation. The “bottom line” is usually regarded as accident frequency and severity. Gains in safety are not always easy to attribute to schemes (e.g. because of “regression to mean” effects or insufficiently large data sets) but the situation is acceptable so long as matters have not been made worse.

The point here is that failure is easier to measure than success. If there is a clear failure then objective results will confirm the concerns expressed by residents and

road users, and the scheme can be modified or withdrawn. If there is no measurable or perceived failure, then the debate centres on the degree of success or value for money, or other aspects which although important are usually considered less crucial in shaping policies and programmes.

The remainder of this section discusses evaluation research carried out into the effects of traffic calming schemes on the following:

Objective Studies

a. Speed
b. Volumes of traffic
c. Accidents
d. Noise
e. Air pollution
f. Parking
g. Pedestrian and street activity (including "staying")
h. Economic and other neighbourhood effects

Subjective Studies

i. Safety
j. Visual appearance and ecology

a. SPEED

An important feature of traffic calming in Europe is that measures are related to target vehicle speeds, usually reinforced by a legal maximum limit. The various speed limits, together with the speeds not exceeded by 85% of vehicles (V85%), are shown in the table below.

SPEEDS AND TRAFFIC CALMING MEASURES

	Legal maximum	In practice (Usual V85% values)
"Erven" or "Mischflacher" (ie. "mixer courts")	Walking pace	12-20 km/h (Up to 30 km/h in Germany)
30 km/h zones	30 km/h	30-35 km/h
Through roads in villages	30 or 50 km/h	>30 or 50 km/h
Urban distributor roads	50 (occasionally 40)	>50 km/h
Main urban traffic roads (other than motorways)	50 - 70 km/h	n/a

It has proved difficult to design Woonerven and other “mixer court” schemes so that drivers keep within the legal maximum speed of “walking pace”, which would be 7-8 km/h. But maximum speeds of 12-20 km/h are easily achieved, and appear to have

become accepted. Indeed many commentators have called for the regulations to specify a 12 or 15 km/h limit rather than the vague “walking speed” limit, which is considered unrealistic and unnecessary. A 15 km/h limit is specified, for example, in the shopping "erf" in the Rijswijk demonstration area.

There is a fear that very low speeds create driver frustration and thus greater dangers if they are required over long distances. The maximum distance from any part of an "erf" is usually set at 400-600 metres (NL001).

Driver acceptance of and compliance with low speed limits depends not only on the physical measures themselves but also on the visual appearance of the street as a “living area” rather than a “traffic road”. The two aspects reinforce each other, and both are necessary for a satisfactory result.

The only known case in Holland where a motorist successfully sued a local council for vehicle damage caused by a speed reduction measure was due to the court's judgment that the intended speed was not sufficiently well indicated by the street’s design - in this case poor lighting of the chicane which the motorist failed to negotiate.

In "erven" speeds are kept below 20 km/h mainly by the use of humps, ramps, and chicanes, together with various reinforcing measures such as narrowings, gate effects and vertical elements. Effectiveness depends on the design of the individual elements, their combination, and their frequency or intensity.

In Holland the speed control “hump” (drempel) has been the subject of rigorous design investigations, and recommendations have now been issued for an optimum shape which is referred to as the “sine wave” shape. Three kinds of hump are recommended, each with the sine cross section, but with dimensions varying according to the desired speed of 20, 30 or 50 km/h.

Chicanes are considered ineffective if the total shift in the axis of the carriageway is less than the carriageway width, or is achieved with a turn of less than 45 degrees.

In "erven" the major problem has been with mopeds (bromfiets) whose speeds invariably remain 5-10 km/h faster than those for cars (N030). (See, for example, Vissers, 1982, "Evaluatie onderzoek in Verblijfsgebieden, wat doen we ermee?") This is partly because a chicane designed to accommodate four-wheel vehicles is less likely to slow a two-wheeler. Moped riders also use “footway” and other parts of the street not available to cars, thus causing more irritation. The problem is also partly attributed to the fact that a majority of moped riders are young people, who sometimes regard the Woonerf as a challenging obstacle course!

The German equivalent of the "erf" is known as a "mischflacher" (mixer court or mixed precinct), but it is not always designed to reduce speeds to below 20 km/h. Nor are some of the design regulations strictly adhered to, notably footways are often retained. As Bowers (D010) has pointed out, this could potentially give rise to confusion since speeds in excess of 20 km/h can hardly be compatible with the legal “walking speed” maximum. In practice, however, the behaviour and perceptions of safety by road users is determined not by the legal speed limit but by the design of the street. (When did a parent ever say to a child “it is safe to play in the street because there is a 30 miles per

hour speed limit”?) So the confusion seems to be more a matter of the appropriateness of the "verkehrsberuhigung" (traffic calming) sign and its associated regulations when applied to schemes which allow speeds of 20 - 30 km/h.

The Federal demonstration project in Berlin's Moabit district provides a useful illustration. The standard traffic calming sign is used for a scheme which does not conform to the regulations. The streets are not true “mixer courts” because footways are retained in many areas, parking spaces are not designated, and the design allows speeds of 20 - 30 km/h. Nevertheless, the scheme has proved to be one of the most effective in creating a safe and pleasant living environment, particularly because a “calm” style of driving has been achieved whereby drivers maintain a steady 20 or 25 km/h rather than accelerate and decelerate between speed reducing measures. The average speed of unhindered vehicles has been reduced from 39 to 20 km/h and the V85% speed went down from 51 to 25 km/h (D032c). This has been achieved by the frequent use of narrowed carriageways combined with planting, and small raised sections or “cushions”. The term “cushion” rather than “hump” is appropriate because speed reduction is achieved without the aggressive jolt associated with most humps.

Many German cities in recent years have attempted to avoid the problems of “erven” (see above) by confining the use of mixer courts only to areas where street activity is intense, and lengths of street are short. In Nordrhein-Westfalen, the ILS has described the following circumstances where a "mischflacher" or mixer court might be appropriate:

- Shops both sides of the street
- High percentage of children
- Lack of off-street play/open space
- High percentage of residents likely to use the street for social purposes (e.g. certain social or ethnic groups)
- High housing density
- High pedestrian relative to vehicle traffic (e.g. school routes)

Where none of these conditions apply, 30 km/h zones are usually now preferred to mixer courts. In some cities (e.g. Stuttgart) mixer courts are being modified to reintroduce the distinction between footways and carriageways, though not by reverting to the traditional street layout.

Similar trends are observable in Holland where “feelings of unsafety” are sometimes reported where no separate area for pedestrians is provided in the street. But where pedestrian activity is intense, there is no problem of mixing cycles, mopeds and low volumes of motor traffic. The market streets in central Groningen provide an excellent testimony to this. Motor traffic volumes of 100-200 per hour are thought to be the maximum compatible with “erven” or “mischflacher”.

The main focus of attention has now shifted to the “intermediate” speeds of 30-50 km/h.

The 30 km/h zone is now commonly found throughout Holland and Germany, where it has been proved that streets can easily and cheaply be modified to achieve speeds of this order. The Dutch SVT recommended speed hump is effective because discomfort

to the driver is minimal below the prescribed maximum speed, but increases exponentially as speed increases (discomfort is measured in terms of vertical acceleration.

Although not yet fully complete, evaluation of the 17 test areas in Holland has shown positive results. The De Vliert area in s'Hertogenbosch provides an example. Traffic in the area was reduced by 20%. Rat run traffic was reduced by a third, despite a doubling of through traffic in the corridor. The scheme included street and junction closures, and speed reduction was achieved with humps and junction plateau.

"After" results in three of the 30 km/h test areas are shown below:

		SPEEDS (V85%)	REDUCTION OF THROUGH TRAFFIC
De Vliert (Den Bos)		20-30 km/h	33%
Poptahof (Delft)	- with humps	20 km/h	10%
	- with chicanes	30 km/h	10%
Heerde		30 km/h	small reduction

In the German town of Buxtehude near Hamburg, where the entire northern half of the town has been converted to 30 km/h (except a surrounding regional road and one other road), speeds have been reduced to just above the 30 limit. This is accepted on the grounds that 30-35 km/h allows the use of low engine speeds in third gear, while not infringing the spirit of the 30 km/h limit (D010). Average speeds on the distributor roads were reduced from 51 to 31 km/h while V85% fell from 59 to 38 km/h. In smaller residential streets "no great speed reduction was achieved, nor needed; the speeds before and after were around 30 km/h" (D032c).

The speed-reducing effect of physical measures depends particularly on the severity of the elements themselves, and the distance between them. For example, humps must be placed no further than 50 metres apart, and preferably 30 metres apart or less, to prevent drivers speeding up in between (e.g. D029a). In terms of achieving a "calm" style of driving, the best results are obtained when the street can be driven at a fairly constant speed, without the driver experiencing any noticeable discomfort, or having to make frequent use of gearshifts, brakes or steering. To a large extent this appears to be more valuable than speed reduction per se, as shown by the Berlin Moabit example (see above).

The use of severe-profile humps every 50 metres (as in some UK towns) may produce slower average speeds, but the driving style and ambience of the street will rarely be described as "calm". In Germany the speed "hump" has been firmly rejected, and indeed is considered to be illegal in most Länder. Preferred instead are changes in carriageway level achieved by ramps, plateau and raised "tables" or "cushions". Such raised portions are usually longer than the wheelbase of cars, and are thus experienced as "two changes of level" rather than "two jolts". The height of the raised portions may be as little as 6cm, or the ramp may be slight.

Increasingly, raised sections are limited in width (as in Berlin Moabit, and in some Nordrhein-Westfalen towns) rather than from kerb to kerb. This allows cycles to pass unimpeded, and the design may allow the wheels of larger vehicles (buses, ambulances etc.) to straddle the raised portion. A further benefit is that surface water drainage does not need to be modified, and this proved a major factor in limiting the cost of the Moabit scheme.

Such a design is useful for bus routes or other main routes where conventional humps may be unacceptable. Ramps and raised carriageways have been used successfully on a main (50 km/h) route carrying buses in Buxtehude. Ramps or cushions are acceptable at compulsory bus stops, where buses are travelling slowly anyway.

The effectiveness of chicanes in reducing vehicle speed depends on the particular design, and are much more susceptible to design failure than changes of level.

Firstly, the view ahead should be restricted, especially where two-way traffic is retained, otherwise speeds will increase when the way ahead is clear. A general rule now adopted is that the horizontal shift should be at least equal to the total available carriageway width (i.e. not including parking space).

Secondly, the chicane must require the driver to turn through an angle of not less than 45 degrees.

Thirdly, the chicane must be created by a permanent feature (kerb build-outs, planters etc.) and should not depend on the presence of parked vehicles. This is to avoid speeds rising when parked vehicles are absent.

Fourthly, the wider the carriageway, the greater the possibility for the driver to take a “racing style” line through the chicane, thus undermining the speed reducing effect.

On the whole, chicanes are less effective and more subject to driver abuse than humps and other changes in level. The use of both techniques together, however, has been particularly effective.

The speed-reducing effects of narrow carriageways and driving lanes have not been precisely determined, but research in Nordrhein-Westfalen has found that speeds are related to street width, and are reduced by two factors:

1. The perceived higher risk of collision in narrower streets and driving lanes
2. The appearance of narrowness created by vertical elements of the street (buildings, trees etc.), the so-called “optical effect”

Where driving speeds are subject to a legal maximum of`50 km/h (i.e. the usual urban limit) a 6 metre width is sufficient for a two-lane, two-way road, and this has been widely adopted in towns and villages in Holland and Germany. However, this width can create problems for cycles when mixed with heavy traffic, and separate provision is usually made.

The problem of larger vehicles requiring wider driving lanes has traditionally meant the provision of over-wide roads which encourage cars to be driven too fast. In Germany this problem is being tackled on main (50 km/h) roads by building one-metre

“occasional” strips either side of narrow driving lanes, which can be used when two large vehicles need to pass. If these strips are in setts or other rough surface, car drivers will avoid using them. Thus the effective width of the street can be reduced whilst still accommodating wider vehicles.

Such occasional strips can be shared with bicycles, depending on overall volumes, but then a smooth surface must be used, and the difference achieved with different colour paving. The smooth surface, however, is much less likely to deter speeding (e.g. in Lunen near Dortmund). Colour differences are also much less effective at night or in poor light.

This problem has been investigated in the village of Borgentreich demonstration project. Here a 6.5 metre carriageway had to be provided to accommodate oversize agricultural machinery. Reduction in the “optical width” by one-metre side strips in a different colour paving has not led to any significant speed reduction. Average speeds in the village centre were reduced by 3 km/h and the V85% fell from 61 to 57 km/h. High speeds are still experienced at the entrances to the village (90 - 100 km/h) despite the “gate effect” created by central dividing strips, mild chicanes and planting (D032c).

Excessive speeds, especially those associated with aggressive overtaking, can be reduced or eliminated by the restriction of the view ahead, for example by chicanes, and by introducing central islands. These again create hazards for cycles if widths are restricted, and separate cycle paths must be provided.

Some one-way streets have been built deliberately narrow (2.25m) so that cars must follow behind cyclists. This is an effective speed reduction measure where a steady flow of cyclists is expected. Good examples are found in the centre of Groningen. On the outer ring road in Eindhoven a carriageway and cycle lane are sufficiently wide to allow cars to pass cycles, but larger vehicles (e.g. buses) must use part of the cycle lane and thus are limited to the speed of cyclists using the lane. These designs operate without generating any apparent driver frustration, though it needs to be said that cyclists are tolerated in Holland to a much greater extent than in the UK.

Research in Nordrhein-Westfalen has found positive correlation between speed and the following factors:

- Use of lane and centre-line markings
- Restriction of parking (e.g. totally or on one side of the road)
- Lane/carriageway width
- “Optical width” (width of street divided by height of buildings)
- Smoothness of carriageway surface
- Forward visibility (especially in two-way streets)
- One-way operation

All of these can be changed or modified to achieve a reduction in average or 85% speeds. The more factors that are modified, the lower the speeds achieved. However, consideration must be given to the predictability of vehicle speeds. A road quickly becomes unsafe (and is perceived as such) if drivers have the possibility of driving

excessive speeds. Preference should therefore be given to measures which minimise the difference between minimum and maximum speeds.

Measures or factors which create a direct and perceived risk or discomfort to the driver are those which are most effective in ensuring slow speeds.

In Nuremberg, speed reductions have been achieved simply by imposing a 30 km/h limit, indicated with 30 km/h zone signs, and small reductions have similarly been achieved in Hannover, but this experience has not been discovered elsewhere. The consensus is that speed reduction requires the introduction of self-enforcing physical measures as described above.

b. TRAFFIC VOLUMES

Reducing traffic volumes creates more possibilities for traffic calming measures. The most usual method of traffic reduction is to use conventional traffic management techniques (closures, no entry etc. to exclude through traffic from residential or other sensitive areas. Traffic reduction may also be achieved on the main road network, examples being Kalker Str in Cologne, Munster Str in Dortmund, and Further Str in Nuremberg. In all these examples, traffic reduction has been associated with upgraded public transport and/or the existence of alternative major roads. The smaller the maximum traffic volume, the greater the opportunity for speed reduction and carriageway reduction. If such measures are not introduced, however, traffic reduction can have a negative impact by allowing higher speeds to be driven.

There are differences of view as to whether traffic reduction should precede traffic calming measures, or whether traffic calming measures should be implemented first to see if these in themselves bring about a traffic reduction. National and Federal policies tend to emphasise traffic reduction first, but there are examples to the contrary. The major traffic calming demonstration in the village of Borgentreich was implemented at least three years before the village by-pass was opened. The main through road in the small town of Bergisch Gladbach near Cologne was narrowed to half its width and bus priority introduced before the completion of alternative road capacity.

The following traffic volumes are considered to be the maximum suitable for various types of residential road:

- Erven/Mischflacher 100 - 200 vph
- 30 km/h zones 300 - 500 vph (Source ?)

The introduction of speed reduction measures can in itself cause a reduction in traffic volumes (or at least a diversion).

The practice most frequently encountered in both Holland and Germany was to first decide the target traffic volume, and then seek a traffic arrangement to achieve it using road closures, one-way streets etc. The speed reduction and calming measures are usually designed according to the expected or target traffic volume.

The composition of traffic is also an important consideration. All streets need to accommodate the occasional larger vehicle for emergency, refuse and other services,

but the practice of designing streets to uniform width to allow large vehicles to pass in all circumstances has long since been abandoned.

This interaction between traffic management measures to control traffic volumes, and traffic calming measures to control the speed and behaviour of the remaining traffic makes evaluation especially difficult.

There is evidence that traffic calming measures reduce and divert traffic, for example in Berlin Moabit, but the extent of this depends on a combination of factors such as:

- Level of congestion and directness of alternative routes
- The degree of speed reduction achieved, and the relative speed on alternative routes
- The proportion of “marginal traffic” such as short trips that might cease to be made. An example might be school escort trips, which may be rendered unnecessary if the walk or cycle route to school becomes sufficiently free of hazards.

It is sometimes thought that rat-run drivers drive faster than those on local business (because by definition they are seeking to minimise journey time). Research in Nordrhein-Westfalen does not support this view, however. Local drivers also drive fast, perhaps encouraged by their detailed knowledge and familiarity with road layout, and usually do not slow until within 50 metres of their destination.

c. ACCIDENTS

Reduction of accidents is one of the objectives of traffic calming, though certainly not the only objective. Success has varied between schemes and indeed there is no agreed criterion of what constitutes success. For example, if the number of serious accidents is reduced but the total number of accidents increases, is this an improvement? There are also difficulties in evaluating the effects of specific schemes. On residential streets in particular (where most traffic calming has been carried out) accidents are so scattered, and before and after data sets so small that it is often difficult to attach statistical significance to the results. Nevertheless, if the practice of traffic calming is taken as a whole, it is clear that there have been more positive results than negative ones. Traffic calming schemes which have increased accidents are the exception that proves the rule.

In Buxtehude there is evidence of significant reductions in serious accidents, but slight injuries and injuries to cyclists have not reduced significantly. It is not yet clear whether recent increases in the latter are due to increased cycling or to factors unrelated to the scheme (D032c).

Planners in Berlin have calculated that the Moabit scheme has already paid for itself through reduced accident costs, due in particular to the large reduction in fatal and serious injury accidents, as shown below (D032c).

ACCIDENT REDUCTIONS IN BERLIN MOABIT
(Comparable before and after periods)

All traffic	Fatal - 57% Serious - 45% Slight - 40% Accident costs - 16%
Non-motorised traffic	
	Pedestrians - 43% Cyclists - 16% Children - 66%

Woonerf and similar schemes usually succeed in preventing serious accidents, though they are not always perceived as being safe (see below). A study of 30 schemes in Nordrhein-Westfalen indicated a fall in accidents overall of 8%. In Boekelt the number of seriously injured fell from 1.3 per 1,000 inhabitants to virtually zero. However, the decline in slight injuries was less marked, and reported damage-only accidents substantially increased. (NL015)

The majority of calming schemes implemented to date have been in residential areas, which usually account for less than 20% of injury accidents (and which usually carry less than 30% of total traffic). Nevertheless, accidents to children are heavily concentrated in residential roads, and it is these that traffic calming measures are expected to reduce (see the figures for Berlin above). Major reductions in overall accident totals can only be achieved with measures on the main road network.

The area-wide schemes in Holland (Eindhoven and Rijswijk) have not produced any negative accident effects, and data suggests that accidents have been reduced in the long term. Also important is the finding that accidents have not increased in the surrounding areas; the problems have not simply migrated to other streets. The only remaining problem, as with speed, relates to moped riders who appear to be more at risk since the reconstruction. This may be associated with higher levels of moped use (NL018).

The crucial factor with pedestrian injuries appears to be speed. Conflicts involving vehicle speeds of 50 km/h or more are likely to result in serious injury or death. Where speeds are below 30 km/h the risk of serious or fatal injury is greatly reduced.

Increasingly, safety is regarded not simply as an absence of accidents, but related to perception and use of the street, and this is discussed under the heading of subjective studies.

d. NOISE

Changes in traffic noise result from five aspects of traffic calming measures:

- Changes in traffic volumes and composition
- Changes in carriageway layout
- Changes in carriageway surface

- Changes in vehicle speed
- Changes in driving style (changes of speed, use of gears etc.)

Reductions in traffic volumes by removing through (rat run) traffic from residential areas usually results in overall noise reduction. This has not usually been accompanied by higher noise levels on the surrounding main roads, where traffic density rises only slightly in relative terms. For example, in the Dutch area-wide experiments, day-time noise levels in the residential areas dropped by as much as 6-10 dBA. The proportion of dwellings requiring noise insulation (threshold set at 60 dBA) dropped substantially as shown below (NL 018).

% OF DWELLINGS EXPOSED TO MORE THAN 60 dBA

	Eindhoven - option			Rijswijk - option		
	1	2	3	1	2	3
Before	13	19	15	33	31	18
After	9	7	1	10	5	7

Reducing carriageway widths on main roads (as carried out for example in Eindhoven, Buxtehude and Cologne) can reduce noise levels in buildings and on footways by taking traffic further away. Sound may also be absorbed by the introduction of trees and planting, though this factor does not appear to have been separately evaluated.

Commonly expressed fears that slower speeds lead to increased traffic noise through more gear changing and speed changes have proved to be without foundation. Vehicle speed correlates positively with noise level. Evidence collected by the ILS in Dortmund shows that a 4-5 dBA noise reduction can be expected if speeds are reduced from 50 km/h to 30 km/h (D029c).

The Buxtehude demonstration scheme produced noise reductions ranging from 1 to 7 dBA, with two 30 km/h streets measured over a six month period showing an average 4 dBA reduction (D032a).

Carriageway surface has a significant effect on noise. Granite setts produce noise levels about 3-5 dBA higher than smooth asphalt even if laid only in short sections. Rumble strips made from granite setts were removed from the inner ring road of Ingolstadt (Bavaria) because of complaints from nearby residents about increased noise. The noise difference between setts and asphalt diminishes with speed, however, and is virtually unnoticed at speeds of below 20 km/h.

e. AIR POLLULTION

As with noise, many believe that speed reductions will increase pollution, but again this is not borne out by scientific tests. The Buxtehude study, for example, found that emissions were lower at 30km/h than at 50 km/h. The extent of the reduction depended on which gear was used, and driving style. In the Buxtehude 30 km/h zones

drivers often adopt a “calm” style with low engine speeds in third gear, travelling at speeds slightly in excess of 30 km/h. If second gear is used a less calm effect is produced and fuel consumption increases (though noxious emissions are still lower than at 50 km/h) (D032a).

CHANGES IN VEHICLE EMISSIONS WHEN SPEEDS ARE REDUCED FROM 50 TO 30 KM/H

	Driving style	
	2nd gear “aggressive”	3rd gear “calm”
CO	- 17%	- 13.4%
HC	- 10.4%	- 21.9%
NOx	- 31.8%	- 47.6%
Fuel consumption	+ 7%	- 6.7%

However, these improvements relate mainly to the residential streets which carry only 20 - 30 % of total traffic and are therefore unlikely to have a major effect on air pollution problems on a regional scale.

The nature of the speed reduction measures, and the styles of driving which they engender are of crucial importance. The benefits of a “calm” style of driving with low engine speeds in third gear are shown in the Buxtehude results. Lower speeds such as those achieved in Erven schemes can actually increase emissions if they involve more acceleration and deceleration, and greater use of 2nd gear. This was found, for example, in the Woonerf streets in the Dutch area demonstration projects where although nitrogen oxide levels fell, the emission of carbon monoxide and hydrocarbons by individual vehicles rose noticeably. Usually in such streets the volume of traffic is reduced so that there is no overall increase in air pollution (NL018).

Evidence so far suggests that schemes designed to encourage steady driving speeds are more effective in reducing emissions than slow speeds per se. Thus frequent use of shallow ramps and speed “cushions’ (as used in Buxtehude and Berlin Moabit) are better than schemes involving sharp changes of level or direction.

f . PARKING

Surplus carriageway width (e.g. when lanes are reduced, or traffic is converted to one-way operation) can be used for additional parking. Angled parking (45 or 90 degrees to the kerb) can be used instead of lateral parking. Angled parking on one side of the road provides roughly the same capacity as lateral parking on both sides. Thus chicanes can be achieved by the use of angled parking on alternate sides of the street without loss of parking capacity. There are also safety benefits claimed from this arrangement because it reduces by half the chance of children being masked by parked cars, as well as reducing the speed at which any impact occurs. This system of parking is now common in Erven and Mischflacher schemes, and in 30 km/h zones in high-density residential areas (but see section on “visual appearance” below).

In Cologne's Kalker Str, a principal radial route and district shopping centre, an innovative solution has been found to the problem of short-period stopping for shopper's cars and delivery vehicles. A double line of lateral parking has been introduced on both sides of the road, and the main carriageway reduced to two 3-metre lanes. Meter parking is provided in the parking lane which lies adjacent to the footway, while a short-stay stopping lane for deliveries is provided between the meter spaces and the carriageway. This unconventional layout operates without undue obstruction to vehicles on the “inside” meter bays. The vehicle manoeuvring involved is thought also to have reduced day-time speeds on the carriageway.

On another main radial route, the Leenderweg in Eindhoven, the main carriageway has been reduced from 12-16 metres to a constant 6 metres width, and the space used to provide a service and parking road parallel to the main carriageway. Capacity of the road has been maintained by retaining additional turning lanes at junctions (sometimes doubling as bus bays).

g. PEDESTRIAN AND STREET ACTIVITY

If “calmed” streets become safer and more pleasant to be in, a measure of this success will be that street activity other than motor traffic will increase in response to the higher quality environment. The quality elasticity of demand for such activity will vary according to a number of factors. Among these might be the extent to which activities were suppressed by previous conditions, the density of development, the social composition of inhabitants, the potential for development of street activity (e.g. for pavement cafes or children's play), micro climate, architectural character, and so on.

In Berlin Moabit street activities are reported to have increased by 60%, and cafes, restaurants and shops have moved out onto the (larger) footways. A small annual payment is made to the city for this facility. Increases in non-motorised traffic (pedestrians and cyclists) were recorded on all streets where traffic calming measures had been applied, with the exception of Bremer Str(D041):

CHANGES IN NON-MOTORISED TRAFFIC IN BERLIN MOABIT (AFTER STUDY)

Wiclef Str (outer)	+ 32%
" " (inner)	+ 54%
Oldenburger Str	+ 27%
Bredow Str	+ 114%

Similar effects have been noted in both residential areas and main roads where the pedestrian environment has been improved (e.g. inner areas of Bonn and Gostenhof West district of Nuremberg). Such changes are much less apparent in low density suburban areas such as certain of the 30 km/h zone demonstration areas in Holland.

Sometimes major beneficial changes in street activity can be achieved where more space is given to “staying” activities. This involves the inclusion of space where children can play and adults can linger to chat or to rest, rather than being in the street simply as pedestrians walking from one place to another. In other words the enjoyment

of the space itself rather than simply access to the activities which line it. The deliberate reallocation of carriageway or “movement” areas to “staying” areas has become a major feature of European traffic calming practice.

A few examples of major urban streets where a pleasant “staying” atmosphere has been created are:

Walder Str (Berlin, Moabit)
Kalker Str (Cologne)
Further Str (Nuremberg)
Bahnhof Str (Buxtehude)

On main shopping streets where carriageways have been narrowed or central islands provided, pedestrians and cyclists can cross more quickly and thus may do so more frequently (NL018). This reduction of the community severance effect of the road is regarded as a benefit of such schemes.

Traffic calming measures give high priority to pedestrian safety, to enable them to be in the street and to cross it without exposure to risk of injury or harassment from drivers. If this greater freedom leads to increased pedestrian activity, there is the possibility that potential accident reduction benefits will be eroded. For example, double the number of pedestrian crossing movements undertaken with half the risk will in theory result in no accident reduction, but the street may still be regarded as safer. Accident evaluations which take no account of changes in pedestrian activity may be misleading.

Traffic calming provides the benefit which may then be consumed in the form of accident reduction or greater pedestrian freedom. While recognised, this concept has not yet been adequately discussed or investigated, but it is of great importance to the long term evaluation of traffic calming measures.

h. ECONOMIC AND OTHER NEIGHBOURHOOD EFFECTS

If traffic calming is successful in making streets safer and more attractive, higher property prices and rents relative to non-calmed areas might be expected. As far as retailing areas are concerned, it is known that rents are on average higher in pedestrianised streets and malls. There is less firm evidence relating to residential property, but there are some interesting pointers.

In Ingolstadt it has been found that private property owners have invested more heavily in their buildings in the reconstructed streets. Moreover, in Ingolstadt as in many other towns, residents have been keen to exploit any opportunities presented for increasing planting in their streets, especially if the unsealed areas available can be adopted as semi-private space. This indicates increased pride in the street brought about by the traffic calming measures. In many towns estate agents often refer in promotional literature to traffic calming as a positive feature. Logic would suggest that this would be reflected in property prices, but the effect may be marginal compared to other factors determining property values. Further research on private investment, property prices and rents is still being undertaken, especially in Germany.

A more direct effect may result from the requirement in German cities for property owners to contribute to the cost of street works (see section on Finance). This may be translated into higher rents which could be a problem for low income families. In wealthier districts residents may be more willing to pay for safer and more attractive streets. Discussions with local authority officials in several cities on this point did not reveal any major difficulties, but there seems to be little quantitative data on the subject. One reason for the lack of data is the fact that many if not most traffic calming schemes have been implemented as part of wider housing rehabilitation work, which also tends to lead to changes in rents and prices. It is therefore difficult to disentangle the specific effects of the traffic calming measures.

The effect of traffic calming and pedestrianisation on retail turnover has been the subject of a major investigation funded by the Anglo-German Foundation. The evidence collected for this study found that traders are almost always opposed to measures prior to implementation, but are in favour of them afterwards. Fears of loss of trade are usually proved to the contrary. There are, however, variations between different retail sectors, and possible impacts on retailing in untreated areas that need to be studied.

In Berlin an unusual situation has arisen where 75% of traders in Beusel Str (in the Moabit district) want the traffic calming scheme proposed by city planners, but the city authority as a whole is opposed.

In the two Dutch area-wide demonstrations it was found that trade had increased except in the food and drink sector, in which turnover lagged behind the national trend.

SUBJECTIVE STUDIES

i. “SUBJECTIVE” SAFETY

The relationship between safety and accidents has already been mentioned. For traffic calming to be judged successful it is important that the level of risk is in accord with public perceptions of safety. If residents perceive a street as being safe but their resulting behaviour exposes them to danger this may aggravate the accident problem. Conversely a street which is perceived as being more dangerous than accident figures suggest, is unlikely to have a calm or pleasant atmosphere.

The major area-wide demonstration projects have investigated not only objective measures discussed in 1 to 8 above, but also subjective evaluations based on interview surveys. Indeed, because objective measures of accident rates are so difficult on residential streets (where most traffic calming has taken place) it is argued that “subjective unsafety” has taken the lead from “objective unsafety” in the evaluation of traffic calming schemes (NL023 p25).

The Dutch demonstration projects in Eindhoven and Rijswijk produced some unexpected results in this respect. A majority of people in the Option 3 (Woonerf) areas described their street as being less pleasant to walk in than before. In these cases the designs including chicanes and absence of separate areas for pedestrians

meant that people were often forced to walk zig-zag fashion and sometimes to cross where visibility was poor. However, in view of the general popularity of Woonerven in other areas, some doubt must be cast on the results. One possibility is that the rather bad start to the public consultation exercise may in itself have led residents to give a negative response (see section on public involvement).

The wider evaluation of 2.000 residents of Woonerven in Holland (undertaken by the Institute of Applied Sociology in Nijmegan), found that despite concerns about the absence of footways, 84% of respondents said that their street was more pleasant to live in than before. This accords with objective studies of 56 Woonerven which indicated a considerable reduction in injury accidents (NL024).

The general conclusion from the two area-wide projects was that in terms of reducing the pedestrian-vehicle conflict, the Option 2 areas (i.e. those with self-enforcing 30 km/h speed control measures) produced as much if not more resident satisfaction than the more elaborate Option 3 (Woonerf) areas. The additional advantage of Woonerven is of course their ability to create a more attractive living environment that can be used as an extension of the dwelling space, but it is clear that popularity with residents cannot be taken for granted (NL015).

There appears to be a strong (though subjective) correlation between residents' satisfaction with schemes (of whatever type) and their involvement in the planning, design and implementation process. This is true particularly of measures in residential streets, and therefore has implications for local authority participation procedures. Traffic schemes have traditionally been focussed on main traffic streets where public involvement has often been minimal. Such an approach in residential streets is much more likely to create a feeling among residents that the council is trying to impose its wishes on citizens. Once this has occurred (as happened in the early stages in the Eindhoven and Ingolstadt schemes), it can be extremely difficult to build a constructive dialogue between residents and the local authority. Proper involvement at the earliest stage is both necessary and helpful to the success of the scheme.

Evidence as to whether traffic calming stimulates more outdoor activity is mixed. A study by Guttinger (1979, "Spelen en lopen in een woonwijk; onderzoek in Gouda Bloemendaal-Oost" reported in NL030 found that street activities were more diverse in Woonerven than in traditional streets.

The large increase in non-motor traffic in the Berlin Moabit area has been noted above.

In studies of Mischflacher in Nordrhein-Westfalen it was found that the pattern of street crossing activity, and where people walked within the street became much more diversified (i.e. using a greater part of the street, not just footways as formerly) (D 024 p33). Early studies of Woonerven in Delft also found that pedestrian activity "spread" across the street after conversion (NL031).

An opinion poll among Woonerf inhabitants in 1982 found that only a few are encouraged by the measures to spend more time out of doors (Neeskens, 1982 "Woonerven: bijdrage aan een beter woonmilieu" reported in NL030).

Subjective safety is still in its infancy as an evaluative criterion, but some pointers are given. Guttinger (1980, “Met het oog op hun veiligheid; de ontwikkeling van een conflictobservatietechniek to beoordeling van de verkeersveiligheid van woongebieden voor kinderen” - see NL030) suggests that subjective unsafety as regards children can be investigated using the following indicators:

- The extent to which child pedestrians are accompanied by adults
- The extent to which children are allowed to play outdoors
- The extent to which children are allowed to cross the street
- The parents’ judgment of the safety conditions of specific street sections

According to Van der Colk (1979 “Verkeersveiligheid in stadelijk gebeiden: opinies van ouders en gedrag van kinderen”) the feelings of inhabitants about their area’s traffic safety are based on accidents, near misses and other occurrences which frighten them. There is a clear difference between the concern of adults for their own safety, and their concern for the safety of others. Adults and children also vary greatly in their perception of risk, and in their acceptance or tolerance of unsafe conditions (NL030).

An interesting and effective evaluation was made in 9 streets in Nordrhein-Westfalen measuring the reactions of drivers to a pair of badminton players in the street. These measurements were made before and after traffic calming measures were introduced. The “before” observations found that drivers approached the players quickly, slowing at the last second, and often reminding the players of the driver's right of way by sounding the horn. “After” studies found a big change in driver behaviour, with drivers slowing as much as 40 metres before the game, and gently giving the players time to move away. Where the traffic calming scheme changed the street scene vehicles were not only driven more slowly, but with greater preparedness to slow down further. Fewer drivers drew attention by hooting. Drivers also did not “tear away” after passing the players. In other words the drivers became more tolerant of interruptions (D024 p32,66). What this demonstrates is that the design of the street affects the driver's expectation from it. If a street gives the appearance of a residential environment then drivers are more tolerant and careful of pedestrian activity within it.

j. VISUAL APPEARANCE AND ECOLOGY

Redesigning streets to calm traffic inevitably alters the appearance of the street, and great efforts have been made in Holland, Germany and other countries to introduce designs which enhance rather than detract from the street scene. Indeed, it is increasingly difficult to say whether traffic calming is an aspect of traffic engineering or of urban design. Most practitioners believe it to be a successful combination of the two. There are indications that the popularity of traffic calming is strongly dependent on the quality and appearance of the various elements. Equally important is the fact that the effectiveness of speed reduction measures is also greatly affected by visual reinforcement (e.g. trees or other elements which affect the character and “optical width” of the street).

Certainly there are many beautiful schemes. Materials are often of a high standard, especially in the schemes involving shopping streets, erven, and conservation areas.

The reactions against the woonerf in terms of pedestrian unsafety are also in some places matched by reactions against their appearance. Perhaps led by German designers, many now believe that the Dutch woonerf, with its intensive use of coloured paving, frequent visual blocks, different textures and plethora of street “furniture”, is altogether too fussy and destructive of traditional street character.

The product of this reaction is the move towards schemes with clean lines, minimum signing and minimum use of colour and texture changes. The Berlin Moabit scheme again provides an excellent example. The view down the street is not interrupted, there are no surface markings (as are found on Dutch speed humps for example) and no departure from the granite and asphalt textures that pre-existed in the area.

The change in approach (from an urban design point of view) is neatly illustrated by the early and more recent schemes implemented either side of the Neusser Str in Cologne. The later schemes do not include chicanes and are of a much simpler design, but high quality finish and attention to detail remains a significant characteristic.

This change is apparent in Holland as well. Phase I of the new housing area of Tenthof in Delft was developed as a woonerf with a complex layout and many corners, twists and chicanes. The later phase II, however, adopts a more simple grid layout of streets which is simpler to navigate, and easier on the eye.

Far from being an afterthought, the design of traffic calming has in some cases been the sole means whereby the measures have gained political and popular support. Bavarian cities, for example, have generally been less enthusiastic, but have implemented numerous schemes in the name of city beautification (see policy section).

Traffic calming measures also tend to be much more readily accepted by residents if trees and other planting is provided as part of the design. This is especially true where residents can themselves be allowed to express themselves through the use and enjoyment of patches they can plant and maintain themselves. This was specifically mentioned as an important factor in Ingolstadt and Cologne.

In Berlin Moabit the “greening” of the area was an integral and major objective of the area demonstration project. (D041) The aim was to introduce more green in order to improve appearance, micro-climate, wildlife and other aspects. Major portions of the wide Moabit streets were taken from carriageway use and unsealed to allow plant growth and planting.

Unsealed area	before	1,006 sq m	after 7,536 sq m (+ 649%)
Footway space	before	4.4 hect	after 6.2 hect (+ 19%)

(increased at the expense of the carriageway)

The increase in the unsealed areas led to a 10% quicker drying out of streets after rainfall. The number of trees in the area doubled and trees were introduced into narrow streets which formerly had no vegetation. In some wider streets the number of trees has been trebled. The performance of newly planted areas (shade, evaporation,

capacity to filter dust) will take time to match the performance of streets with mature trees.

The 220 hectare Buxtehude project included the planting of 303 trees and the planting of open areas amounting to 3425 square metres.

In the village of Borgentreich, another of the Federal area-wide projects, farmers objected to initial proposals for extra trees since they are responsible for leaf sweeping in autumn. Nevertheless, trees have been planted in large quantities in this and other village schemes, especially on the approaches to the village and to create a “gate effect” at village entrances. Any effect of this on the “optical width” of the street and thus on vehicle speeds may increase slowly with the growth of the trees.

8. CONCLUSIONS

Traffic calming in Holland and West Germany is no longer a limited or isolated traffic engineering technique for tackling localised problems in residential streets. Over the past fifteen years it has developed into a widely-practised and well-articulated procedure for reducing the damaging effects of road traffic in built-up areas. It is integrated with wider strategies for traffic and transport, and for urban renewal and regeneration.

The practice of traffic calming is aimed not just at reducing road accidents, but at creating a more “livable” environment. This involves the adoption of multiple objectives including reduced accidents, greater safety, a more attractive streetscape, more green, more space for walking and playing, and priority for “staying” activities rather than movement.

While the aim of traffic calming is to resolve these new urban traffic priorities, many schemes go beyond this in terms of design, quality and expense, and together represent a major civic investment to achieve broader planning and development objectives.

Traffic calming schemes may be seen as part of the urban revival which now spreads across Western Europe. Historic quarters of cities are being conserved and renovated, older living areas are undergoing housing refurbishment and major environmental improvement, and run down areas in the industrial heartlands such as the Rhur area are the subject of economic regeneration initiatives. Traffic calming has arisen from and forms part of this new faith in urbanity.

Traffic calming techniques have been developed and evaluated to the point where it has become a major field of urban traffic engineering and also of urban design. To understand its justification and implementation, however, it must be seen alongside other aspects of urban planning and development. For example, schemes in older areas are more often than not paid for out of housing renewal, conservation or highway maintenance budgets. It appears that a minority of schemes have made a separate and additional call upon civic resources.

The various techniques employed are well known in themselves (humps, ramps, narrowings, chicanes, build-outs, planting etc.) but, as the report has attempted to show, the designs vary enormously according to the type of street, traffic composition, function, objectives and so on. Schemes are increasingly applied not just to residential areas but to main traffic streets, local distributor roads and through roads in villages as well. It is now possible to find examples of traffic calming in virtually every kind of street, and attempts are now being made in both countries to collate and classify the vast amount of information on individual schemes. This will help in the design of future schemes.

Evaluation is rarely confined to an individual measure such as a hump or a chicane. It is recognised that effective traffic calming requires a combination of techniques applied on an area-wide basis. There is little doubt that in terms of both controlling traffic behaviour, and public acceptability, the effectiveness of area-wide schemes is

greater than the sum of individual parts. As one Dutch engineer put it: “if a scheme is to work right it must look right”.

An important feature of European practice is that measures are related to and reinforced by new statutory speed limits. The range currently includes maximum speeds of “walking pace” (Erven and Mischflacher, or shared surface courts); 30 km/h zones, which now cover a substantial proportion of residential areas; 40 km/h for some local distributor roads; and of course 50 km/h (or 30 mph) which still remains the standard urban limit, and which is retained on the main traffic routes.

Measures and combinations of measures have been developed to ensure that motor vehicles are driven no faster than the legal maximum. However, slightly faster speeds are often tolerated, especially in Germany, providing that a calm style of driving is achieved. While designs to achieve slow speeds have been proven, techniques for enforcing the 50 km/h maximum on main traffic streets are not yet so well developed. The principle difficulty appears to be that changes of level on main routes are often regarded as unacceptable, though examples do exist.

The imposition of speed limits is regarded as important since it removes the possible liability of the council for damage caused if drivers travel at excessive speed through speed reduction measures. Although legal speed limits are valuable in this respect, the philosophy in both Holland and Germany is that the appropriate speed should be obvious to the driver (and other road users) by virtue of the design of the street and the measures within it. Successful self-enforcing speed control measures render the legal speed limit sign superfluous, except in the rare cases of litigation. This is the aim of traffic calming: to inculcate desired behaviour through design rather than regulation.

An obvious question is which schemes (or type of scheme) are most successful. Although the answer to this is partly a matter of judgement, the author’s view is that for residential areas two approaches have proved their superiority. The first is the self-enforcing 30 km/h zone. This is cheap enough to be universally applied throughout urban areas and brings a high proportion of the benefits of the much more elaborate and expensive "Erven" schemes. The Erf remains appropriate in certain circumstances, especially where pedestrian volumes are high in relation to vehicle volumes, but it requires too much modification to the street to be a universal solution. Moreover, it is now recognised that footways should be retained in mixer courts where possible, and this brings us to the second “model” approach.

The Berlin Moabit scheme is regarded as highly successful in achieving the multiple objectives of traffic calming at small cost. The design strikes a balance between the advantages of slow speeds and the advantages of simplicity of design. Speeds fall between the very slow speeds of Erven and the 30-35 km/h achieved in 30 km/h zones while driving style is calm (minimum braking and acceleration). Other problems of pedestrian feelings of unsafety in Erven are avoided by the retention of separate footways and straight carriageways.

Observation of daily life in the streets of Moabit is a delight, and serves to show how high-density inner city streets can become safe and pleasant places in which to live. Traffic calming on main roads in both urban areas and villages has also been developed, though not yet to the same degree of sophistication as for residential

areas. The approach concentrates on the reallocation of the space between buildings to achieve higher priority for living and to protect vulnerable road users (pedestrians and cyclists). Reliable speed reduction has not proved easy to achieve, but there are plenty of schemes which demonstrate how traffic annoyance can be dramatically reduced.

Main road schemes have usually not set out to reduce overall network capacity. The traditional approach of building roads to uniform width throughout their length has led to gross over-provision of carriageway space in sections between junctions. Most traffic calming schemes on main roads have sought to “reclaim” this carriageway space for pedestrians and cyclists and for “living” or “staying” purposes.

The great majority of traffic calming schemes, on all types of road, have proved to be both effective in terms of their objectives and popular with users. Schemes which produce major adverse reactions are usually quickly modified; few have been withdrawn altogether.

As far as objective measures of success are concerned, schemes have led to reduced traffic volumes, reduced accidents, reduced severity of accidents, reduced noise and reduced air pollution. These benefits have been achieved without the creation of compensating problems on surrounding untreated roads. The relative success of these various objective measures varies greatly from scheme to scheme, and precise predictive techniques are avoided.

Equal importance is now attached to the evaluation of “subjective” measures of success. These relate primarily to “livability” as perceived by residents and other road users. This involves methods of social investigation which lie beyond the traditional training and competence of traffic engineers. But there is strong evidence that the effectiveness and acceptability of traffic calming schemes is determined as much by the overall “feel” of the street or area as by the individual physical elements within it. People perceive the success of the street in much broader ways than accident statistics or speed measurements. There seems to be a powerful syntax effect. The most popular schemes are those which are effective not only in reducing speeds and other sources of nuisance, but at the same time in converting a traffic corridor to a living environment. Successful traffic calming thus requires a combination of traffic engineering and urban design.

Accident reduction is a major objective. Most schemes to date have concentrated on residential areas which by and large have a diffuse pattern of accidents, and small accident numbers in relation to the size of the street network. Strategies for accident reduction which concentrate on the main traffic routes are clearly required to tackle the rump of the urban road accident problem, but this approach is insufficient in itself because it leaves untouched those accidents which are indigenous to residential areas, notably child accidents, two thirds of which take place off the main road network.

Now that satisfactory and popular solutions have been found to the problem of traffic nuisance in residential areas, the future direction of traffic calming (apart from spreading to currently untreated residential areas) will be towards the main traffic roads. New schemes and research programmes are now under way for local

distributor roads and main traffic arteries that pass through shopping, village, and other areas that have a “living” function. Considerable development of calming techniques for such roads is in prospect for the 1990s. The pace of this development, at least in the larger urban areas, will depend on whether or not total traffic volumes can be contained or reduced. This is recognised in Holland, for example, where a strategy of road pricing restraint for the Randstadt is being investigated. But this must be the subject of future reports.

Finally, traffic calming still has its critics even in Holland and Germany where its practice is firmly and widely established. The last word is left to Dr.-Ing Volker Meewes of the HUK-Verband in Cologne:

> “Representative enquiries among the population show, and have done for years, that the majority is in favour of traffic calming.This means that it will continue, even if the few who oppose it make a lot of noise and some press media create the impression that this minority is the majority.”
> (D046, translation A. C. Clater)

APPENDIX A

EUROPEAN STUDY VISIT, SEPTEMBER-OCTOBER 1988.
Funded by Nuffield Foundation
T. M. PHAROAH, Dept. Town Planning, South Bank Polytechnic.

Friday 16th September
Dep Heathrow 12.00 midday
Arr Amsterdam Schiphol 2.00pm.
Get taxi to AUTOPON, Kollenbergweg. 11
Night at Aalsmeer

Saturday
17th September
Drive to Groningen via Waddenzee dyke and Leeuwarden.
Also Sneek on main A7 - shared strips either side of carriageway and Oudehaske Village-erf just off A7, due south of Leeuwarden.

1.00pm afternoon: Meeting with Drs Gerrit. van Werven (contact from Roger Higman) of City Council. Visits to Hoogkerk 30 kmph zone, new Woonerf development, city centre traffic schemes.
Night: Groningen

Sunday 18th September
Drive back to central Holland via the following:
Zuidlaren, Zuidwolde, Heerde, 30 kmph zones
Night: Den Haag.

Monday 19th September
Meetings in The Hague:
10.00am
Mr. Soer van Herk. Mr Oenema (coordinator of 30 km zone experiments) and G. Alink; Directie Verkeersveiligheid, at Koningskade 4, Den Haag.
pm. visit Rijswijk, area-wide demonstration project
Night: DOORN

Tuesday 20th September
9.00am. Teun De Wit (contact of FOE), CROW Research Institute, Galvgalaani Str. EDE

12.00 Dirk H. Grotenhuis (DELFT public Works Dept), Oude Delft
pm. Visit Woonerf schemes in north Delft and Tenthof.
30kmph zones at Poptahof
Night: Nijmegan

Wednesday 21st September
9.00am J. Neeskens, (30km research) Institut voor Toegepaste Sociale, NIJMEGAN
pm. Visits to 3Okmph zones and Woonerf schemes, Nijmegen

Night: Esche (nr Eindhoven)

Thursday 22nd September
9.00am Mr Nuyten, 7th floor Room A718. Technisch Dienst.
Gemeente EINDHOVEN, Dienst Openbare werken;
am and pm Visits to Eindhoven area-wide demonstration project
Night: As Wednesday

Friday 23rd September
Drive to Rhur area. Meeting with Helmut Holzapfel.
Ministerium fur Stadtentwicklung.
Wohnen und Verkehr, Breitestrasse 31, DUSSELDORF
Night: Dortmund

Saturday 24th September
Drive to Hannover via BORGENTREICH (village traffic calming)
Night: Hannover

Sunday 25th September
Drive to West Berlin
Night: West Berlin

Monday 26th September
and Tuesday 27th September
Meetings and visits in BERLIN
10.00am Monday
Dipl.-Ing J. Schilcher, Bezirksampt Tiergarten von Berlin,
Abteilung Bau- und Wohnungswesen Tiefbaumpt,
Alt-Moabit 103
Engineer in charge of MOABIT scheme.
plus Claus Dyckhoff from Senator fur Stadtentwicklung und Umweltschutz
2.00 Dipl-Ing Michael Lembrock, Deutsches Institut fur Urbanistik (DIFU).
Strasse des 17.Juni. 110
Nights: West Berlin

Wednesday 28th September
Drive to Nurnberg (270 miles. six hours)
Night: Nurnberg

Thursday 29th September
am Visit Furtherstrasse NÜRNBERG for photos.
Drive to INGOLDSTADT
pm Meeting with
Herr Weidemann, Stadt Ingoldstadt
Visit schemes then drive to MUNCHEN (45 miles)
Night: Munchen

Friday 30th September
Visit scheme in south west of city
Night: Munich

Saturday 1st October
Drive to Frankfurt via ESSLINGEN area wide demo project
(visit "O" bahn in Esslingen - trials of dual mode vehicles)
Night: Frankfurt

Sunday 2nd October
Visit traffic calming schemes in city centre
Night: Frankfurt

Monday 3rd October
Drive to KOLN Via MAINZ.
Visit Mainz BRETZENHEIM district area-wide demo project
Night: Koln

Tuesday 4th October and Wednesday 5th October
Meetings and visits in Nordrhein Westfalen
9.00am Dr. Ing. H. Keller. Bundesanstalt fur Strassenwesen.
Bruderstrasse 53, BERGISCH GLADBACH (east of Koln)
(For info on accident effects of traffic restraint)
2.00 John Whiteleg and Dr.-Ing. Ulrich Just). Institut fur Landes - und Stadtentwicklungsforschung (JLS) Konizswall 38-40 DORTMUND

Wednesday: visit Lunen through-road scheme
pm Further discussions with John Whiteleg at JLS
Nights: Dortmund

Thursday 6th October
Drive to Utrecht
Night: Utrecht

Friday 7th October
Drive to Schiphol by 3.0pm for 4.0pm flight
Arrive Heathrow 5.00pm

APPENDIX B

REFERENCES Reference prefix denotes country to which it applies.

NL = Netherlands (Holland)
D = Federal Republic of West Germany
EC = more than one European country
UK = United Kingdom

NL001 CROW, 1988 “ASVV Aanbevelingen voor verkeersvoorzieningen binnen de bebouwde kom”

NL003 SVT 1984/5 “Aanbevelingen voor Stadelijk Verkersvoorzieningen”

NL011 Ministry of Transport and Public Works, 1986 “Manual: Traffic Provisions for People with a Handicap”

NL015 Min. Transport and Public Works Jan 1986, “Residential Neighbourhoods and Traffic Zones”

NL017 Min. Transport and Public Works Dec 1986, “RVV Berichten over Verkeersveiligheid” issue devoted to 30 km/h zones

NL018 Institute for Road Safety Research (SWOV) 1985, “Reclassification and Reconstruction of Urban Roads in the Netherlands: Effects on Safety, the Environment, and Commerce”

NL020 Min. Transport and Public Works 1988, “Doorgaande Wegen in Kleine Kernan: Actie 25%”

NL023 Luikens, H. et al 1981, “New Concepts in the Layout of Urban Districts and the Design and Management of Traffic Therein”

NL024 Heeger, H 1985, “Replanning and Redesigning of Public Space in Dutch Towns”

NL029 Min. Transport and Public Works 1982, “From Local Traffic to Pleasurable Living”

NL030 Kraay, J. (SWOV) et al 1984 “Towards Safer Residential Areas”

NL031 Delft Public Works Dept. 1973 “Helping Pedestrians in Residential Areas”

NL032 ANWB, 1977 “Woonerf” (lst Edition)

NL034 ANWB, 1980 “Woonerf” (2nd Edition)

D001 Der Bundesminister fur Raumordnung, Bauwesen und Stadtbau, 1986, “Stadtverkehr im Wandel”

D002 Do. 1979 “Wohnstrassen der Zukunft”

D007 BASt 1985 “Third Kolloquiumz Forschungsvorhaben Flachenhafte Verkehrsberuhigung”

D010 Bowers, P., 1986 “Road Design in Residential Areas: German Approaches to Environmental Traffic Restraint”

D024 Der Minister fur wirtschaft, Mittelstand und Verkehr, des Landes Nordrhein-Westfalen, 1979; “Grossversuch Verkehrsberuhigung in Wohngebeiten; Schlussbericht de Beratergruppe”

D029 Just, U. (ILS Dortmund) Various papers on evaluation of traffic calming schemes.

D030 Doldissen, A; Teurke, K; Keller, H; Krause, J., Various papers on German Federal Research Programme on large scale integrated traffic restraint strategies.

D031 ADAC 1984 “Leise fahren, Kraftstoff sparen”

D032 Doldissen, A. Various papers on the six German Federal projects.

APPENDIX C

FINANCIAL STATEMENT

ITEM	£
Travel to Government and other agencies and to schemes in Netherlands and West Germany:	
Air return, car hire, petrol	550
Accommodation, 21 nights @ £25	525
Subsistence: 21 days @ £15	315
Research costs	
Translation 70 hours @ £7	490
Photographic consumables	90
Telephone calls	25
TOTAL COST	1995
Nuffield Small grant received & spent	1995

T. M. Pharoah

South Bank Polytechnic -
Department of Planning, Housing & Development (formerly Town Planning)

January 1989