European priorities for pedestrian safety

Jeanne Breen, Executive Director, European Transport Safety Council

1. Introduction

The safety of people walking in urban areas has now to be considered in many European countries in the context of policies for encouraging people to travel on foot, by cycle or by public transport rather than by car in order to reduce environmental damage, improve public health, and enhance the quality of life in towns and cities.

The principal conclusion of a recent review by the European Transport Safety Council (ETSC) was that by implementing known countermeasures it should be possible to achieve considerable increases in the use of healthier and more environmentally friendly means of transport and still reduce the numbers of deaths and injuries among pedestrians and cyclists. However, further concerted action needs to be taken by policymakers at local, national and international levels to ensure that this positive scenario can be brought about (ETSC, 1999a).

Practically everyone needs to walk whether for work, shopping, education or leisure and making the pedestrian environment safer will affect many people. The core of this paper is to set out the challenge that providing for safer walking presents to policymakers and professionals concerned with the many relevant aspects of urban planning and design of the road transport system and its use.

The aim is, also, to reflect the consensus which exists, at least between independent road safety experts from across the European Union, about the strategies and priority measures needed to reduce pedestrian crash injury risk against the background of policies to increase levels of walking. Updates on developments in European Union and national policies on pedestrian safety will be presented along the way.

The basis of this contribution are recent ETSC's recent reviews on the Safety of Pedestrians and Cyclists in Urban Areas and Priorities for EU Motor Vehicle Safety Design, as well as the contributions on vulnerable road user safety made recently by the OECD, ECMT, and the EU projects, MASTER, DUMAS, PROMISING and WALCYNG.

Wherever possible, the international statistical comparisons presented include New South Wales and Australia in addition to EU countries. These indicate broadly similar motorisation levels and per capita pedestrian death rates.

2. The amount of walking in Europe

Survey data from a selection of seven European countries show that 15-30% of all trips are made by walking, the highest figure being for Great Britain (PROMISING, 2001). For short trips the share of walking can rise to 40%. This EU project also identified that:

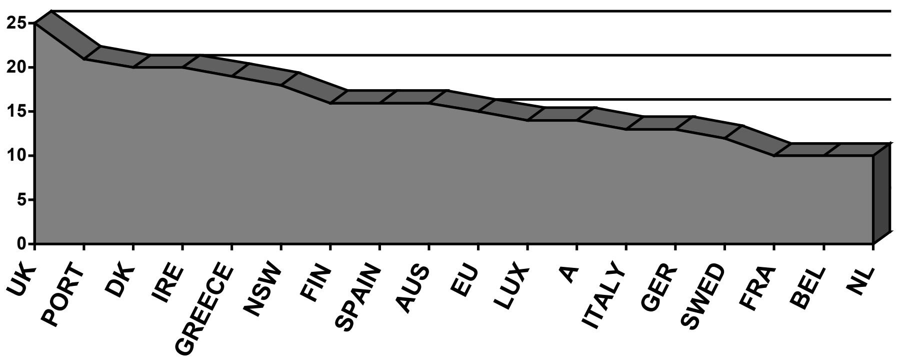
- the average length of walking trips varies from just under 1km to 2.8km
- the larger the city, the more walking trips people tend to perform
- the number of daily walking trips is higher for women than for men
- the distances and the proportions of trips performed by walking seem to have been decreasing since the early 1980s, which may be partly related both to the increased travelling distances resulting from urban development, and to the increase in vehicle ownership.

3. The risks faced by pedestrians in EU countries

While car users comprise the greatest proportion of overall road deaths (57%), the risk of death on EU roads is substantially higher for vulnerable road users. It has been estimated, albeit roughly, that walking is around 9 times riskier than travel by car for the EU as a whole. Pedestrian deaths comprise 15% of total road deaths, with the UK (25%) and the Netherlands (10%) at either end of the range.

Table 1. EU deaths per 100 million person km		ETSC 1999b
Motorcycle/moped	16	
Foot	7.5	
Cycle	6.3	
Car	0.8	
Bus and coach	0.08	
Rail	0.04	

Figure 1. Pedestrian deaths as % of road deaths: 2000 Source: IRTAD 2002



Whether measured by rates of pedestrian deaths per 100,000 population or motor vehicles which, of course, do not take any account of the level of the activity there are substantial differences between Member States with the highest rates in Portugal and Greece and the lowest rates in Sweden and the Netherlands. More information is needed about levels of pedestrian and cyclist traffic in the EU, however, before crash risk differences can be fully understood.

Figure 2. Pedestrian deaths per 100,000 population: 2000 Source: IRTAD 2002

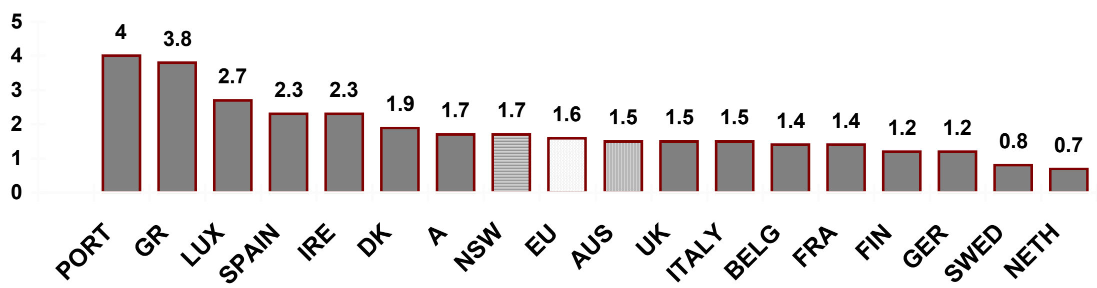


Figure 3. Pedestrian deaths per 100,000 motor vehs: 2000 Source: IRTAD 2002

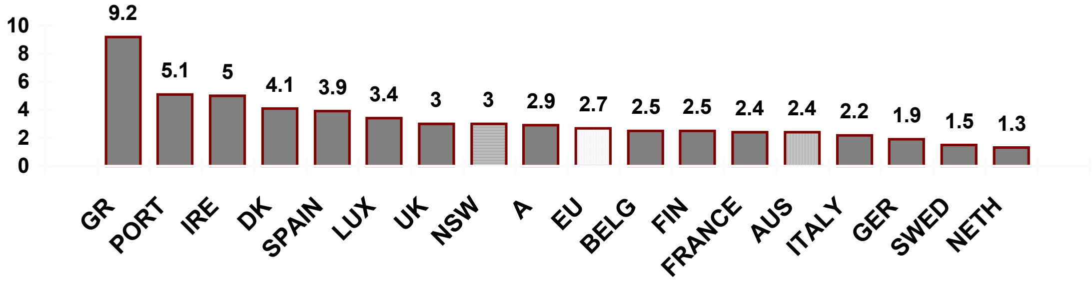
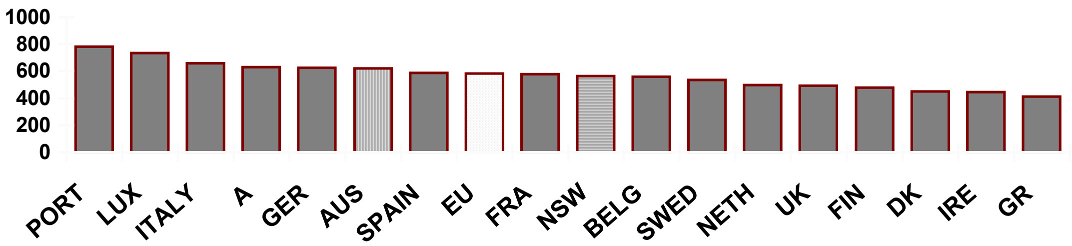


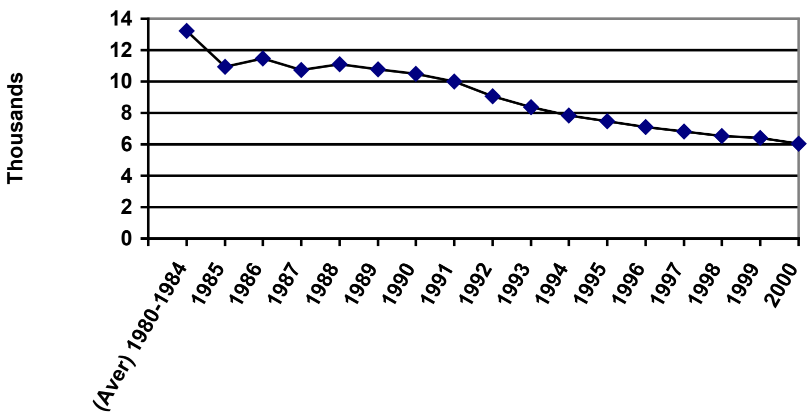
Figure 4. International comparisons in levels of motorisation Source: IRTAD 2002



The average severity is generally higher in rural areas, but the great majority of casualties to pedestrians occur in urban areas. The over-55 and under-12 age groups are those with the highest risk of pedestrian injury. Risk from traffic consists mainly of risk from motor vehicles – around 90% - and mainly from contact with the fronts of cars.

Accident analysis shows that about 50% of pedestrian deaths occur while crossing a road. About a quarter occur while boarding or alighting from a bus or getting into or out of a car. Others occur while walking along the road, playing, running, or working. Most fatal crashes involving pedestrians are not located at a marked crossing, the vast majority occurring more than 50m from such a crossing. Elderly people are most frequently hit by vehicles when halfway or further across the street, while children are mostly hit when starting to cross.

Figure 5. EU totals for pedestrian fatalities 1980-2000



The overall long-term trend in deaths has been downward for pedestrians. Between 1980 and 1995, the pedestrian death rate per capita for the EU as a whole fell by 30%. Studies indicate this may be due in some instances to a decline in walking (for example, amongst children) as more people take to their cars for local journeys.

However, several Member States are now experiencing annual increases in pedestrian deaths and encouragement is now being given in various countries to travel by foot, bicycle or public transport. For example, the Danish National Traffic Plan states that 4% of total car traffic should be converted into cycling and walking by the year 2005 and one-third of all car traffic under 3 km into non-motorised travel. As travel by public transport is also encouraged, increasing account needs to be taken of the safety of walking or cycling to catch the bus, tram or train.

The ageing of the road user population experienced internationally (shown below) is also likely to influence future trends and increase the need for action. For both Australia and the European Union (15), over one fifth of the population will be 65 years or above by 2030. Despite the rising number of older driving licence holders in many countries, declining driving ability and financial constraints mean that many motorists will have, at some stage, to give up their car. A larger percentage of the older population will be dependent on public transport which will involve pedestrian trips. The risk of death in EU traffic for pedestrians aged 65 and older is currently four times higher than for young adults.

Table 2. International comparisons: Percentage of population aged 65 or above

COUNTRY	**2000**	**2010**	**2020**	**2030**
AUSTRIA	15.4	17.8	20.1	25.2
BELGIUM	16.8	17.9	21	25.4
DENMARK	14.9	16.7	20.3	23
FINLAND	14.5	17.1	22.6	25.8
FRANCE	16	16.8	20.6	24
GERMANY	16.2	19.7	21.4	25.8
GREECE	17.3	19.5	21.8	25.4
IRELAND	11.3	12.2	15.3	18.7
ITALY	18.1	20.6	23.5	28.1
LUXEMBOURG	14	14.5	16.4	19.8
NETHERLANDS	13.6	15.3	19.7	23.9
PORTUGAL	15.4	16.9	19.4	22.8
SPAIN	16.9	18.4	21.2	26.4
SWEDEN	17.3	19.2	22.7	25.1
UNITED KINGDOM	15.7	16.7	19.6	23.5
EU (15) AVERAGE	**15.5**	**17.2**	**20.4**	**24.2**
AUSTRALIA	**12.4**	**13.9**	**17.6**	**21.1**
USA	12.6	13.2	16.5	20
JAPAN	17	21.8	26.8	28.3

Source: US Bureau of the Census, International Databases February 2001 in Transport and Ageing Society, ECMT 2001

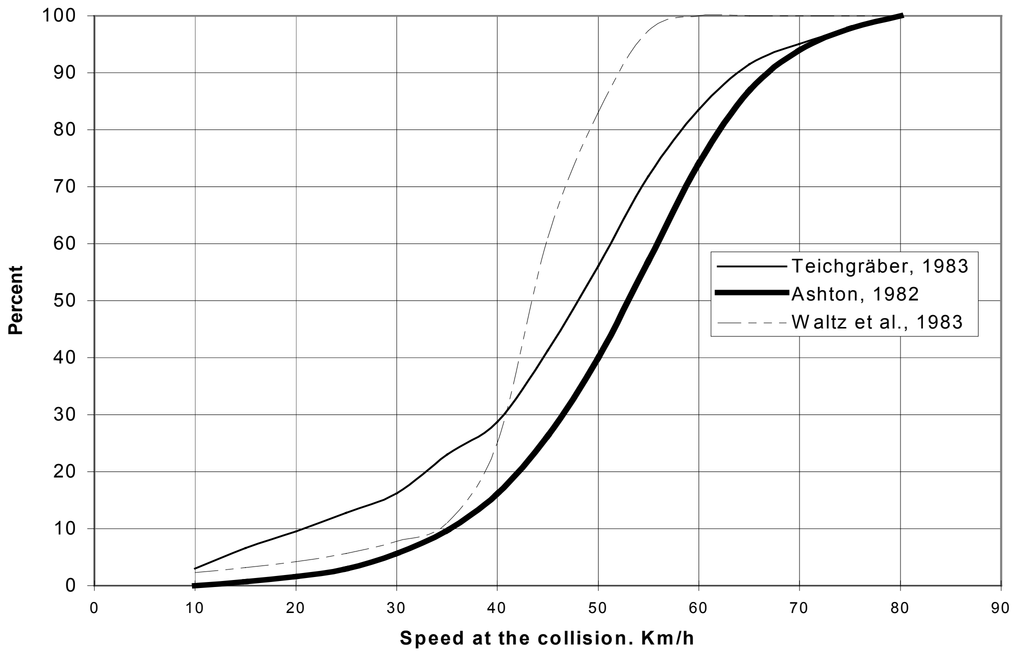
4. The key problems for pedestrians in today's traffic system

Most road safety problems for pedestrians are common to all European countries and beyond. These result from a complex mix of factors. However, underlying all other problems is the fact that the modern traffic system is designed largely from a car-user perspective. Mass motorisation in much of Europe since the 1960s has created a traffic system which caters mainly for motor vehicle users. Only since the 1980s has there been understanding about the need for coherent planning of route networks for pedestrians and only since the 1990s has long term planning for sustainable transport policies got off the ground (OECD, 2001).

The following problems emerge as being key issues for improving pedestrian safety and need to be addressed in combination in future traffic system planning.

Vulnerability. Most pedestrian casualties are either children or older road users, the most vulnerable of citizens and are hit by the fronts of cars. Until safer car fronts are provided by the car industry, the only protection available is clothing. Speed plays an important role in determining the severity of the outcome of collisions. As Figure 6 illustrates, if the collision speed exceeds 45 km/h the likelihood for a pedestrian to survive the crash is less than 50 per cent. If the collision speed is less than 30 km/h more than 90 per cent of those struck survive. Speed management, therefore, is a key element in a safer traffic system for vulnerable road users.

Figure 6: Pedestrian deaths by different impact speed of car (SNRA)



Flexibility Pedestrians are very flexible in their behaviour and flexibility is one of the main advantages of walking. In relation to other road users, however, this presents a problem. A driver can never be sure when or where to expect a pedestrian.

Instability Pedestrians may trip or fall in the traffic environment. A pedestrian may stumble and receive serious injuries just because of an uneven surface. The instability of pedestrians is an even bigger problem when they are mixed with motor traffic.

Invisibility Pedestrians can be difficult to see: They are small compared to a car, and can be hidden by one. At night the problem is more severe. A parked car is the most commonly cited source of obstruction.

Differing abilities Pedestrians include children with lack of experience, elderly people with reduced capability, and people with reduced mobility.

Consciousness of effort Making a detour in a motor vehicle may use extra fuel, but for pedestrians it means extra muscular activity. They are, therefore, highly motivated to find and keep to the easiest routes, often the most direct ones. Studies have shown that pedestrians place a higher value on their time than drivers or those on board public transport vehicles.

Impairment due to alcohol and drugs 35% of adult pedestrians (over the age of 16) killed in a crash and tested for alcohol were found to have blood alcohol levels above the legal limit for driving. This rate was higher than that of drivers involved in fatal crashes (Fontaine et al., 1997).

'Estrangement' Pedestrians are usually doing things other than thinking about walking as the priority task, like window-shopping or chatting with friends. This, together with the fact that the modern traffic environment is often designed for cars rather than for pedestrians, creates a state of estrangement. Providing pedestrian facility is typically an afterthought rather being considered as an integral part in the planning and design of the traffic system. Even the majority of European car drivers believe that much consideration should be paid to walking and cycling when planning for the future according to SARTRE, a survey of car drivers conducted in 19 European countries in 1997.

5. Recognising physical limitations and needs of pedestrians in safety strategies

In the development of EU and national targeted programmes, and most explicitly in those embodying the sustainable safety or Vision Zero concepts, it is recognised increasingly that preventing road death and disabling injury entails a traffic system that is better adapted to the needs, errors and physical vulnerabilities of its users rather than one which expects users to cope with increasingly demanding conditions. While challenging to deliver, this approach is founded in pragmatism and ergonomics. Its innovation lies in recognising that road death and severe public health loss is a feature of poor design; that it can and should be avoided by putting to greater effect and implementing more widely in targeted programmes, key safety principles and measures which have been known about for many years.

The European Commission has accepted that such an approach is necessary to meet the highly ambitious target which has just been set to reduce deaths by 50% by the year 2010 across the EU (CEC, 2001a). In their consultation on a new EU road safety programme 2002-2010, which is expected shortly, the Commission has already concluded that a better balance is needed between the safety of vulnerable road users and the mobility of motor vehicle users especially in urban and residential areas (CEC, 2001b).

In the next sections, the strategies and measures which European experts believe are key to the delivery are set out and observations made on the efforts at EU, national or local level. The focus is on evidence-based strategies and measures aimed at the provision of safer environments through planning, infrastructure provision and vehicle design.

6. Key strategies and measures for improving pedestrian safety

There are many ways in which transport policy in general and road safety policy in particular can contribute to reducing crash injury risk from traffic for those travelling on foot.

ETSC has identified the key strategies for pedestrian safety as follows:

- Land use planning which minimises exposure to risk in the course of pedestrian journeys
- Creating safer, attractive, connected pedestrian routes within urban safety management framework
- Managing traffic mix, by separating different kinds of road use to eliminate conflicts, where conditions are favourable to separation.

- Creating safer conditions elsewhere for integrated use of road space, e.g. through area-wide speed and traffic management, increased pedestrian and vehicle conspicuity, and vehicle engineering and technology.
- Mitigating the consequences of crashes through car crash protective design.
- Modifying the attitudes and behaviour of drivers of motor vehicles through information, training and the enforcement of traffic law.
- Consulting and informing pedestrians about changes being made for their benefit, and encouraging them in steps that they can take to reduce their risk.

6.1. Land use planning to minimise risk exposure in the course of pedestrian journeys

Land use planning can make a useful contribution to minimising pedestrian exposure to risk of accident and injury. In planning the evolution of land-use, priority can be given to locating the most likely destinations for walking and cycling - homes, schools, workplaces, shops, social and recreational facilities, and public transport stops - where they can be more readily served by safe, attractive and convenient routes for walking and cycling.

As sites and buildings are adapted, redeveloped or developed for the first time, opportunities can be taken to achieve layouts which separate access by motor vehicles from that on foot, and adapt the latter to the existing local network of pedestrian routes, including routes from public transport stops.

6.2. Creating a hierarchy of safe, attractive integrated pedestrian routes

Classifying the urban road network according to road function, setting appropriate speed limits according to that road function and improving road layout and design to encourage better use is now recognised, amongst EU Member States active in road safety, as fundamental to urban safety management.

The Netherlands, in particular, has made considerable progress in establishing road hierarchies and the UK and the Nordic countries have stated their intention to do this to provide a better framework for area-wide risk reduction in their national road safety strategies. The development of EU best practice guidelines on urban safety management, amongst other themes, is foreseen in the new EU road safety programme, which is expected to be announced this summer.

In the context of encouragement for walking, urban safety management needs to give high priority first to identifying the pattern of journeys that people want to make on foot and then to creating safe, attractive and connected routes for this pattern of journeys. These routes should be designated in conjunction with the functions of each road for all kinds of road user, and in particular so that motor traffic uses each road in ways that are consistent with the safety and convenience of pedestrians.

Routes will typically consist of a mixture of sections of footpath separate from any carriageway, wholly pedestrian areas with or without admission of cyclists, footways alongside carriageways, and carriageways or other surfaces shared with motor vehicles. Where routes cross appreciable flows of motor vehicles, careful attention will be given to the location and design of the crossing point. Where the routes are not separated from carriageways, and even more so where surfaces are shared with motor vehicles, the layout will be such that the speeds of the latter are moderated.

Concentration of motor traffic onto main roads should enable the more local roads to be adapted to enable them to perform their functions in respect of motor vehicles consistently with their forming parts of safe and attractive routes for pedestrians and cyclists. The more these roads are used for walking and cycling, the more aware drivers will become of the likelihood of encountering pedestrians and cyclists, and thus the lower the risk that motor vehicles will pose to them. On public transport routes, whether bus or light rail routes on main or more local roads, or bus or rail services on segregated tracks, stopping places should be served by the network of routes for walking and cycling.

A fresh look at road hierarchies in relation to pedestrian safety has been undertaken recently by researchers coming together in the EU PROMISING project. It was based on the requirements of coherence of the network, directness, safety, comfort and attractiveness on the one hand and on the new concepts for road safety in the Dutch sustainable traffic system and the Swedish Zero Vision on the other hand. The hierarchy was developed only for built-up areas and is set out in Table 2.

Table 3. Hierarchy of roads proposed in PROMISING

- ❑ through-traffic route with a speed limit of 70km/h and only grade-separated crossings;
- ❑ main street or urban arterial road with speed limit of 50km/h and, in some areas 30km/h;
- ❑ residential street with a speed limit of 30 km/h;
- ❑ walking-speed street;
- ❑ car-free areas for pedestrians and cyclists.

With reference to this hierarchy, it is worth noting that the long debate about whether the general speed limit to be favoured across Europe should be 50km/h or 60 km/h has been largely resolved in favour of 50km/h, with increasing use of 30km/h off main roads. ETSC's comment on grade-separate crossings can be found in a later section.

6.3. Separating different kinds of road use

Separation can take the form of pedestrian areas, footways alongside carriageways, sections of footpath separate from the carriageway and grade-separated crossings. Pedestrians need designated physical space with adequate pavement width such that pedestrians need not walk on the carriageway and for those using wheelchairs.

6.3.1. Pedestrian areas

Pedestrian areas may be designed as such or be conversions from streets used by vehicles. Their value in improving safety has been demonstrated widely, especially for shopping streets (e.g. DUMAS). Pedestrian areas may be exclusively for pedestrian use, for pedestrians and cyclists or for pedestrians and cyclists along with some permitted vehicles at certain times of the day. The facility for vehicles to use converted areas outside times of closure will often remain for reasons of access and servicing, but the surface and layout of the street are designed for pedestrians, with a clear indication of the paths to be followed by vehicles when they have access.

While streets dominated by heavy flows of traffic tend to be threatening to pedestrians, traffic-free areas, such as shopping precincts, with too little activity, can also promote anxiety. Whilst the fear of personal crime may be out of proportion to its reality, this needs to be considered in the layout and design of areas used by pedestrians, if they are to be used.

By physically restricting access for vehicles, pedestrian zones create an environment where travel on foot and by cycle is safer. Opinion on admission of cyclists to these areas may be divided, but there is a need to avoid pedestrian areas resulting in unsafe or inconvenient conditions for cyclists, for example by forcing them to use busy distributor roads. In Mechelin cycling is permitted in pedestrian streets in order to avoid detours for cyclists and evaluation had shown that this, so far, has proved to be safe (Dykstra et al, 1998). Research in the UK indicated that conflicts between cyclists and pedestrians in pedestrian areas were less of a problem than appeared (Trevelyan and Morgan, 1993). Segregating cyclists and pedestrians in pedestrian areas will not always be possible. Where it is desirable, cycle movements can be combined with those of selected vehicles, such as buses and service vehicles, permitted at particular times of day or channelled by defined paths.

6.3.2. Grade–separated crossings

Pedestrians and cyclists are particularly at risk when crossing heavily trafficked roads and are generally safer when separated from traffic. However, the benefits of grade-separated crossings, which can be expensive in relative terms, are not always realised. To be successful, grade-separation, either by footbridges or subways, should be without steps or troublesome ramps and keep vulnerable road users on their natural desire-line whilst motor vehicles undergo the changes in grade and level. The main use is for crossing roads with speed limits of 60km/h or higher or heavily trafficked roads. Subways should be brightly lit, regularly cleaned, have good through visibility and be consistently overlooked (IHT, 1997).

6.4. Creating safer conditions in shared road space:

Where separation can be achieved in ways which provide convenient and attractive routes for all road users, it very largely removes risk from traffic in the areas of separation - but this advantage may be offset by increased risk where road users re-enter shared space. Integration of different kinds of road use by sharing of space often has the advantages of requiring less adaptation of the roads and paths and enabling more direct routes to be provided.

Taken together, the means of reducing risk require action to create safer conditions for integrated use of shared road space through:

(a) managing speed and traffic through improving junction design and layout, implementing area-wide treatments and speed zones and developing intelligent speed adaptation and
(b) improving vehicle and user conspicuity.

6.4.1. Area-wide speed and traffic management

Road safety engineering measures to create safer conditions for pedestrians can be considered in terms of traffic reduction, speed reduction, junction treatments, the redistribution of road space and the creation of special facilities.

Traffic reduction The selective closure or partial closure of minor streets can offer lightly trafficked routes for cyclists and a safer pedestrian environment as part of an area-wide approach to avoid displaced traffic leading to more crashes elsewhere. Even at low speeds, mixing with heavy traffic, especially lorries, is hazardous. The diversion of through and unnecessary traffic from some areas will reduce potential conflict but will require appropriate advance signing and, possibly, some road construction.

Speed reduction and traffic calming measures
Speed of motor vehicles is critical to the safety of vulnerable road users. At low speeds drivers have more time to react to the unexpected and avoid collisions. At speeds of below 30 km/h pedestrians can mix with motor vehicles in relative safety.

The development of speed management and traffic calming to deal with inappropriate speed in urban areas in Europe has been documented by Kjemtrup and Herrstedt (1992). These techniques comprise traffic management measures ranging from discouraging traffic from entering certain areas to installing physical speed reducing measures including roundabouts, road narrowings, chicanes and road humps (Webster, 1993). Such measures are often backed up by speed limits of 30 km/h, but they can be designed to achieve various levels of appropriate speed (DRD, 1989, 1991, 1993).

Traffic calming reduces the speed of motor vehicles by various physical modifications: vertical and horizontal deflections, changes in surface colour and texture, a reduction in overall carriageway area, and signs and other symbols to convey to drivers that they need to have greater awareness of vulnerable road users. Gateways may indicate entries into traffic-calmed areas. Traffic calming measures, based upon various national guidelines, are now common throughout the EU and are often introduced as part of area-wide urban safety management Recent experience in the Netherlands has shown positive effects of traffic calming measures not only implemented in traffic calming areas, but also on surrounding traffic arteries. Speeds have also been reduced on 'distributor roads' by constructing traffic calming facilities which include use of roundabouts.

Experience in several EU Member States over the last twenty years has shown that accident reductions of between 15 and 80 per cent can be achieved by comprehensive area-wide treatments (Brilon and Blanke, 1993; Herrstedt et al, 1993; IHT, 1990a; CERTU, 1994). The results indicate that application of such speed management measures in urban areas throughout the EU might reduce the total number of injury accidents by 5%.

Speed limits In urban areas, speed limits should reinforce an easily understood road hierarchy. Speed limit zones of 30 km/h are most appropriate where an urban safety management strategy has been adopted. Self-enforcing measures in the zones are usually necessary to reduce speeds.

Table 4. Serious accident risk by urban road type (per mill mot veh km, the Netherlands)

	Speed limit km/h	Risk
Woonerf and residential roads	30	0.20
Residential roads	50	0.75
Urban arteries	50/70	1.33

SWOV, 1997

As the Table above illustrates, the more urban roads which can more appropriately be given a ‘residential’ function with the maximum speed limit of 30 km/h the better.

In the Netherlands, re-classification of the road network is well underway to distinguish between areas where priority can be given to residential, recreational and agricultural functions, which comprise 65-90 per cent of total road length in the network, and traffic arteries which give priority to traffic flow. It has been established that two-thirds of the Dutch road network within built-up areas can be converted into 30km/h zones. Central and local government have signed an agreement to convert 50% of these streets into 30km/h zones by the year 2002. To date, the number of kilometres of 30km/h-streets has been increased to 19,000 km with 9 people killed a year on these streets.

Monitoring of this rapid expansion In the Netherlands over the last few years has shown very large reductions in casualties, particularly in fatalities - perhaps 17% of fatalities in urban areas had been saved through this policy by 2000. With more direct conversion from 50km/h to 30km/h having taken place over the last 2-3 years, the impact on fatalities is expected to increase significantly. There have also been substantial improvements to the 50/70km/h roads in the Netherlands. These include new roads built to a high standard incorporating roundabout junctions, improvement of 50km/h roads surrounding 30km/h zones, and also improvement of some 15% of existing 50km/h roads. The Dutch Transport Ministry has recently put forward the case to Government for around 2.5 billion Euro billion up until 2010 for the reshaping of the road network within the sustainable safety programme (Sunflower Congress, Amsterdam 2002).

In the town of Baden in Austria, about 75% of the road network is today part of a 30kmh zone or woonerf. Since the introduction of its integrated transport and safety plan in 1988 which introduced a range of measures, the town has seen a 60% reduction in road casualties (Lines and Machata, 2000).

In terms of cost benefit of area-wide speed and traffic management, research and experience in the British five towns study (1980s) has shown that the additional travel time, vehicle wear and tear and fuel costs are small, and reduce the overall benefits by no more than around 15%.

Developing intelligent speed adaptation Telematics solutions could also contribute to reducing crashes including collisions with pedestrians through speed limiters to enforce the posted speed limit. Intelligent Speed Adaptation (ISA) is the global name for systems that "know" the permitted maximum speed and use that knowledge to inform the driver and/or intervene in the vehicle's control to prevent it from being driven faster than the permitted limit. Intervention control can be by:

- haptic throttle (i.e. a throttle providing force feedback to the driver), in some versions, this can be overriden by the driver with a "kickdown,"
- through the engine management system to ignore demand from the driver for speeds exceeding the limit, perhaps supplemented by
- mild braking.

There are three types of ISA in terms of the degree of intervention of the system. The lowest level is informative or *Advisory* ISA. Next is voluntary or *Driver Select* ISA. Here the information on speed limit is linked to the vehicle controls but the driver can choose whether or not to have the control enabled. Finally there is *Mandatory* ISA where speed limiting is enforced. Knowledge of the speed limit could come from roadside beacons or from a modified navigation system in the form of an enhanced on-board digital road map coded with speed limits for each road combined with a GPS-based location system. The latter is the so-called autonomous version of ISA which does not require extensive investment in roadside infrastructure. The most recent estimates of the accident savings from ISA for all road users have been made by a UK national research project and are shown in Table 5 (Carsten and Tate, 2000).

These estimates are based on a prediction of 40% compliance with an Advisory system and 50% compliance with a Driver Select system. Full compliance with speed limits would occur with a Mandatory system. Clearly, the Mandatory systems predict the largest accident savings, with the Dynamic Mandatory system being the most effective. These predictions are broadly in line with estimates previously made for Sweden (Várhelyi, 1996).

It has been estimated that around 20% of pedestrian accidents would be reduced on urban roads from enforcement of urban speed limits by Mandatory ISA (Carsten and Tate, 2000). Varhelyi (1996) estimated that there would be a 78% savings in pedestrian injury accidents at pedestrian crossings with an ISA that slowed vehicles to 30 km/h.

Table 5. Predicted accident savings for Great Britain by ISA type

System Type	Speed Limit Type	Injury Accident Reduction	Fatal and Serious Accident Reduction	Fatal Accident Reduction
Advisory	Fixed	2–21%	4–30%	5–37%
	Variable	2–22%	4–31%	5–39%
	Dynamic	3–27%	5–38%	6–47%
Driver Select	Fixed	5–21%	8–30%	10–37%
	Variable	6–22%	9–31%	11–39%
	Dynamic	10–27%	14–38%	18–47%
Mandatory	Fixed	11–31%	15–43%	20–53%
	Variable	12–33%	17–45%	22–55%
	Dynamic	19–50%	28–65%	35–75%

However, a number of steps have to be taken before ISA can be implemented:

1. Agreement needs to be reached on standards for such aspects as: road maps, driver interface, vehicle control and, for Dynamic ISA, communications. This needs to be harmonised at a European level to enable a pan-European capability.
2. ISA-capable cars need to be put into manufacture.
3. Before mandatory use can be considered, a majority of the vehicle fleet should be equipped.
4. There has to be public and political acceptance.

ETSC promotes the need for further research and development towards harmonised standards for Intelligent Speed Adaptation systems towards an eventual requirement for ISA capability on all new vehicles sold. In the meantime, encouragement needs to be given to manufacturers providing ISA systems via the European New Car Assessment Programme to enable the consumer to start benefiting from a voluntary system and speed limits need to be introduced into digital road maps.

A description of the range of demonstration projects carried out in Europe is given in the complementary presentation to this Conference on Priorities for EU motor vehicle safety design – pedestrian safety.

Pedestrian crossings Pedestrian crossings are perceived to be safe places to cross the road. However, while crossings give some protection to the young and elderly, many crashes occur in their vicinity: the 50m either side of a signalised crossing is particularly dangerous.

Road lighting, refuges, safety fences and raised pedestrian crossings can all improve the safety of crossing. A package of measures, including, for example a raised pedestrian crossing and safety fences, is likely to reduce the number of pedestrian accidents at pedestrian crossings by about 60% and the number of vehicle accidents by about 35% (PROMISING, 2001). However, bus stops on refuges in the middle of streets can be particularly hazardous for pedestrians (OECD, 2001). Where roads are wide and vehicle flows relatively light, narrowing at pedestrian crossings can be effective.

Zebra crossings are also often used because of their relatively low cost. Signal–controlled pedestrian crossings can improve safety especially on higher speed roads or those with high traffic levels (Jensen, 1998). School crossing patrols provide a managed means of safer crossing for children as a particularly vulnerable group.

Increasingly, where signal-controlled crossings are being upgraded, closer attention is being given in identifying the pedestrian crossing phase to pedestrian 'value of time' assessments which tend to be higher than those of motor vehicle users.

Guard rails A continuous safety fence on the edge of the footway can improve safety at conflict points but should be installed only where there are risks of crashes from pedestrians walking onto the road. Guardrails restrict people's freedom and are resented unless there is no practical alternative. Drivers must be able to see pedestrians waiting to cross at the end of a length of guardrail.

Shared use of footways Cycling on the footway is common. Indeed in some countries, such as Belgium and the Netherlands, small children are allowed to cycle there. However it is of much concern to many pedestrians, particularly the elderly and people who are visually impaired. In specific instances where no on-carriageway solution can be found, and where visibility is good, it may be appropriate to convert the footway to shared use. Widening of the footway clear signs and markings will help to make shared use more acceptable. Segregation by white line only may be expedient but segregation by kerb or level is preferred by the visually handicapped.

Facilities for people with reduced mobility A significant proportion of people have some degree of reduced mobility and all of us are sometimes ill, impaired or encumbered. The resulting needs must be understood before facilities, especially pedestrian crossings, are designed or redesigned. Blind or partially-sighted people can usually follow kerb lines or the facades of buildings, but they can have problems in finding their way in pedestrian areas (IHT, 1991). Different surface textures or directional guidance paving can help them. Street furniture can be a hazard and should not be placed on the natural routes taken by blind or partially-sighted people. Changes in level should avoid the exclusive use of steps. If steps are unavoidable, the top and bottom of flights of steps should have warning surfaces. Dropped kerbs at pedestrian crossings assist those with physical impairments while tactile surfaces help those with visual impairments.

Parking regulations Parked cars are a traffic hazard for pedestrians, particularly children. Research has shown that prohibiting on-street parking improves safety. The number of accidents is reduced by about 25% in streets where on-street parking is prohibited.

6.4.2. Improving vehicle and user conspicuity

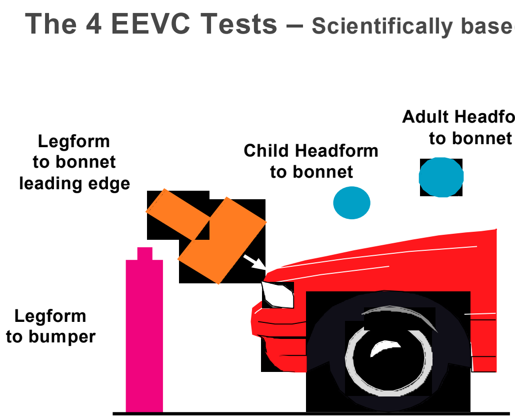
About 30% of struck pedestrians fail to see the car before the collision. The more conspicuous motor vehicles are to road users outside them, and the latter are to drivers, the more opportunity both will have to avoid collisions. Road layout can help in this and so can the use of daytime running lights by drivers, the use of lights at night by cyclists, and the wearing of reflective or light-coloured clothing by pedestrians and cyclists (ETSC, 1999a).

6.5. Mitigating the consequences of crashes

Since the majority of severe pedestrian collisions are with cars, major improvements in crash protection for pedestrians can be achieved in the short term and with great efficiency by changing car design.

Developing technical tests suitable for use in legislation to require protection for vulnerable road users in frontal impacts with cars has been the focus of a 22-year EU-funded research and development programme. Funded by the EU and Member States, the programme involving national transport laboratories, government departments and industry, was brought together by the European Enhanced Vehicle-safety Committee (EEVC).

The pedestrian tests, proposed by EEVC originally in 1991 with an updated report to the Commission in 1994 (EEVC 1994) and in 1998 (EEVC 1998), are an integrated package of four tests representing impacts to the parts of the body which most frequently sustain severe injuries in car to pedestrian impacts. Sub-system tests were used because they have many advantages over pedestrian dummies for tests intended for legislative use.



The state of the art EEVC tests comprise:

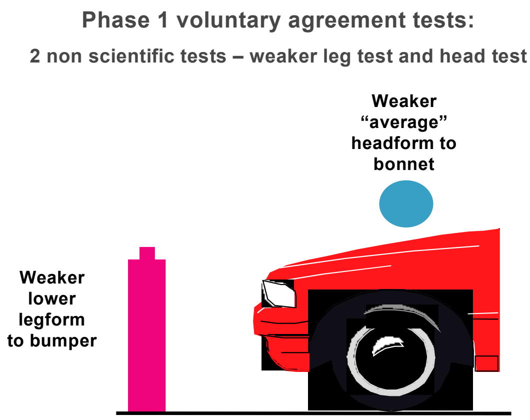
1. Legform to bumper test to prevent serious knee joint injuries and leg fractures
2. Upper legform to bonnet leading edge test to prevent femur and hip fractures and injuries
3. Child headform to bonnet top test to prevent life-threatening head injuries
4. Adult headform to bonnet top test to prevent life-threatening head injuries

On the basis of national and European studies carried out under the EU programme, it has been estimated that around 2,000 lives and 17,000 serious injuries to pedestrians and cyclists could be prevented annually if all cars on EU roads today met these tests. An updated benefit analysis on pedestrian savings is expected to be published shortly by the UK TRL.

EEVC-based pedestrian tests have been used since 1996 by the European New Car Assessment Programme (EuroNCAP) which provides information to consumers on the crash performance of new cars and which receives substantial Commission funding. No car tested has yet performed well enough to have passed the EEVC tests proposed for legislation. Results to date indicate that only 3 EuroNCAP tested cars have received 3 out of a possible 4 star rating, 65 have obtained two stars and 14 have obtained one star (Official Report, 2001).

However, just as the European Commission was expected to come forward with legislation, with a Directive promised in the last two road safety action programmes (, with a draft proposal for regulation translated into all the Community languages (6065/2000) and following pressure from the European Parliament and Council of Ministers for a legislative proposal, the European car industry came forward with an alternative proposal for a voluntary agreement. The European Commission is currently consulting the European Council of Ministers and the European Parliament as to whether to accept it or to propose a Directive (CEC,2001c).

This proposal comprised two phases of pedestrian protection tests (the second phase being subject to review in 2004 before being confirmed) and several other measures assessed by safety experts to be either peripheral to pedestrian safety or needing separate treatment by Directive (anti-lock braking, daytime running lights). The detail is presented in the complementary paper being presented at this Conference.



The Phase 1 tests – the only certain pedestrian sub-system tests in the agreement - have been roundly criticised by experts as non-scientific (Janssen 2001, Hobbs 2001, Lawrence 2001). The Phase 2 tests mention the possibility of adopting EEVC by 2010 but 'equivalent measures' are allowed and, as previously noted, the second Phase would be subject to a review in 2004.

The safety content of this agreement has received close scrutiny from experts in the leading research organisations involved in European pedestrian work and have been rejected by European non-governmental safety and consumer organisations for several reasons.

- The agreement would not implement with certainty the scientifically developed cost-effective EEVC tests.
- The industry's own Phase 1 tests were fewer in number and weaker than EEVC and offered a 75% lower level of protection against fatal injury according to the UK TRL (Official Report of the House of Commons, 12.11.2001). Independent experts involved in pedestrian protection research told the Commission Hearing on Pedestrian Protection on 6th February 2001 and a subsequent UK Parliamentary briefing that, in addition to providing substantially lower levels of protection than the EEVC tests, the Phase 1 tests were not scientific; the tests were not a natural first step towards EEVC, could drive car design in the wrong way for effective protection as well as producing serious side-effects (Janssen 2001, Hobbs 2001, Lawrence 2001).
- The Phase 1 lower leg bumper test would lead to a situation where many of those saved from lower leg fractures would instead suffer serious knee joint injuries, which are more important because these have a greater risk of permanent disability and consequently are of higher societal cost.
- The Phase 1 head impact test used a headform which represents an older child than selected by EEVC and did not represent the adult head, thus providing inappropriate protection for the adult head and leaving one third of the bonnet area unprotected.
- The introduction of a lower leg test which is not accompanied by a bonnet leading edge test requirement in Phase 1 would be likely to increase femur and pelvic fractures.
- The absence of the bonnet leading edge tests would not protect against fatal child head injuries nor femur and pelvic injury.
- The agreement failed to implement best practice achieved already on the road today. The Honda Civic offers now 80% of EEVC (without using new technology) at an

additional cost, according to the TRL of only £6.50 (10 Euro) – that is 3 times the level of the Phase 1 protection which the industry offered to implement fully in 11 years time.

- If any small initial saving occurred as a result of the agreement, this would be outweighed in a very short time by the large safety gains of a Directive implementing EEVC.

The opinion of the lead Committee in the European Parliament (four Committees have considered the issue) has indicated support for the take up of EEVC or equivalent test methods (which do not exist) by the year 2010 in a Framework Directive. A final opinion is expected in June and the Commission has indicated that that Parliament's opinion will be most important in contributing to their final decision.

ETSC continues to campaign for legislation which implements EEVC with certainty and for car industry focus on meeting the state of the art EEVC pedestrian tests as soon as possible. ETSC is also urging the European New Car Assessment Programme to combine the star ratings from car occupant and pedestrian tests to give consumers a quick reference guide to the overall crash test performance of new cars. EuroNCAP has recently taken the decision to continue with EEVC rather than include the voluntary agreement Phase One testing in its programme.

6.6. Modifying drivers' attitudes and behaviour

The attitudes and behaviour of motor vehicle users towards pedestrians are very important. Training provided by driving instructors, the advice and information that drivers receive from user and safety organisations, and the influence exerted upon them by enforcement should all be reoriented to promote attitudes and behaviour based on higher priority for the safety of pedestrians on the roads the drivers use. Emphasis should be placed both upon greater consideration and upon greater compliance with traffic laws concerning speed and giving way, whose effect on the safety of pedestrians is strongest.

6.7. Consulting and influencing pedestrians

Achievement of safe routes for walking and cycling which are also attractive to their intended users will be helped by consultation with pedestrians, cyclists and prospective cyclists in the catchment areas of the routes, as well as research into the journeys they wish to make on foot or bicycle.

Even on the best practicable routes, safer walking calls for competence on the part of the pedestrians. Information, education and training should therefore be provided for pedestrians of all ages from the nursery and kindergarten through the school years to young adulthood, and later as parents and as middle-aged and elderly people adjusting to the changes in capability that come with advancing years.

7. Implementation strategies

Action on pedestrian safety can be taken at international, national and local levels. Improvements need to be considered within the framework of national and local targeted road safety programmes and as part of a comprehensive pedestrian safety policy. Effective implementation of measures for safer walking requires dedicated and technically informed effort by all of the many professionals involved, together with commitment by policymakers and the support of a convinced public.

This requires systematic dissemination of research-based interdisciplinary technical guidance that synthesises current best practice to town planners, architects, highway and traffic engineers, road safety professionals, the police and judiciary, driving instructors, teachers, those who work with parents and elderly people, and designers of vehicles and protective equipment. It also requires technically supported guidance in policy formulation to be communicated to policymakers, who in turn should be encouraged to join with road safety organisations and road user groups in campaigns to inform the public and win their acceptance of the necessary policies and measures.

The report on pedestrians (PROMISING, 2001a) described an implementation strategy as consisting of the following steps:

- *Identification and understanding of pedestrian safety problems:* This may take place at various levels, for example concerning a whole country or a specific part of a town.
- *Selection of relevant safety actions and measures:*
- *Definition of implementation conditions:* These arise from case-specific analyses.
- T*hree-step implementation process:* It consists of *strategy, preparation* and *executio*n.
- *Pedestrian safety improvement and feedback:* The result of the implementation is fed back to the overall understanding of pedestrian safety problems

8. Conclusions – a change in thinking

A better balance between the mobility and safety of all road users is necessary to allow them to participate fully in society. Walking needs to be recognised as a mode of transport in its own right if people are to be encouraged to travel on foot or by public transport rather than by car in order to reduce environmental damage, improve public health, and enhance the quality of life in towns and cities.

Given that the focus of planning and infrastructure provision for at least the last thirty years has been to consider the mobility of vehicle users as the main priority, this is clearly going to take some time.

However, this does not mean that very positive results cannot be achieved in the short term, whether in infrastructure of vehicle engineering as, indeed the examples set out in this paper demonstrate.

9. Acknowledgement

This paper is based principally on the review activity of the following experts from across the EU who comprise the following ETSC Working Parties:

Safety of Pedestrians and Cyclists in Urban Areas

Dr Rudolf Gunther (Chairman) (D)
Professor Richard Allsop (Editor) (UK)
Dr Lars Ekman (S)
Mr Dominque Fleury (F)
Dr Lene Herrstedt (DK)
Dr Christa Michalik (A)
Ir Edgar Janssen (NL)
Mr Derek Palmer (UK)
Mr Antiono Lemonde de Maecdo (P)

Road Vehicle Safety

Prof Adrian HOBBS (Chairman) (UK)
Mr Dominique CESARI (F)
Mr Edgar JANSSEN (NL)
Mr Anders KULLGREN (S)
Prof Klaus LANGWIEDER (D)
Mr Dietmar OTTE (D)
Prof. Fernando PINA DA SILVA (P)
Mr Pete THOMAS (UK)
Mr Thomas TURBELL (S)
Dr Oliver CARSTEN
(ETSC Road User Behaviour and Telematics Working Parties) (UK)

I am particularly grateful to Professor Richard Allsop, Chairman of the ETSC Road Infrastructure Working Party for his help with updating the road safety engineering aspects.

10. References

ETSC (1999a) *The safety of pedestrians and cyclists in urban areas*, European Transport Safety Council, Brussels,1999

ETSC (2001) *Priorities for motor vehicle safety design*, European Transport Safety Council, Brussels, Belgium, 2001

OECD (2001). *Safety of vulnerable road users*. Organisation for Economic Co-operation and Development, Paris, France.

ECMT (2000) *Declaration on safety in road traffic for vulnerable users,* European Conference of Ministers of Transport, Council of Ministers, 30-31 May 2000, CEMT/CM (2000) 2/final

DUMAS (1998) *Developing Urban Management And Safety; Work Package 6: Safety for pedestrians and two-wheelers*. Danish Road Directorate, Copenhagen, Denmark.

MASTER (1998) *MAnaging Speeds of Traffic on European Roads*, Final report, VTT, Finland, 1998

PROMISING (2001) *Promotion of mobility and safety of vulnerable road users.* Final report of the European research project PROMISING, SWOV Institute for Road Safety Research, Leidschendam, the Netherlands, 2001

WALCYNG (1998) *How to enhance WALking and CYcliNG instead of shorter car trips and to make these modes safer.* Department of Traffic Planning and Engineering, Lund University, Sweden, and FACTUM Chaloupka, Praschl & Risser OHG, Vienna, Austria.

ETSC (1999b) *Exposure data for travel risk assessment:current practice & future needs in the EU*, European Transport Safety Council, Brussels, 1999

IRTAD (2002) *International Road Traffic and Accident Database*, OECD. Federal Highway Research Institute (Bast), Bergisch Gladbach

FONTAINE, H. (1997) *Typological analysis of pedestrian crashes*. Journée d'Études sur les Crashes de Piétons, Paris, 12 September.

SARTRE (1998) Cauzard, J.-P. & Wittink, R.D. (eds.) (1998). *The attitude and behaviour of European car drivers to road safety; Project on Social Attitudes to Road Traffic Risk in Europe SARTRE 2. Part 1: report on principal results*. SWOV Institute for Road Safety Research, Leidschendam, the Netherlands.

CEC (2001a) Commission of the European Communities. *White Paper on the Common Transport Policy for 2010: Time to Decide* COM (2001) 370

CEC (2001b) Commission of the European Communities. *Consultation Paper on a 3rd Road Safety Action Plan 2002-2010 "A Partnership for Safety",* Brussels, 31 May 2001

EVSC (2000) Final Report External vehicle safety control project, Institute for Transport Studies, University of Leeds, 2000

DYKSTRA H. et al (1998) *Best Practice to Promote Cycling and Walking*. Dykstra H., Levelt, P., Thomsen J., Thorson O., van Severen J., Vansevenant p. Nilsson P., Jorgensen E.,Lund B. & Laursen J. Danish Road Directorate, 1998

TREVELYAN,P. & MORGAN, J.(1993) *Cycling in Pedestrian Areas*. Transport Research Laboratory report 15, Crowthorne, Berkshire 1993

IHT (1997) Institution of Highways and Transportation, *Transport in the Urban Environment*, London, 1997

KJEMTRUP, K., HERRSTEDT, L.(1992).*Speed management and traffic calming in urban areas in Europe: a historical view.* Accident Analysis and Prevention, 24(1), 57-65.

WEBSTER (1993) *Road humps for controlling vehicle speeds.* Project report 18. Crowthorne: Transport Research Laboratory (TRL).

DRD (1989) Danish Road Directorate *Hastighedspåvirkning*. VDL rapport 80. Copenhagen, 1989

DRD (1991)	Danish Road Directorate *Urban traffic areas, part 7*. Copenhagen
DRD (1993)	Danish Road Directorate *Hastighedspåvirkning*. VDLnotat 7. Copenhagen
BRILON, W., BLANKE, H. (1993)	*Extensive traffic calming: results of the accident analyses in 6 model towns*. Paper presented at the ITE-Conference, The Hague.
HERRSTEDT, L. et al (1993)	Herrstedt, L. Kjemtrup, K. , Borges, P., Andersen, P.S. *An improved traffic environment.* Report 106. Copenhagen: Danish Road Directorate, 1993
IHT (1990)	Institution of Highways and Transportation. *Guidelines for urban safety management*. London, 1990
CERTU (1994)	*'Ville plus sûr, quartiers sans accidents'. Realisations; evaluations*. Lyon: CERTU.
ETSC (1995)	*Reducing traffic injuries from excess and inappropriate speed*, European Transport Safety Council, Brussels, 1995
SWOV (1997)	*Sustainable solutions to improve road safety in The Netherlands.* SWOV Report D-97-8. Leidschendam: SWOV Institute for Road Safety Research
LINES, C. MACHATA, K. (2000)	*Changing streets, protecting people – making road safer for all – the EU Dumas Project*, ETSC Best in Europe Conference, Brussels, Sept 2000.
CARSTEN, O. & TATE, F.(2000).	*Final report: integration. Deliverable 17 of External Vehicle Speed Control Project.* Institute for Transport Studies, University of Leeds, UK.
VÁRHELYI, A. (1996).	*Dynamic speed adaptation based upon information technology: a theoretical background*. Bulletin 142, Department of Traffic Planning and Engineering, University of Lund, Sweden.
EEVC (1994)	*Proposals for methods to evaluate pedestrian protection for passenger cars. Final EEVC WG10 report*.
EEVC (1996).	*EEVC test methods to evaluate pedestrian protection afforded by passenger cars*. Presented to the 15th ESV Conference, Melbourne, Australia.
EEVC (1998)	*European Enhanced Vehicle-safety Committee. EEVC Working Group 17 Report, Improved test methods to evaluate pedestrian* protection afforded by passenger cars, December 1998
OFFICIAL REPORT, 2001	House of Commons, 12.11.2001, London
CEC (2001c)	Commission of the European Communities Communication from the Commission to the Council and the European Parliament - Pedestrian protection: commitment by the European automobile industry on a draft negotiated agreement on pedestrian protection COM(2001)389 final
JANSSEN E. (2001)	Test methods to evaluate pedestrian protection. Chairman - EEVC WG 17 Presentation to Commission hearing on pedestrian protection, February 6 2001
HOBBS C.A. (2001)	Safer car fronts for pedestrians and cyclists. Chairman- ETSC Vehicle Safety Working Party presentation to Commission hearing on pedestrian protection, February 6 2001
LAWRENCE G	Background to pedestrian protection test methods and current EU/car industry proposals, Transport Research Laboratory. Presentation to British MPs, House of Commons, 17.10. 2001