TRANSPORT LEARNING

Empowerment of practitioners
to achieve energy savings
in urban transport

**TRAINING MODULE**

# 5

# Street design, streetscape and traffic calming


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The material for training module 5 “Street design, streetscape and traffic calming” was compiled by *Octavia Stepan and Irina Rotaru* in 2011.

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# About the project TRANSPORT LEARNING

TRANSPORT LEARNING – Empowerment of practitioners to achieve energy savings in urban transport – started in May 2011 and is a 32 month project supported by the European Commission within the Intelligent Energy Europe programme.

TRANSPORT LEARNING aims to create knowledge and capacity on sustainable transport policies and measures in municipalities and energy/ management agencies of Europe's convergence regions. It further aims to strengthen market activities on sustainable transport by integrating them into the business portfolio of energy/ management agencies, thereby supporting regions which are catching up economically.

The project aims to reach a wide audience, creating a large-scale impact and in the long-term safeguarding ongoing training and education on sustainable transport. In order to achieve this, TRANSPORT LEARNING creates and implements its training and site visits and exploits its outputs for a long-term impact. It will realise:

- 64 2-day training modules on topics mirroring the needs of the trainees in Bulgaria, Spain, Greece, Hungary, Italy, Poland, Portugal and Romania; to a minimum 650 participants;
- Mini-projects (practical training projects) resulting in a minimum of 170 projects being successfully carried out;
- Site visits for politicians and decision makers in order to support trainees' actions and sustainable transport generally in the convergence regions;
- Integration of training materials into academic and training courses to ensure long-term impact on students and working professionals;
- Website providing information, news, e-Learning platform, Online Training Resource Centre and all outputs of the project in 9 European languages.

Through all these measures TRANSPORT LEARNING will substantially contribute to energy-savings in transport by creating the required knowledge and capacity to work effectively in the field of sustainable transport.

## The TRANSPORT LEARNING consortium

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# 1. What is street design?

## 1.1 Street design: result and process

Design is usually understood to relate to aesthetics, fashion and appearance, and to changing the character of the surface. However, design in relation to the city, its public space, its streets and the movements which take in them should be understood as the final output of a chain of actions and activities. This chain starts with the adoption of a mobility public policy and goes all the way through to the elaboration of a Sustainable Urban Mobility Plan and the implementation of this plan. In this respect **street design is the result of a policy-planning-implementation chain**. Thus, the streetscape encompasses street design evolution and is a "time accumulated product", reflecting the life style of the people living in a place, their way of using the street space and their mobility behaviour and habits.

Besides being one of the final outputs of a mobility policy, **street design is also a process in itself**. This understanding relies on the necessity to integrate multiple interests and constraints into the conception of the street space. Five or six decades ago the conception of a street was based on the principle of reconciling by separating the speed of vehicles with the safety of all street space users. Street design was a branch of statics concerned with the dead weight of vehicles and the quality of pavements / asphalt, and a branch of dynamics concerned with the kinetic effects of the velocity and mass of multiple independently controlled objects, the time-distance separations between visual stimulus on a driver's retina, muscle activity and vehicle response, the mechanics of braking and acceleration, and the relation between speed and street geometry (curvature radius, lane's width, separation of roadways and sideways etc.). For a long time the street was seen as a space connecting destinations used only by motorised traffic. This perception has changed, however, and the street is presently seen not merely as a traffic corridor but as one of the most active and interactive places in the city. Thus, for the benefit of all its users and uses, street design should take into account not only the standards imposed by motorised traffic, but also functional, economic, social and aesthetic criteria such as:

- the economic vitality of the shops bordering the street;
- the physical comfort of the adjacent residents (especially the noise and pollution levels);
- the security of the children that go to school via or play on the footway/ pavement;
- the comfort of elderly or impaired[1] people when crossing or walking along the street;
- the ambience of the street in general.

[1] Impaired street users include not only people with a permanent physical disability but also people with a temporary mobility disability or difficulty (e.g. pedestrians with prams/pushchairs, children with school bags, etc.). Street design should adapt and integrate devices or amenities that facilitate people's movement and help them to negotiate their way.

In brief, **street design is a process because the designer should not base its conception exclusively on technical reasoning but also on correlating it with should also take into account other criteria from related fields.**

## 1.2 Definition of street design limitations

Street design should be one of the outputs of a coherent mobility policy. It should offer comfort in use to all users whether they are walking, cycling, driving, watching, sitting, eating, talking and so on. At the same time, it should adapt to the site determinants and integrate the different transport modes that travellers wish to use.
However, no matter how high its quality, street design alone cannot determine people's choice of travel mode. It can enhance the appeal of or favour the use of a certain mode; it can also stimulate users to discover the benefits of the street space when performing both necessary activities (like going from A to B) and social or leisure activities (like eating in an outside restaurant, playing in a group, sitting on a bench and talking etc.), but design alone cannot determine peoples' modes of travel. Street design must correlate with other fields such as land use and mobility, campaigns to promote sustainable transport, access restrictions, and parking space management etc.
It should also be noted that in certain cases, even though the initial intention of designers was to create places for people, the resultant streets were high in quality but also highly rigid in design and failed to attract and stimulate the presence of people. Therefore, designers and planners must consider whether the use of design norms and standards serves the purpose of enhancing safety for pedestrians or whether it has the opposite effect of generating a more unsafe environment that deters people.

## 1.3 Street design elements

Several classic elements are considered when designing a street. These elements will be briefly described below. Though most often in design guidelines the characteristics of these elements are detailed separately, in real design practice these elements never function independently but are correlated. This means that a slight modification of one of them generates a series of changes in the function and/or use of the others.

- **Footways / pavements**

The footway is mainly used for pedestrians' movements. However, it also integrates activities and the amenities that support these activities. People on footways may be standing, waiting for others or for transport, talking with each other or on the phone, sitting on a bench, gazing at shop windows, playing, eating etc.
Certain elements of footway design affect their space usability and accessibility, including:

- Width;
- Grade and cross-slope;
- Passing space;
- Changes in level and curb ramps;
- Vertical and side clearance;
- Obstacles and protruding objects;
- Surface.

***The footway design width*** extends from the curb or planting strip to any building, fence or planting that forms the opposite border of the footway. Most often the design width affects pedestrian usability. It varies according to the area. For example, a 1.5m footway is wide enough to accommodate pedestrian traffic in a residential area, but a much wider footway would be necessary in a commercial area to include amenities such as street furniture, newspaper stands, advertising boards, signage etc.

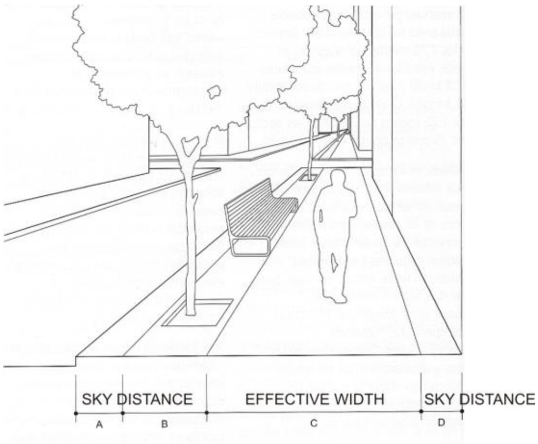



Figure 1 – Sky distance and effective width for a footway (Source: Calmar el trafico – Pasos para una nueva cultura de la movilidad urbana, Gobierno de Espana, 2008)

The design width is also affected by pedestrians' tendencies when walking in the footway space. Most often pedestrians prefer to travel in the centre of the footway (effective width) and avoid travelling on its sides (sometimes called sky distance) to separate themselves from traffic, utility poles, bus shelters, parking meters, sign poles and other street furniture. It was observed that on a footway of approximately 3.0m only an effective width of 1.8m is used by pedestrians for travel and in most cases the sky distance along the building is approximately of 0.6m.

***Passing space*** is a section of path wide enough to allow two wheelchair users to pass one another or travel abreast. The passing space provided should also be designed to allow one wheelchair user to turn in a complete circle.

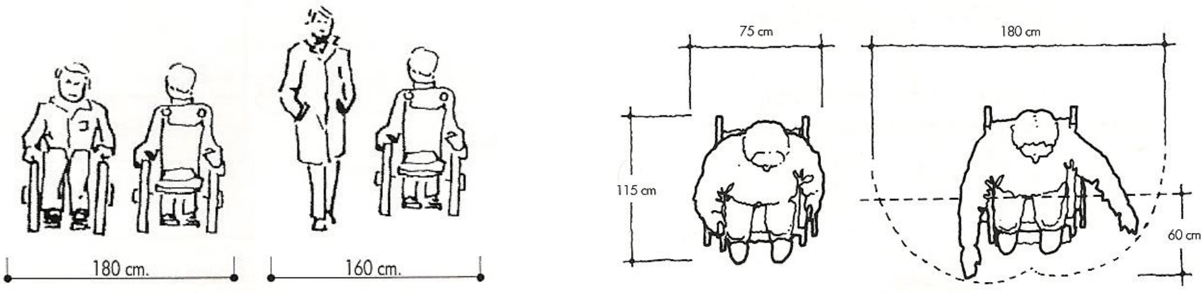



Figure 2 – Passing space (left) and Turning space (right) – minimum dimensions required by wheelchair users on footway (Source: Calmar el trafico – Pasos para una nueva cultura de la movilidad urbana, Gobierno de Espana, 2008)

***The surface*** is the material on which a person walks or wheels in a pedestrian environment. The type of surface determines ease of movement. For example most people can cross asphalt floors without much difficulty, while gravel surfaces might prove difficult to cross by some people (wheelchair users, people wearing high heels etc.). Footway surfaces are generally asphalt but commonly include tile, stone and brick.

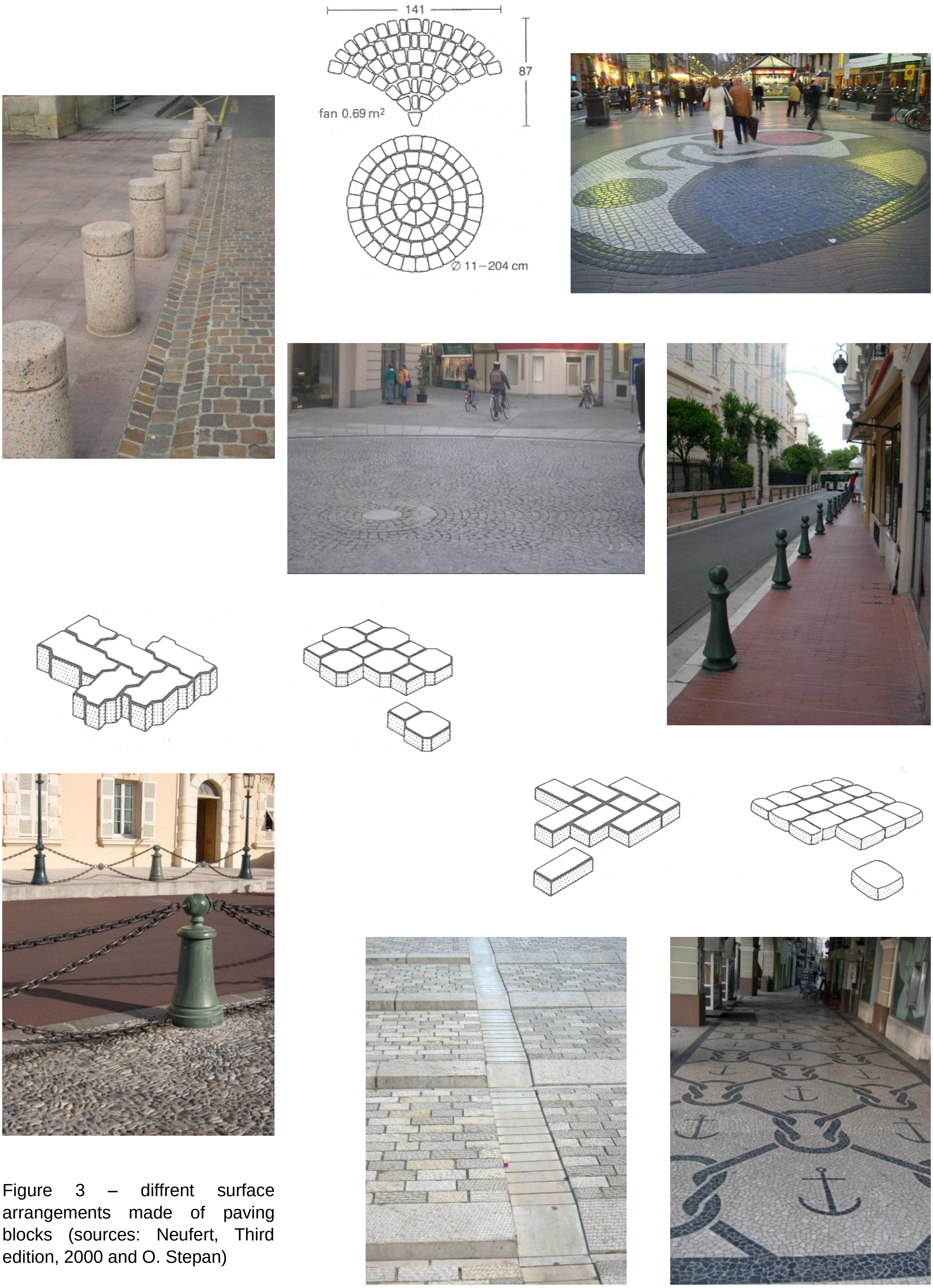



Figure 3 – diffrent surface arrangements made of paving blocks (sources: Neufert, Third edition, 2000 and O. Stepan)

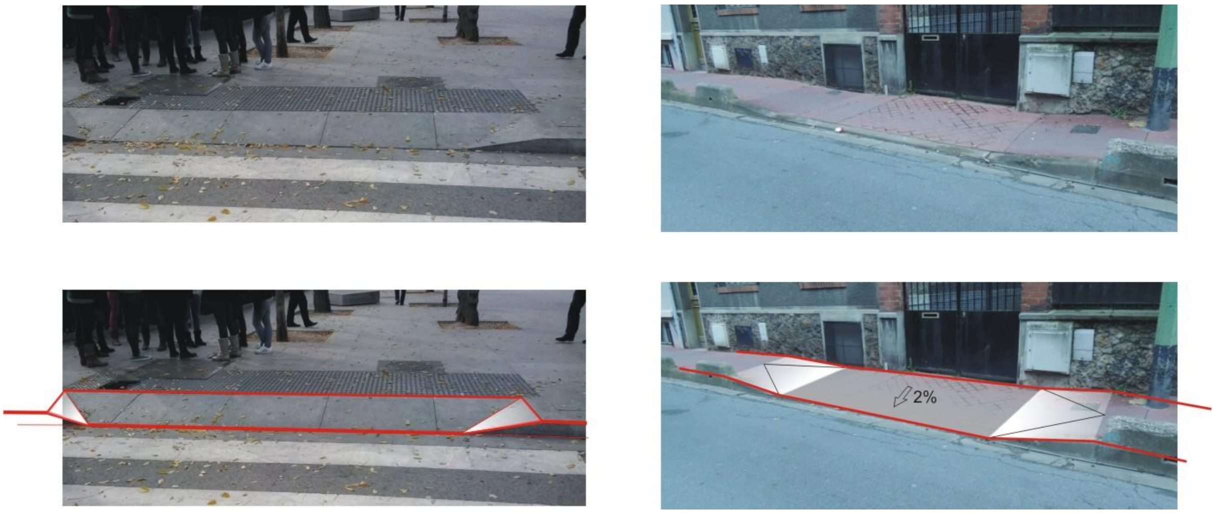



Figure 5 – **Perpendicular curb ramp** (left) **Parallel curb ramp** (right) (Source and editing: O. Stepan)

***Curb ramps*** are used to ease the level transition between the footway and the roadway. They are most commonly used at crossroads but may also be used at midblock crossings and medians. Curb ramps should have comfortable grades and cross-slopes in order to be easily used by elderly and mobility impaired users.

Depending on the street and situation, different types of curbed ramps could be used, including:

- Perpendicular curb ramp;
- Parallel curb ramp;
- Built-up curb ramp.

***The crosswalks*** are the part of the roadway used by pedestrians when crossing the street. From this perspective they are a critical part of the pedestrian network, especially if different walking paces are considered. Older people, children, youngsters, adults, powered wheelchair users and manual wheelchair users have different starting times, different reactions and different travelling speeds. Consequently, crosswalks are usable not only when their position in relation to the footway, the roadway and the intersection is taken into consideration, but also when the crossing times are accommodated to the slower travelling speeds.

Midblock crossings spanning multiple lanes can be difficult for some pedestrians to negotiate. In these cases curb extensions can be used to reduce crossing times and to increase visibility between pedestrians and motorists. A median is another effective method for reducing crossing distances.

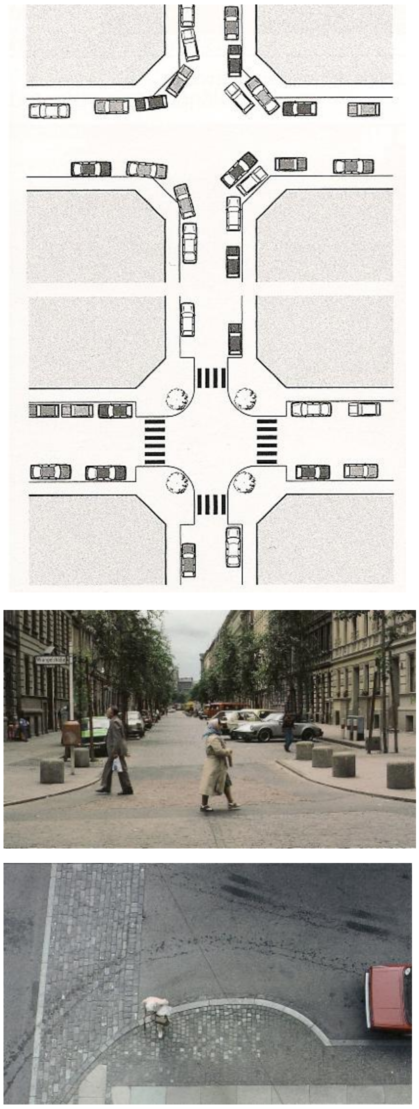


Figure 4 – Curb extensions used to reduce crossing distances and improve visibility for both pedestrians and drivers (Source: Calmar el trafico – Pasos para una nueva cultura de la movilidad urbana, Gobierno de Espana, 2008)

As a general rule when designing a footway, pedestrian movement and comfort should prevail over other activities. Amenities should thus be positioned in such a way as to avoid clutter and travel obstruction. This principle applies in residential areas and on streets with heavy pedestrian movement (e.g. those serving subway and other PT stops, entrances to important buildings etc.). However, to make the street space more appealing for potential customers, the position of amenities, urban furniture, shop stands and restaurant terraces on the footway may be different in commercial areas.

- **Roadway – carriageway**

The roadway is the part of the street occupied by stationary or moving vehicles. It is generally divided into two or more lanes with a middle line separating the two directions. Depending on the organisation of the traffic and street network, all the lanes may go in the same direction (one-way street); some lanes may go in one direction and the others in the opposite one (e.g. the case of PT and cycling priority lanes); or the number of lanes going in different directions may be equal.
At a minimum, the roadway should have at least one lane to provide space for a car or a line of cars to pass. The design norms in various documentation specify that the width of the lane depends on:

- the maximum speed allowed in the area;
- the side and vertical clearance;
- the space for drainage gutters; and
- other clearance and protection spaces (e.g. hard shoulders)

However, in general lane width is estimated to be between 3.00m and 3.75m. Narrower lanes or one-lane streets with roadway widths from 2.25m to 2.75m (especially in the historic centres of European cities) allow cars to pass and do not impede the flow of traffic.
As a general rule, the width of the lanes, and thus the width of the roadway, is proportional to the  speed limit – the higher the speed, the wider the lane/roadway required.

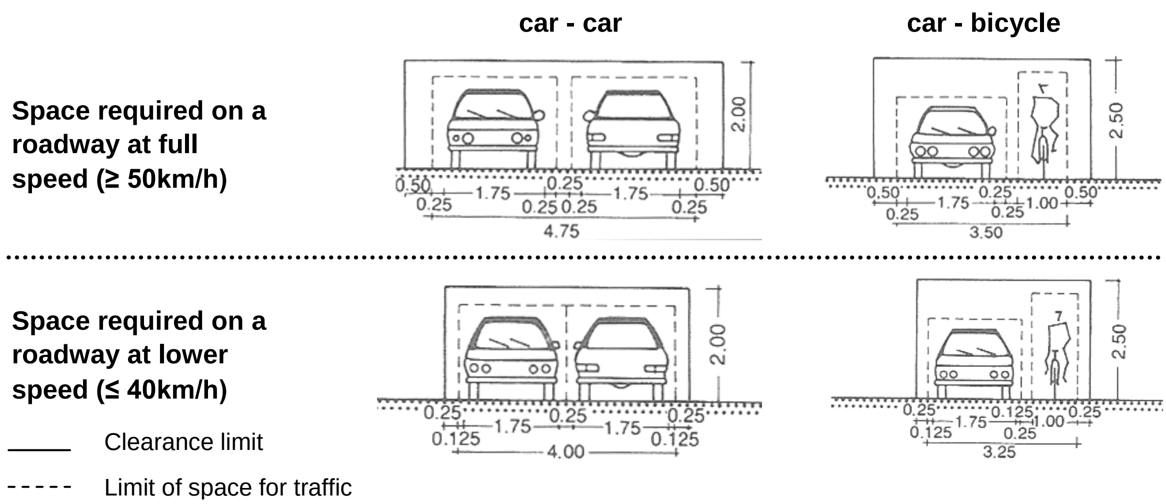



Figure 6 – Space required by cars on a roadway depending on their speed (Source: Neufert, Third edition, 2000)

### *Intersections – crossroads, junctions*

*Junctions* are where one street flows directly into another. *Crossroads* are the point at which two or several streets intersect each other.

Depending on the traffic volume and the street/road type, junctions/crossroads can be designed at *different levels*. In this case, the intersecting streets do not cross each other, communication between streets being intermediated by connecting devices like braces/suspenders. If this design favours traffic flows and high speeds for cars, it makes it very difficult for pedestrians and cyclists to cross the intersection and reach the other side of the street.

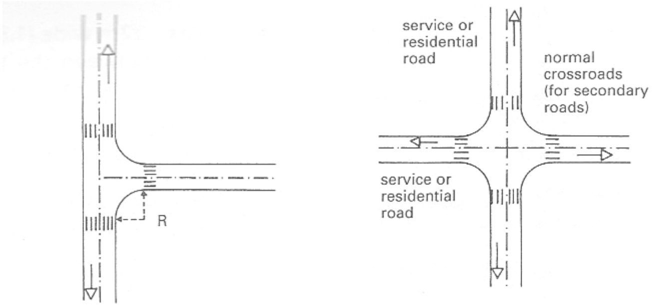



Figure 7 – Junction (left); crossroad (right) (Source: Neufert, Third edition, 2000)

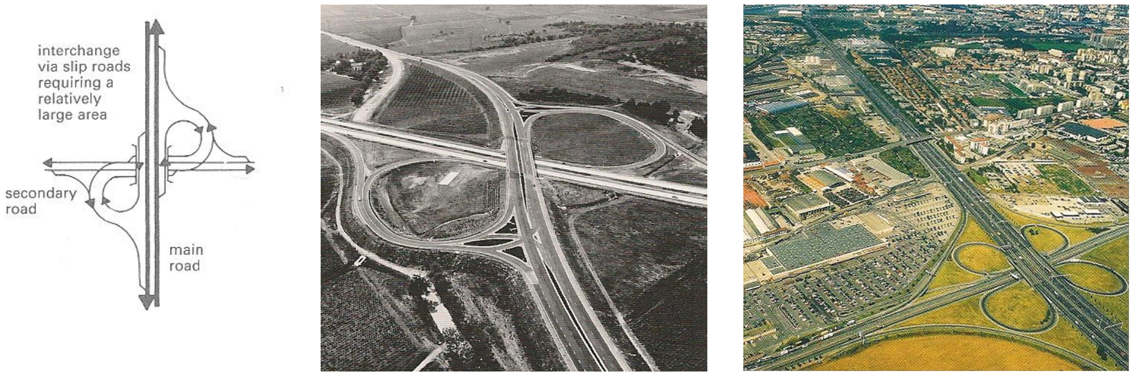



Figure 8 – Crossroads designed at diffrent levels (Source: Neufert, Third edition, 2000; Espace urbain, 2003)

In some countries (e.g. France, U.K., Portugal, etc.) the intersection between several streets of different types has been solved with *roundabouts* (in French “le rond-point”). Roundabouts offer several advantages:

- traffic is calmed / car speeds are reduced;
- traffic lights are rarely necessary;
- the risk of serious accidents is reduced;
- less noise is generated.

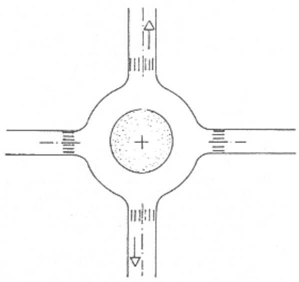


Figure 9 – Roundabout design (Source: Neufert, Third edition, 2000; Espace urbain, 2003)

The diameter of roundabouts depends on the dimensions of the vehicles (cars, vans, trucks, trailers etc.), the available space and the acceptable length of tailbacks caused by high volumes of traffic.
There are other ways to design intersections, especially when traffic calming is required in a particular area (for example offset crossroads, raised intersections, traffic circles and star diverters), but these will be detailed in the traffic calming section.

- **Medians**

Medians are used in a street space to separate the through traffic from the local traffic and, often, to extend the footway area and to provide a special pedestrian realm. On one side medians border a central roadway of, most often, four lanes for fast and nonlocal traffic. On the other side they border a local access lane for slow moving traffic. Medians can have various configurations and widths: some are only planted strips, while others contain rows of trees, footways, bus shelters, benches, bike paths and parking, light poles, advertising panels etc. Thus streets with medians provide access to abutting properties but unlike other streets are often designed for leisure and recreation.

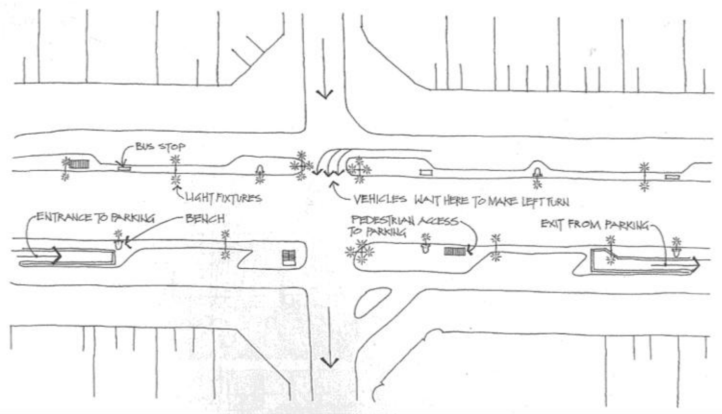



Figure 10 – Median functions (left) (Source: The Boulevard Book, 2002); Avenue de la Grande Armée, Paris median (right-up); Avenue Montaigne, Paris - median and access lane (right-down) (Source: O. Stepan)

- **Cycling infrastructure**

In the past decades cities throughout Europe have acknowledged the necessity to improve their transport provision and to better respond to the needs of residents for active travel options. Consequently cycling networks were developed in an effort to overcome the constraints of different aspects such as street pattern configuration, site configuration, traffic and sustainability, in an integrated way. In intensely transited urban areas in particular, the cycling network was set up by:

- Narrowing existing traffic lanes;
- Removing some traffic lanes;
- Removing on-street parking;

- Sharing the lane between cycling and public transport (especially bus);
- Making cycling paths on one-way streets;
- Widening roadways or paving shoulders.

When designing a cycling network specific issues must be addressed, including:
- Lane/path widths for all travel modes;
- Intersection design;
- Signing, marking and striping;
- Footway conditions.

To better respond to different traveling speeds and urban conditions, traffic engineers, planners and bicycle activists often frame the development of the cycling network around two types of bicycle facilities: cycling lanes and cycling paths.

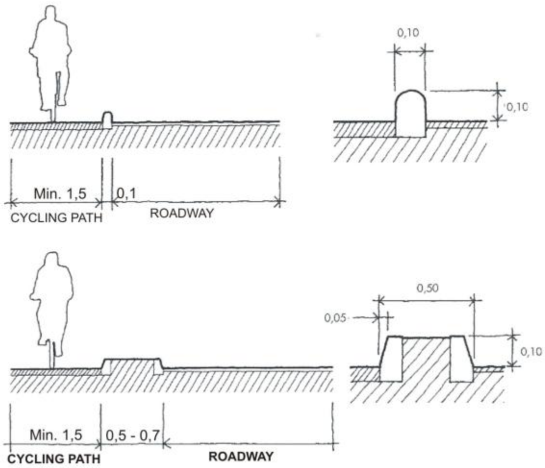
**A cycling lane is a portion of the roadway dedicated to cyclists**. Most often it is used in suburban areas or at the entrance of urban agglomerations where there is a reduced number of intersections and accesses to abutting properties. In general **they are only visually separated from the roadway, by painted strips.**
In urban areas, cycling lanes should be placed on streets with moderate traffic where the speed limit does not exceed 50 km/h and should be **signalled with dedicated signage and pictograms.**


Figure 11 – Cycling lanes (Source: www.eltis.org)

It is possible to **demarcate cycling lanes with "transparent" markings** such as rubber flanges, bollards or flat flexible tags; these separators should be easy to cross and be placed continuously or at regular distances.

Figure 12 – Cycling lanes with transparent, crossable markings (Source: Manual de las vias ciclistas de Gipuzkoa, Diputacion Foral de Gipuzkoa, 2006)

In some cases when placed **along interurban roads the cycling lane occupies the space of the shoulder**. If this is the case then the shoulder should be paved to ensure safe travel for cyclists and pedestrians. However, because the main function of the shoulder is to allow slower cars to stop or deviate, the presence of cyclists is not signalled with special signs and pictograms.




**The cycling paths** are **circulation spaces dedicated exclusively to bicycles. They are located in urban areas** and facilitate connections between inner city neighbourhoods. Their width is recommended to be 1.50m. In order not to impede cyclists' trips and to improve their travelling speed, cycling paths are **physically separated from the motorised traffic.**

If the **cycling path is placed on the roadway** the delimitation between the roadway and the cycling path may be achieved in one of the following ways:

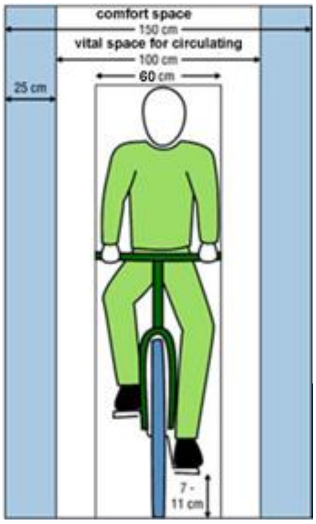
Figure 13 – Cycling paths physically separated from the roadway – Top: on the roadway by a raised curb; Bottom: between the roadway and the sidewalk (Sources: Manual de las vias ciclistas de Gipuzkoa, Diputacion Foral de Gipuzkoa, 2006 and www.eltis.org)

- a curb with a height of approx. 15cm regularly interrupted to allow water drainage. The curb should be withdrawn 20-30m before an intersection to allow better visibility between the car drivers and the cyclists;
- placing the cycling path at an intermediate level between the sidewalk and the roadway. The vertical drop between the different parts of the streets (footway, cycling path and roadway) is approx. 10cm. This type of cycling path, traditionally used in Copenhagen, should level with the roadway 20m before important intersections in order to allow better visibility between car drivers and cyclists; when it crosses secondary streets this type of cycling path is raised to the same level as the crosswalk and the footway;
- placing the cycling path between the footway and the adjacent on-street parking row; the separation between the cycling path and the row of parked cars can be a concrete curb of 10 to 15cm high; the width of the curb/separation should take into account the opening of the cars doors towards the cycling path relative to the cyclists' security and comfort/movement space;

Figure 14 – Cycling path on the sidewalk (Source: O. Stepan)

A last case is when the **cycling path is placed on the footway**. Though, like in the previous situations, the cyclists have their own dedicated circulation space, this solution has the disatvantage of reducing the cyclists' speed because they have to pay attention to slower street users. If this is the case it is recommended to keep the pedestrians area along the edges in order to give them easy access to the abutting properties, and to place the cycling path along the footway curb on the same side as the roadway. In order to ensure good visibility for each path, the cycling path should be marked by painted strips and pictograms. If necessary (and especially for the visually impaired) the pavement of the cycling path can have a different texture than the pedestrian path.

**Cycling path width** should respect the basic space requirements for cycling: bicycle width (0.6m), the necessary room for manoeuvre under various conditions and the comfort space In other words, it should be wide enough to ensure cyclists' physical and visual comfort while traveling.



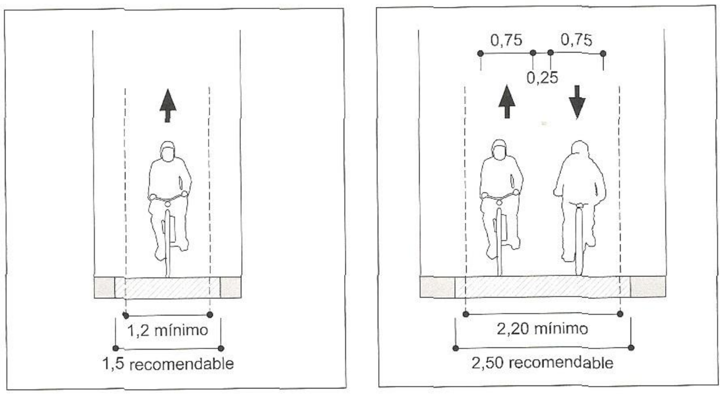




Figure 15 – Cycling path width (Sources: Guide de bonnes pratiques pour les aménagements cyclables , Centre de Recherches Routières, Belgium, 2009 and Manual de las vias ciclistas de Gipuzkoa, Diputacion Foral de Gipuzkoa, 2006)

At the same time the cycling path width depends on the position and width of motorised traffic, on-street parking rows and footways. Though in some design manuals (*Neufert*, Third edition, 2000) the minimum width of a single cycling path is 1.00m, others (*Recommandations pour les aménagements cyclables*, CERTU, 2008; *Urban Planning Design Standards*, APA, 2006) recommend a width of between 1.40 and 1.70m, especially when riders could be travelling at higher speeds.

One of the most sensitive points of a cycling network is the design of **intersections**. Whether an intersection is controlled by YIELD signs, or traffic lights,  to increase the safety of road users, it must:

- slow the motorised traffic;
- have a good degree of legibility/readability;
- have clear visibility.

In the case of **cycling lanes crossing an intersection without traffic lights** the design should try to reduce the "conflict area" and crossing time as much as possible. There are three ways to reduce the conflict area:

- maintain a raised level for the cycling paths (as with the crosswalk orfootway level) along the entire intersection;
- transform the cycling path into a cycling lane (preferably 20m) before the intersection – this solution is especially recommended when the cycling lane is hidden by a row of parked cars;
- distance or completely separate the cycling lane from the roadway – this solution is recommended in low density urban areas or suburban areas but is not recommended for highly urbanised areas.

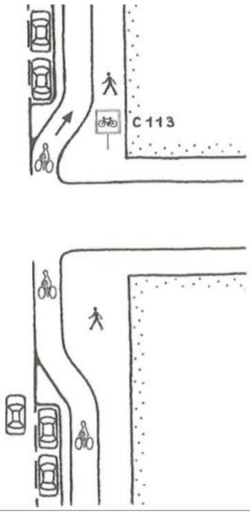
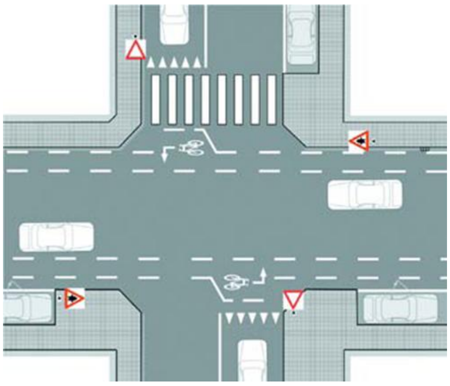
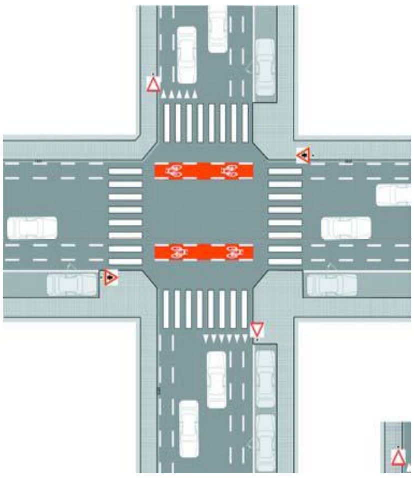



Figure 16 – Intersection without traffic lights - the physically separated cycling path becomes a cycling lane before the intersection and on street parking is not allowed 20m before the intersection (Source: Recommandations pour les aménagements cyclables, CERTU, 2008)

In the case of **intersections with traffic lights** the following aspects should be taken into account:

- the time necessary to cross and clear the intersection in relation to the traffic lights crossing times;
- the right turns of all vehicles and especially the conflict points between cyclists and cars;
- the left turns of all vehicles and especially the conflict points between cyclists and cars;
- the design of a refuge or "sas": a waiting area for cyclists facilitating their turns to the left.





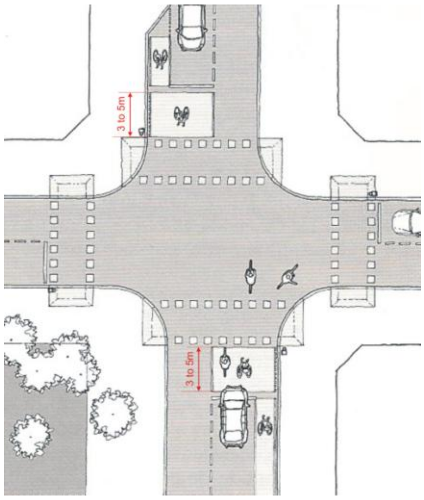



Figure 17 – **Intersections without traffic lights** - Left: the cycling path is on the street with priority – extend the cycling paths along the intersection; Middle: the cycling path is on the give way street – interrupt the cycling path markings before the intersection (Source: Guide de bonnes pratiques pour les aménagements cyclables , Centre de Recherches Routières, Belgium, 2009) Right: **intersection with traffic lights** – design a sas or refuge of 3 to 5m in front of traffic lights and behind the crosswalk (Source: Manual de las vias ciclistas de Gipuzkoa, Diputacion Foral de Gipuzkoa, 2006)

# 2. A brief history of car-induced changes to street space and streetscape

## 2.1 The principle of "cell and artery"

The principle of cell and artery is a result of the functionalism movement in Europe's urban planning and architecture, which was popular before and after the First World War. Most historical accounts of city and urban planning of this era credit the famous functionalist Le Corbuiser for its completion and implementation, yet the engineers provided the defining framework for the 20th century street layout and urban fabric. The principle of "cell and artery" goes hand in hand with the zoning concept, also called the functional specialisation concept, and streets hierarchy.

In their efforts to cope with the changes brought by "the era of mechanisation" and especially by the car - the expansion of the cities, the increase in mobility and distances travelled - designers and planners were driven by two ideas:

- greater efficiency through the division of labour and;
- specialisation of the city areas similar to the specialisation and functioning of organs in the human body.

Thus for the better functioning of the "city organism", its fabric was divided into zones assigned with a particular function/use (residential, commercial, industrial, recreational etc.). The connection between these single-use zones was made through "speed streets" dedicated mainly to cars rather than pedestrians. At the same time cars tended not to be permitted in the inner area of the zone. This structure, associated with the human organism's organisation and functioning, is often called "the cell and artery" principle.

From the classic transport perspective, the **cellular layout groups origins, destinations and non-movement** within bounded areas so that **motorised traffic can bypass on the edges. The arterial layout requires the road systems to be organised in a hierarchy** according to the traffic volume and travel purpose, with each level linked dendritically to the next (from the parking lot through local streets, collector streets and primary highways, to dedicated express-ways).

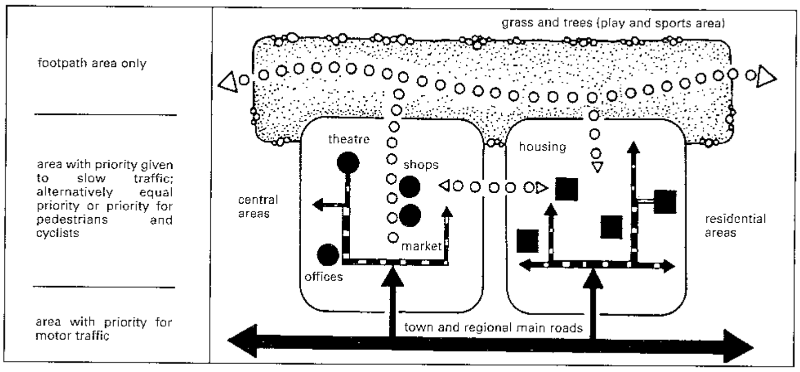



Figure 18 – Diagram representing the principle of cell and artery and the separation between pedestrian network and major traffic arterials (Source: Neufert, Third Edition, 2000)

## 2.2 The street hierarchy – Functional Classification and the principle of “inverse correlation between access and movement”

The hierarchical organisation of the street network was developed in correlation with the speed and power of motorised vehicles and consequently it reached the present version, often called Functional Classification. It passed through several steps along the way. These are outlined below.

- One of the first street classifications can be seen in the Barcelona Plan proposed by Cerdà in 1854. The first modern theorist of urban planning proposed:
    - *Urban roads* or *transcendental streets* that correspond to the route and to its extension in urban areas; the “transcendental way” has a slightly inferior profile when it crosses the city, but it belongs to the territorial scale;
    - *The actual urban streets or diagonals* (the equivalent of today’s arterials) which allow a diagonal link between the cell of one neighbourhood and that of another;
    - *The particular urban streets* (the equivalent of today’s local streets) that serve the residential areas and allow links between neighbours, families and individuals.

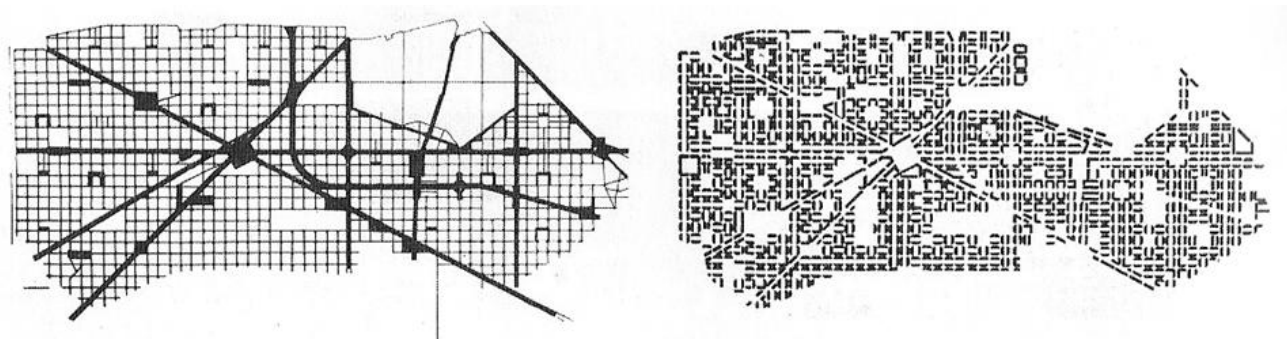


Figure 19 – The extension of Barcelona proposed by I. Cerdà – urban pattern and built pattern (Source: Cerdà Urbis i Territori, Exhibition Catalog, Madrid, 1994)

- Then came “*The Charter of Athens”*, which isolated the traffic function from the other city functions and proclaimed it as the fourth function of the city, the ordering basis for housing, work and recreation. The *Charter of Athens* specifies that:

  *“Art. 60 – The traffic roads must be classified after their nature and build according to the vehicles and their speed.*
  *Art.61 – The intersections at high volumes will be organized for continuous traffic flow by designing different levels.*
  *Art.62 – The pedestrian should be able to walk in other pathways than the car*
  *Art. 63 – The roads should be differentiated according to their destinations: residential streets, walking streets, transit streets, main streets/principal arterials.”*

- Based on this classification, between 1925 and 1948, Le Corbusier proposed “the 7V” - the abbreviation of the French “7 voies” – 7 roads. For more information about each road type see Figure 16.

These purely hierarchical street layouts were implemented in post-war newly erected towns all over Europe, but not in the major existing cities. It took another decade of economic growth and traffic generation before the engineers were ready to implement this hierarchy in the ancient urban fabric.

- The synthesis of street design and a hierarchical system was made by Buchanan in the "*Traffic and Towns"* Report. Buchanan showed how the principle of the cell ('environmental area') and movement network could be translated into a general strategy for redesign or replacement of the inherited urban road system.

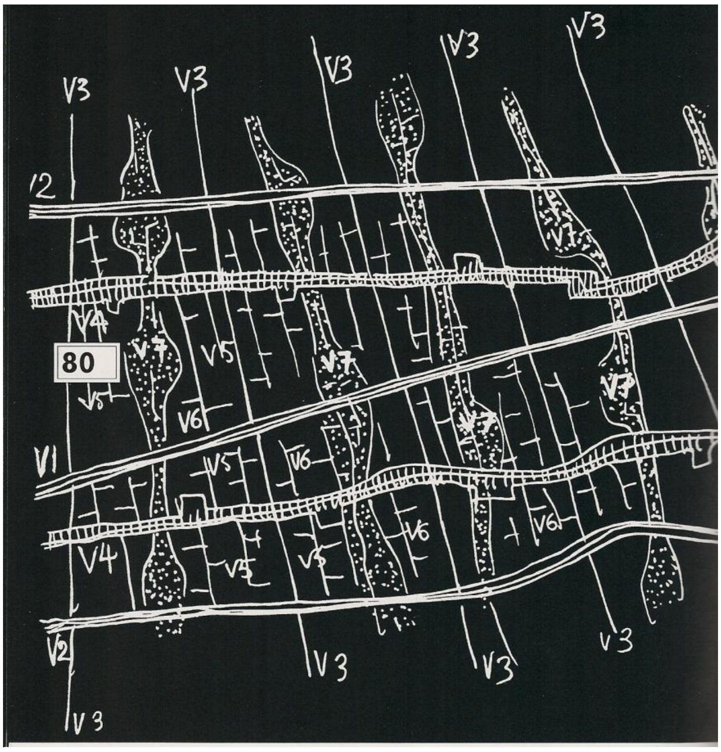



Figure 20 – Chandigar Plan by Le Corbusier – Streets classification in 7 categories (in French 7V-7 voies) (Source: La rue est a nous tous! - The street belongs to all of us!, 2007)
**V1 –** Road for heavy traffic – crosses the national territory; **V2 –** Principal artery of a conurbation; **V3** – Road exclusively for motorised traffic, without footways, on which no door from adjacent property is allowed to open; **V4 –** Commercial neighbourhood street within a cell; **V5 –** Road for motorised traffic within a cell; **V6 –** Street at low speed to serve residences used by pedestrians and vehicles; **V7 –** street for green area used by pedestrians and cyclist.

*"The function of the distributory network is to canalize the longer movements from locality to locality. The links of the network should therefore be designed for swift, efficient movement. This means that they cannot also be used for giving direct access to buildings, nor even to minor roads serving the buildings,* ***because the consequent frequency of the junctions would give rise to traffic dangers and disturb the efficiency of the road.*** *It is therefore necessary to introduce the idea of a 'hierarchy' of distributors, whereby important distributors feed down through distributors of lesser category to the minor roads which give access to the buildings. The system may be linked to the trunk, limbs, branches and finally the twigs (corresponding to the access roads) of a tree. Basically, however, there are only two kinds of roads – distributors designed for movement, and access roads to serve the buildings".*

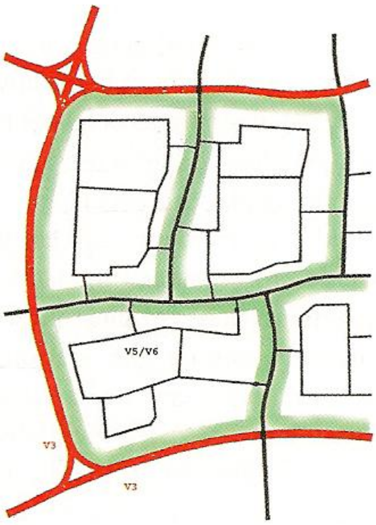



Figure 21 – Roads hierarchy by C. Buchanan, 1963 (source: La rue est a nous tous! - The street belongs to all of us!, 2007)


Figure 22 – Functional Classifications and their relationships (Source: Regional Plan Association, http://www.rpa.org/images/FRP_Radburn.jpg)

- Consequently, by the mid-1960s, traffic engineers had developed a system of streets based on an absolute separation of movement and access. **This method, often called Functional Classification, became accepted practice and is still in use today. Functional Classification separates streets into different types according to the vehicle movement and property access functions that they are supposed to have and perform. Basically, this method assigns specific movement and access functions to each street type. The two functions are inversely correlated. Thus the higher the movement function, the lower the access functions.**

## 2.3 Street hierarchy consequences for street space - from sharing to segregation

Street hierarchy and functional classification brought several changes to the way street space was perceived and thus used.

Figure 23 – Sharing space on Victoriei High Street, Bucharest, around1930s (Source: Power Point presentation Old Bucharest)

First of all it should be noted that prior to the development of the street hierarchy, pedestrians, cyclists, carriages with horses, public transport (represented by trams) and cars **shared** the street space in the sense that **they were equally using the space of the street for daily travels.** At the same time the street was the space of public contact and interaction, where people saw, met and talked to each other. It was also the space of exchanging goods and marketing, where shopkeepers and customers met and negotiated their deals. The street stimulated the civility, conviviality and vitality of the city, and in this sense it was the **major social and economic scene of the city**.

However, as cars gained in speed and their number increased considerably, people and authorities were faced with a considerable number of accidents and fatalities. The solution was found in "the separation of the transport modes" in order to avoid their interaction and collision. The separation occurred in two phases:

- First, transport modes were clearly separated within the street space into a special path for pedestrians (the footway), another for cars and carriages (the carriageway or roadway), and another for PT (tram tracks or PT special lanes). This kind of separation was not new. In fact, it is the classical separation of the street space and the way we understand the street today. Though it is not shared equitably between all its users and uses, the street space is used in common by all transport modes.

- From this first separation each type of transport mode developed independently to the point that different modes no longer shared the same street space.
  Thus to the benefit of continuous traffic flows, roadways extended the city's pattern in the form of freeways and/or expressways where pedestrians were not allowed. Pedestrians' safety relative to cars was ensured by placing them on artificial ground level decks built over moving traffic. Decks, skywalks and bridges became a standard in the city's new extensions and social housing projects. In other words the concept of the street space in the classic sense was replaced by a severe segregation, with each transport mode having its own specialised space: expressways, freeways, arterials for motorised traffic and elevated decks and skywalks for pedestrians and cyclists.

Where street hierarchy could not be applied (e.g. in the ancient city centres), a poor compromise was found in a patchwork of standard and non-standard streets. A quasi-hierarchical street pattern was achieved through selective widening, waiting restrictions, turning prohibitions etc. Pedestrian access was restricted by barriers placed along the footway curbs. Consequently, in the built city areas, the traffic flow took priority over walking, especially at permitted cross points where the interaction with cars is unavoidable.

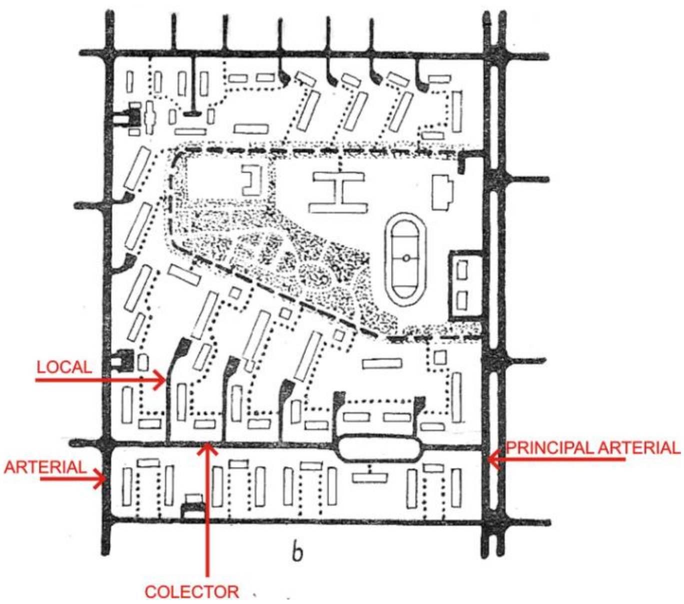



Figure 24 – Street types in Functional Classification and their relationships (Source: Urbanismul, R. Laurian)

**In brief, the principle of inverse correlation between access and movement made it impossible for streets to have both a high movement function and a high access function**. Thus **the**

**possibility of having "shared streets" was excluded**. Additionally, although both access and movement are considered in the hierarchic classification, it is obvious that **the emphasis** - in terms of space, design intentions and funding **– is on movement.** This is reflected by the names of the streets in the classificatory system (freeway, expressway, arterials, collector streets, local streets) as well as in the way these classifications are described in most of the associated documentation (French, British, or American).

## 2.4 Streetscape modifications brought by "motorised design"

In 1961 Jane Jacobs proposed two terms to describe the cumulative effect of the traffic favouring measures: **"city erosion**" and **"automobile attrition".** Attrition means abrasion by friction, a rubbing away at the edges of something, but not its elimination. The erosion or attrition of the city to which Jacobs referred consisted in the breaking up of the street (mentioned in the previous subchapter 2.1.3), the reduction of the city's density and diversity, the disembowelling of the neighbourhoods and the blurring of the local character… "so everywhere becomes no place" (Jacobs, 1961, p.352). More than five decades later the description of city erosion remains timely.
A number of elements caused "the erosion of the street space":

- First, the streetscape was affected by the presence of the car as an object in itself. Over the past six or seven decades, the streetscape has been transformed by the number of cars filling the street space. Thus the traditional geometry and spatial arrangement of the street, in the classical sense of juxtaposition of fronts and ground, is now interrupted by rows of parked and moving cars.
- Second, as was previously described, in order to accommodate increasing traffic volumes, the past 60 to 70 years has witnessed the transformation of city layouts by the construction of new speed roads (motorways, expressways, etc.) completely different in design, conception and appearance to previous "classic streets". Moreover in this "up-gradation" process of the street network, numerous other older streets have been unrecognisably altered:

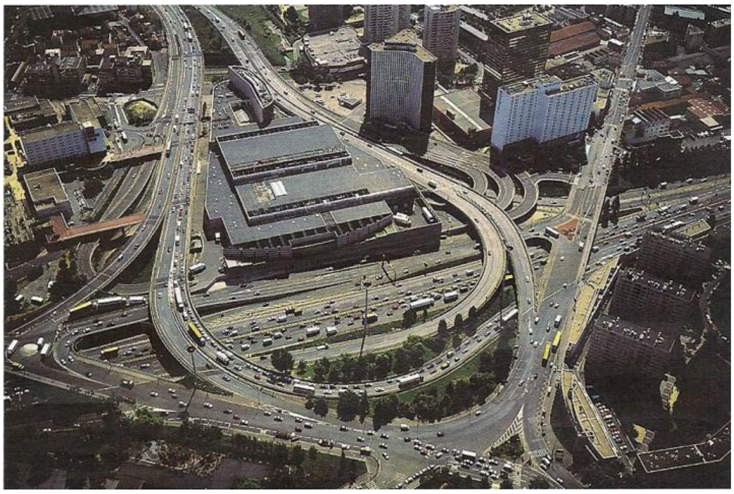
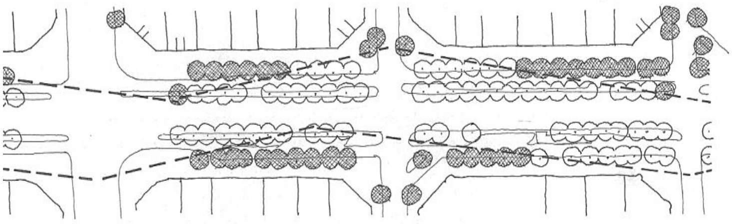


Figure 25 – Bagnolet gate on the east side of Paris ring-road "Périférique" – sample of highway and motorway intersection (Source: Paysages en mouvement, 2005)

  - Most of the old roadways gained considerably in width because their traffic lanes were broadened or because they were transformed into dual roadways

- to accommodate continuous traffic flows at high speeds; besides fluency, the roadway widening was made in the name of safety and collision avoidance;
- Often wider roadways were attained at the expense of narrower footways or by eliminating bike lanes and, when they existed, medians and/or tree lines;
- The space allocated to footways, medians or tree lines was also reduced at intersections where, in order to allow cars to turn, the curb radius was increased giving more space to the roadway;



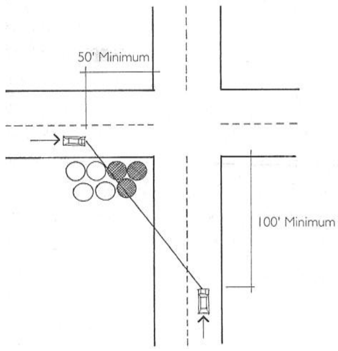



Figure 26 – Effect of applying site distance norms on a boulevard with medians (left); Site distance and tree removal (right) (Source: The Boulevard Book, 2002)

- If they were preserved, the tree lines were reduced in length or density by cutting the trees which hindered driver visibility. This operation occurred especially at intersections where right or left turns could not be completed at high speeds if the driver's line of vision was not clear of obstacles;
- The street lamps, initially installed around the 1860s to ensure better visibility for both footway and carriageway traffic, were replaced by higher light poles to ensure drivers' visibility at night; as with trees, street lamps and benches interfering in drivers' visibility were eliminated.

The alterations of the street geometry and street amenities listed above influenced the configuration of the street as a whole and consequently the streetscape.

- Third, the increase in traffic has required the presence in the street space of a "forest" of signs and urban furniture necessary to guide and control the traffic. Often the non-roadway space is used as a residual zone for objects (and people) that might impede moving traffic. Thus, sign poles and traffic lights poles, bollards, guard rails, cable television boxes, telephone kiosks, junction boxes, postal boxes, recycle bins, advertising panels, closed-circuit television cameras and control boxes are all "clutter" objects placed on the footway which affect pedestrians' visibility, the effective usable width of the footway and thus the movement of pedestrians.
- Fourth, hierarchical street design reversed the relation between street frontages, street importance and street width. If in conventional street design the streetscape was defined by building frontages and the street importance was measured by the height and architectural adornment of its buildings, in hierarchical street design the importance of the street is given by its traffic capacity which is put in an inverse correlation with the building capacity. Thus, in the name of traffic fluency, safety and pollution avoidance, the most important arteries pushed away their buildings. The unoccupied strips which accompanied the main thoroughfares of the city were the generators of "residual-delinquency spaces" (sometimes called "junk spaces") that often caused city centres to decline.

In other words, designing streets for velocity requires the absence of frontage and, paradoxically, a slow geometry of sluggish curves and visibility angles that are unresponsive to classic building enclosure and different textures/materials. The resulted streetscape is uninviting and uncomfortable for slow-speed street users (pedestrians, cyclists); in this environment they are losing their sense of orientation, feeling unwelcome and lost.

- A fifth modification of the streetscape has been generated by the land use changes brought by the accommodation of stationary cars. It is estimated that cars remain parked for around 90% of 24 hours (CERTU*, Accidents en Milieu Urbain: Sorties de Chaussée et Chocs contre Obstacles latéraux*, 2001). Cars are not negligible street or public space consumers. Work places, shopping centres and other places of assembly have to accommodate car parking. Hence, significant parts of the public realm have been given over to car parks, either in the form of concrete multi-storey structures or spaces at ground level. The streetscape is affected mostly by on-street and ground level parking which, for pedestrians and cyclists, often generates the feeling of moving through a sea of cars.

# 3. Street design revival

By the end of 1970s the primacy of hierarchical street networks in general and the reign of the car in particular had waned. There are several reasons for giving up the “motorised street design” and embracing other solutions. These reasons and, where possible, counter-arguments to them will be briefly explained below.

## 3.1 Reasons to reconsider street design

### 3.1.1 Traffic fluency – traffic congestion – traffic induction – traffic evaporation

It is increasingly difficult for urban planners and transport engineers to find a solution for traffic congestion and to prioritise cars in the central and dense area of the city. The construction of multi-level motorways, as happened in some cities, proved to be inefficient and, in fact, a traffic generator rather than a fluency factor. In other words, **the very existence of a new road space is a stimulus for traffic growth**. This phenomenon had been called **traffic induction** and became more apparent, for example, after the construction of the M25, the orbital motorway around London.

It was also noticed that while building a new road generates traffic, **restricting access to roads decreases traffic**. In a given situation, when streets are closed and access has been restricted, measurements indicate a decline in the overall volume of traffic. This includes even the streets nearby the restricted area, which were expected to become extremely burdened by traffic. This phenomenon is called **traffic evaporation**.

### 3.1.2 Segregation – sharing

It has proven difficult to design and plan specialised spaces/lanes for each transport mode and/or user group (pedestrians, wheel chair users, and people using cars,, rollerblades, bicycles, electric bicycles, scooters and motorbikes, buses, express buses, trams, light trains etc.). Considering the high value and occupational rate of the land in the city centre, it has been impossible to provide a separate lane or space for each category of speed. Therefore the hierarchical organisation of the street network and the segregation of the street space have been reconsidered and new street designs have attempted to reconcile the car with other transport modes. Most often this approach has been materialised by rediscovering the classical streets, especially urban boulevards, and by sharing the street space between different users and uses.

### 3.1.3 Safety and health

Professionals advocating a rigid separation of space and hierarchical rules have been well received because they have invoked the magic word: "safety".

Health and safety has always been a significant factor in the relationship between engineering and urban design. Healthy open air living, separation of space for land use zones, street-free movement and pedestrian safety were persuasive arguments of the paradigm of free-flow highway design. For several decades the balance of argument has been shifting.

First, there are questions about the evidential basis of conventional highways standards. Non-compliant streets do not appear to have a poorer safety record than those designed to motorised specifications. Studies have proven that urban accident rates do not correlate with the degree of direct vehicular access from premises opening onto main roads. Also, according to a study made by Allan Jacobs and his team, classic street designs, like multi-way boulevards, which mix local access and through traffic and which are contrary to the principle of inverse correlation between access and movement, do not prove to be more dangerous environments than conventional segregated highways (Jacobs, A., *The Boulevard Book, 2002*).

Then there are questions about street/road improvements in relation to safety. As a study by CERTU shows, motorists tend to underestimate their speed and habitually drive above the posted speed limit, especially on well-engineered roads (CERTU*, Accidents en Milieu Urbain: Sorties de Chaussée et Chocs contre Obstacles latéraux*, 2001). Because standardised roadways have a consistent geometrical configuration and benefit from the presence of line safety devices (such as white lines, crash barriers and pedestrian guard rails), they increase motorists' sense of comfort and reduce their level of caution. An American study published in 2000 modelled the safety dividend of highways improvements undertaken between 1984 and 1997 and found, contrary to the rigid design standards, that they caused traffic fatalities and injuries to increase. (Noland, R.B., *Traffic fatalities and injuries: are reductions the result of 'improvements' in highway design standards*, 2000).

Widening the perspective of public health consideration, a growing body of research shows that a sedentary lifestyle is the most common cause of the main diseases of the developed world – diabetes, cardiovascular diseases, cancer and chronic obstructive pulmonary disease. Hierarchical suburban street layouts, designed for favouring the flow of motorised traffic, reinforce an automobile-dependent lifestyle, which in turn discourages routine exercise and active travel behaviours. In this sense, health associations have documented significant increases in obesity in many European countries. National and international health organisations (such as The National Institute for Health and Clinical Excellence in the UK) have been involved in the promotion of active travel street and neighbourhood designs:

*"NICE calls for a major shift of priority in town planning away from motor vehicles, to "ensure pedestrians, cyclists and users of other modes of transport that involve physical activity are given the highest priority when developing streets and roads." The Department for Transport, local authorities and town planners must work together to maximize potential for people to be "physically active as a routine part of their daily life". (Active Travel campaign, SUSTRANS, Creating the environment for active travel, information sheet FH09).*

### 3.1.4 Stakeholders' perception and behaviour

Residents have also started to object to the interference of transport infrastructures, such as freeways and motorways, in their "home territory". They have complained about traffic pollution, and the destruction of their living environment and/or the urban heritage.

An impressive study about the impact of traffic on the perception and behaviour of the street residents was conducted by Donald Appleyard in the 1970s and is presented in *Livable Streets* (1981). Appleyard considered three residential streets in San Francisco which were apparently identical but different in their volumes of traffic. They were labelled according to their traffic volumes as follows: Light Street (with 2000 vehicles/day), Medium Street (with 8000 vehicles/day) and Heavy Street (with 16000 vehicles/day). Through a complex questionnaire residents were invited to indicate how friendly their street was, the number of friends and acquaintances they had on the street and the places they used to meet. Analysis of the data led to the finding that those who lived on Light Street had three times more friends and two times more acquaintances than those living on Heavy Street. The author concluded that this finding was related to the "home or personal territory" identified and appropriated by each street type resident. He writes that:

"In conclusion, there was a marked difference in the way these three streets were seen and used, especially by the young and the elderly. Light Street was a closely knit community whose residents made full use of their street. The street had been divided into different use zones by the residents. Front steps were used for sitting and chatting, sidewalks for children playing and for adults to stand and pass the time of day, especially around the corner store, and the roadway by children and teenagers for more active games like football. However, the street was seen as a whole and no part was out of bounds. Heavy Street, on the other hand, had little or no sidewalk activity and was used solely as a corridor between the sanctuary of individual homes and the outside world. Residents kept very much to themselves. There was no feeling of community at all.[…]".(Appleyard,D., *Livable Streets*, 1981, p. 22-24) (Annexe I presents the study diagrams).

The shopkeepers realised that if they wanted to make the streets of their pedestrian precincts more appealing they needed to attract more visitors, and thus to adjust their businesses to the passing traffic flows. In fact, in order to attract customers, shops need to be in contact with the traffic flows so that they can tempt passers-by to stop and buy.

### 3.1.5 Street liveability

Finally, although it is not possible to reinstate the street space as a social space as it was before the car era, in most cases people (residents, shopkeepers, tourists or other local stakeholders) wish for the street to be a liveable place. In other words, designs for cohabitation between all transport modes and between all the users of the street space should be sought. The street should be seen as a comprehensive place comprised of traffic, social, economic and aesthetic activities and functions.

# 4. Models in street design

The street crisis brought by the radical separation and hierarchical organisation of the street network found its answer in attempts to put all transport modes on "the same ground level" by mixing street users as much as possible.

- A first step was to "rejoin" the pedestrian decks with the main thoroughfares and to reinvent the conventional streets with two traffic ways, footways, crossroads and an outdoor market or commercial activities. This was the case with the large housing projects (in France called "grandes ensambles" but also existent in many other European countries) where there was a total inversion of the principle of separation. In fact, instead of being designed out, traffic was designed in. The opening up of these residential enclaves rests on mixing and traffic calming in order to enable the cohabitation of cars and people.

- A second initiative aimed to show that the "routification" of the city centre environment, which brought freeways, motorways and inner ring roads, is a reversible process. Revitalisation was the key word in interventions that replaced exclusive movement arterials with streets designed for the coexistence of parked vehicles, pedestrians, cyclists and traffic streams of varying speeds. Interventions tended to do one of two things:
    - shift motorways to underground tunnels to allow street tissue to grow back (e.g. The Big Dig, Boston, US; The concrete collar, Birmingham, UK – see case studies in annex II) and
    - restore urban boulevards and particularly prevent the degradation and cluttering of their pedestrian areas (e.g. Paris Boulevards such as Avenue Montaigne, Boulevard Saint-Michel, Boulevard Beaumarchais; and also Passeig de Gràcia, Barcelona, Kensington High Street, London – see also case studies in annex III).

- A third set of initiatives concentrated on eliminating the main cause of the streets hierarchy and separation of street uses: the speed of motorised vehicles. Such initiatives adopted different measures that urged the driver, physically and/or psychologically, to slow down. Thus speed limits of 20-30 km/h were first imposed in residential areas and then extended to non-residential higher-order roads. This method, called traffic calming, resulted in increased sharing of streets between all users (pedestrians, cyclists, trams, cars etc.) Shared spaces like "wonnerfs", home zones etc. were intended to ameliorate street safety and liveability through a non-conventional street design which eliminates visibility splay, rigid corner geometry and signage. In sum, the aim in introducing traffic calming zones and shared spaces was to achieve speed reduction and attentive driving through an enhanced sense of place and locality.
  This third category of methods is elaborated below.

## 4.1. Traffic calming, shared space, 30 zones

Most of the street design and street normative guidelines define traffic calming as the adoption and implementation of a set of measures which adjust the street configuration for the purpose of slowing motorised traffic and favouring non-motorised modes. For example:

- "Traffic calming is the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behaviour and improve conditions for non-motorized street users". (Institute of Transport Engineers – *"ITE Traffic Calming Definition")*
- "Traffic calming involves altering of motorist behaviour on a single street or on a street network. It also includes traffic management, which involves changing traffic routes or flow within a neighbourhood". (Transportation Association of Canada – "*The Canadian Guide to Neighbourhood Traffic Calming*").

However, traffic calming does not deal only with physical measures and devices that slow motorised traffic by altering drivers' behaviour. It should be understood as a more comprehensive concept encompassing all kinds of initiatives designed to manage the street space for the benefit of non-motorised traffic. In this sense, it is not only devices, such as humps, diverters, traffic circles, chicanes and neckdowns that should be considered within traffic calming but also any measure/initiative that slows traffic. Examples include the transformation of an entire (residential) street into a yield street or a "woonerf"; initiatives that push pedestrians and cyclists onto the roadway and make drivers more aware of their presence; placement of art/colourful objects in the middle of the roadway; clothing the roadway in a rough surface; changing the colour or design of building enclosures and façades, etc. All such measures are designed to facilitate sharing or cohabiting of the street space. Because they aim to reduce traffic speed and volume they should be considered part of the "traffic calming" concept.

In fact, the proposed solutions to the problems of traffic speed, street separateness and hierarchical organisation have been refined with time. If early measures focused more on the laws of physics and one or few streets, the later rely more on human psychology and have the tendency to extend to large areas or to be applied differently according to the characteristics of each city area.

This chapter is structured around the whole list of measures and initiatives intended to calm traffic suggested above. First, the basic understanding of **traffic calming** will be explained together with physical traffic calming devices. The "**30 zone**" will then be explained and some examples showing where and how to implement it will be provided. Finally, "**shared spaces**" and the different ways to achieve them will be detailed, starting with the Dutch "**woonerf**", going through the English "**homezones**" and "**encounter zones**", the Swiss "**begegnung**" or the French "**zone de rencontre**" and ending with improvements to classical streets, such as European boulevards, to make them more pedestrian-friendly.

## 4.1.1 Traffic calming

Traffic calming measures have tended to be used on residential streets but most recently have also been adopted for collectors and arterials. Communities are increasingly using centre medians and other traffic calming measures to create boulevards (or parkways) as alternatives to standard arterial streets.

This section covers physical traffic calming measures that reduce traffic speed and cut-through volumes in the interest of the safety and liveability of streets. However, the implementation of traffic calming devices should include education and enforcement measures such as:

- enhanced police enforcement;
- speed displays;
- neighbourhood speed watch;
- neighbourhood traffic safety campaigns etc.

Though very important, these education and enforcement measures do not constitute this subchapter's object of study and will therefore not be explored in detail.

While most traffic calming measures affect both volume and speed, they are classified according to their dominant effect:

- Full and half street closures, diverters of various types, median barriers and forced turn islands form the group of **volume control devices**. **Their main purpose is to discourage or eliminate through traffic.**
- Speed humps, speed tables, raised intersections, traffic circles, chicanes, chokers, lateral shifts, and realigned intersections are classified as **speed control devices**. **Their main purpose is to slow traffic.**

**1. Volume control devices**

**a.** ***Full street closures***, also called ***cul-de-sac*** (from French) or ***dead ends***:

- Are placed across a street to close it completely to through traffic, leaving only the footways or bike lanes open;
- May consist of landscape islands, walls, gates, side-by-side bollards or any other obstruction that leaves an opening smaller than the width of a car.

**b.** ***Half closures***, also called ***partial closures*** *or* ***one-way closures***:

- Are barriers that block travel in one direction for a short distance on otherwise two-ways streets;

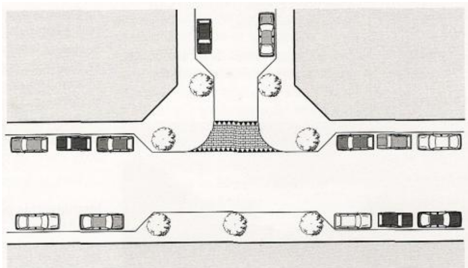


Figure 27 – Full street closures – cul-de-sac (Sources: Calmar el trafico – Pasos para una nueva cultura de la movilidad urbana, Gobierno de Espana, 2008 and Espaces Urbaines, 2003)

- Are most often placed at intersections and are used to make car travel to a neighbourhood circuitous;
- When two half closures are placed opposite one another at an intersection the result is a ***semi-diverter***;
- Can be located internal to blocks between residential and non-residential land uses; this has the advantage of buffering residences from traffic.

***c. Diagonal diverters*** are raised islands or other barriers placed diagonally across an intersection, blocking through movement; like half closures, they are intended to create circuitous routes through neighbourhoods.

***d. Median barriers*** are raised islands located along the centreline of a street intersection so as to block through and left-turn movements.

***e. Forced turn islands*** are raised islands placed at intersections that block certain movements on approaching to an intersection. They can also be called *right turn islands*.

Other less used devices are: ***star diverters*** and ***truncated diagonal diverters*** or ***forced turns***.

2. **Speed control devices**

*a.* ***Speed hump*** is a rounded area placed across the street. It has a parabolic shape and it is recommended to have a design speed of 20-30km/h. The hump profile may vary in height, length and shape, but most commonly the length is approximately 3.5m. In some cases the space between the hump and curb is wide enough to accommodate bicycles. However, this space may encourage motorists to cross a hump with one wheel on the hump and other in the gutter.

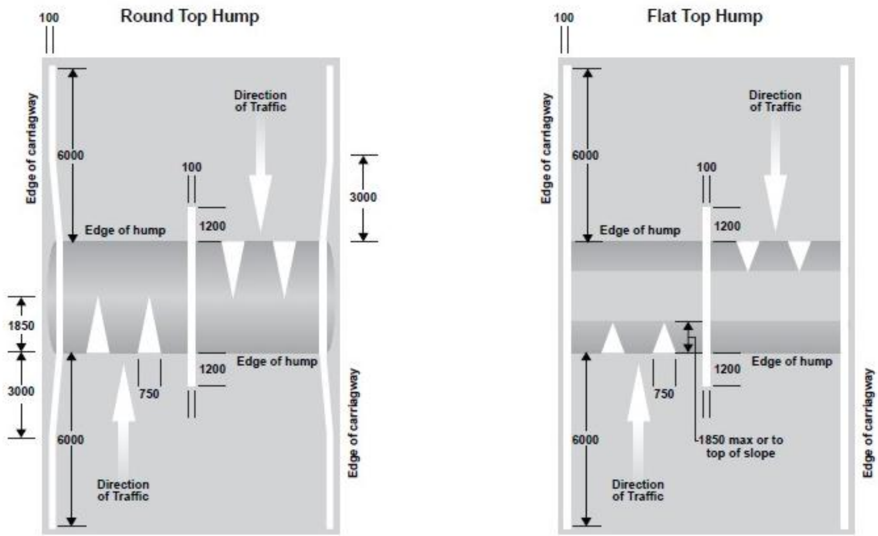



Figure 28 – Speed hump technical details and photo (Sources: Local Transport Note1/07- Traffic calming, Departalent for Transport, March 2007 and O. Stepan)

b. ***Speed table*** is a flat-topped raised platform that is long enough for the entire wheelbase of a passenger car to rest on the top. The flat-toped platform is often covered in textured materials like brick. Most speed tables are 7 to 10cm high and around 6.5m long in the direction of travel.

c. ***Raised crosswalk*** is a speed hump with a flat top marked for pedestrian crossings. They bring the roadway up to the footway level, increasing pedestrian visibility and safety. As speed tables they are often covered in textured materials.

d. ***Raised intersections*** are flat-topped areas covering an entire intersection, with ramps on all approaches and often textured materials on the flat section. They are usually raised to footway level, making the entire intersection, including the crosswalks, a pedestrian zone. They are particularly useful in dense urban areas, where the loss of on-street parking associated with other traffic calming measures is considered unacceptable.

Figure 29 – Examples of raised crosswalks in the UK and Copenhagen (Source: Walk 21, Thorton, B. Guidance on Walking Audits – training material in Active Access Project)

e. ***Textured pavements*** are roadway surfaces paved with brick, concrete pavers, stamped asphalt, cobblestones, or other surface materials that produce constant small changes in the vertical position of the car. They are usually used in conjunction with other traffic calming devices but may be used alone. A notable limitation to textured pavements such as cobblestone is that they may present difficulties for pedestrians and cyclists, particularly in wet conditions.

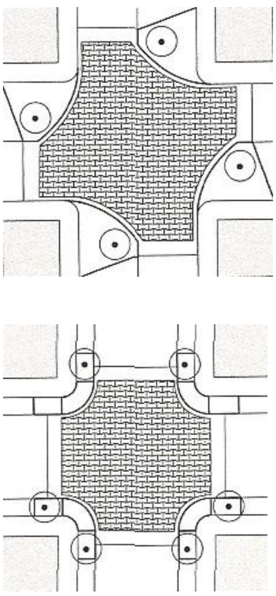


Figure 30 – Speed tables, raised intersections, (Sources: Calmar el trafico – Pasos para una nueva cultura de la movilidad urbana, Gobierno de Espana, 2008 and O. Stepan)

f. ***Traffic circles*** are raised islands, placed in intersections, around which traffic circulates. Usually they are controlled by YIELD signs in all approaches and are placed on residential streets. Traffic circles prevent divers from speeding through intersections by impeding the straight-through movement and forcing drivers to slow down to yield.

In some cases they raise concerns for the safety of cyclists or pedestrians because the horizontal deflection that occurs at circles may force cars into pedestrian crossings on cross streets. Also, where streets are designed with separate bike lanes, cyclists tend to get cut off or squeezed as, at traffic circles, these lanes merge with car traffic lanes. If this is the case, signs instructing drivers to yield to merging cyclists have to be installed.

Another concern about circles is their cost. Generally, they cost several times as much as speed humps or speed tables. The added cost is due to the size of the features, use of concrete rather than asphalt, and the need for landscaping. However, the cost may not appear so excessive when compared with raised intersections. This is an appropriate comparison since both circles and raised intersections calm traffic on two streets at once at a crossing point.

g. ***Roundabouts***, like traffic circles, require traffic to circulate around a centre island. But unlike traffic circles, they are placed on higher volume streets (such as collector and arterials), to allocate rights-of-way among competing movements. They are often used in the place of traffic signals and/or all-way STOP signs.

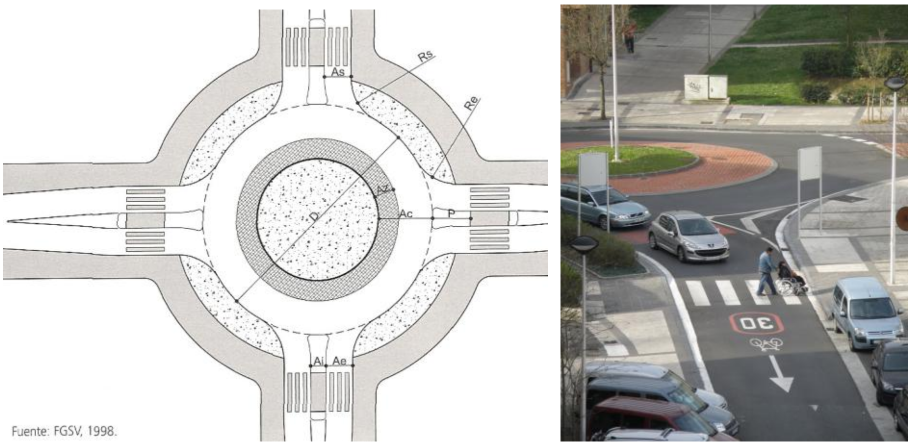


Figure 31 – Roundabout design (Sources: Calmar el trafico – Pasos para una nueva cultura de la movilidad urbana, Gobierno de Espana, 2008 and www.eltis.org)

There are some debates about whether roundabouts are traffic calming measures or just another way to design an intersection. Considering that they involve deflection at the entry point (which limits speed) and circulation, they indeed calm traffic. Additionally, they have been found to have significantly lower accidents than signalised intersections.Modern roundabouts are distinct from old traffic circles and rotaries in the following ways:

- Approaching traffic must wait for a gap in the traffic flow before entering the intersection. In contrast, traffic in an old traffic circle enters at high speeds and then must merge and weave, which is more hazardous;
- Roundabouts require a yield-at-entry (yield to approaching traffic already on the roundabout). In comparison, old traffic circles operate on a yield-to-entering (yield-to-right) basis. Consequently, unless they do not have large diameters, they tend to have high traffic volumes;

- In general, modern roundabouts are more compact.

h. ***Realigned intersections*** are changes in alignment that convert T-intersections with straight approaches into curving streets in order to slow drivers.

i. ***Chicanes*** are streets on which curb extensions alternate from one side of the street to the other, thereby creating S-shaped curves. They reduce both speed and volume. Design must prevent cut-through driving down the centre-line. Manuals recommend shifts in alignment of at least one lane width.

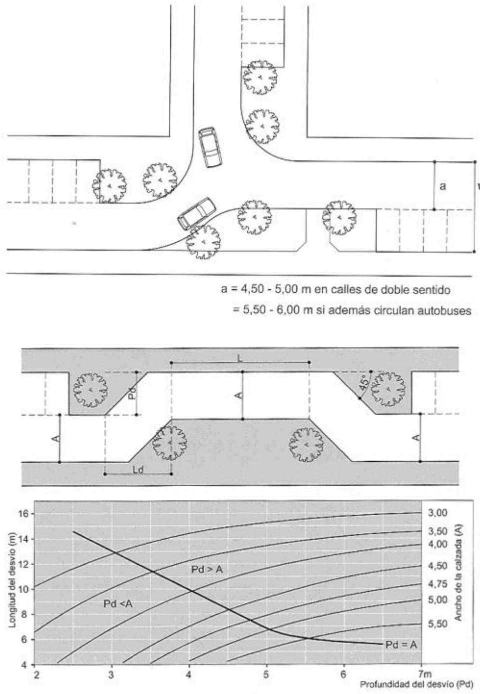



Figure 32 – Realigned intersections (right). Chicane (left) (Source: Calmar el trafico – Pasos para una nueva cultura de la movilidad urbana, Gobierno de Espana, 2008)

j. ***Neckdowns*** are curb extensions at intersections used to reduce the roadway width. If they are coupled with cross walks they are referred to as *safe crosses*. The primary purpose of neckdowns is to "pedestrianise" the intersection. They do this by shortening crossing distances for pedestrians and drawing attention to pedestrians via raised peninsulas. By tightening curb radii at the corner, the pedestrian crossing distance and the speeds of turning vehicles are also reduced.

k. ***Centre islands narrowings*** are raised islands located along the centreline of a street that narrow the travel lanes. Centre islands may be more effective when they are short interruptions to an otherwise open street cross section, rather than long median islands that canalise traffic and separate opposing flows. The latter have been found to sometimes result in increased traffic speeds, while the former result in slower traffic.

l. ***Chokers*** are curb extensions at midblock that narrow the roadway by widening the footway or planting strip. They are also called *midblock narrowings, midblock yield points*, or *constrictions.* Chokers can leave the street cross section with two lanes, albeit narrower lanes than before, or take it down to one lane.

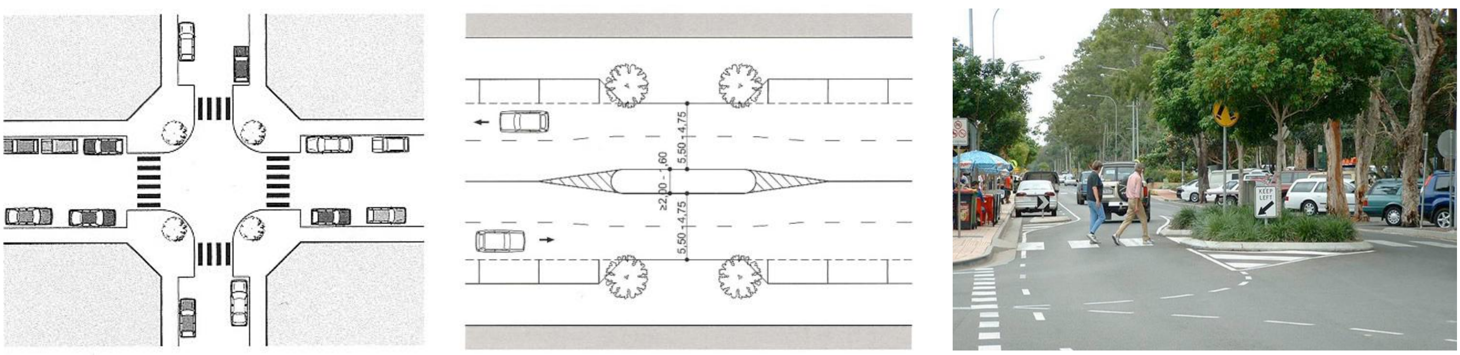


Figure 33 – Neckdowns design (left); Centre island narrowings design and example (Sources: Calmar el trafico – Pasos para una nueva cultura de la movilidad urbana, Gobierno de Espana, 2008 and Walk 21, B.Thorton)

Tempo-30 Zone

## 4.1.2 “30 zone”

A “30 Zone” is an area in which vehicles are not allowed to exceed a speed of 30km/h. The purpose of the speed limit is to render the streets in these areas more comfortable and more safe for all users, but particularly for pedestrians. In comparison to “encounter zones” or “pedestrian zones”, pedestrians in “30 zones” do not have special priority over other modes of transport (particularly cars) and must use the footways. However, the reduced speed of vehicles allows pedestrians to make use of the entire street space by crossing it safely and easily from any point. Thus, if there are no crosswalks in place, pedestrians can cross the street where they wish, which improves their freedom of movement in the street space.

If the main objective of 30 zones is to make pedestrians’ travels more safe, comfortable and easy, they also benefit cyclists in that the speed limit (30km/h for all users) makes it possible for bicycles and motorised modes to share the roadway; it is not necessary to design special bike lanes or strips separating bicycles from traffic. In some countries (The Nederlands, Belgium, France, etc) the streets in a 30 zone allow bicycles access in both directions, but only in one direction for motorised traffic.
In sum, a 30 zone is an area where non-motorised transport modes are encouraged by reducing the speed of motorised vehicles.


Figure 34 - Plan for implementing 30 zones in Lorient, France - The implementation of 30 zones all over the city was made step by step based on a coherent classification of the street network (left); The residential 30 zone - 30 zones are present in almost all residential areas in the city (right-up); Avenue Anatole France in Lorient – the 30 zone allows an easy cohabitation between all transport modes (Source: *Zones à circulation apaisée*, Fiche 1, CERTU, 2008)

The adoption and implementation of a 30 zone does not require expensive or difficult design reconfigurations. The classic street (central roadways flanked by footways) can be easily integrated into a 30 zone by simple interventions such as:

1. Markings informing the drivers, in particular, and the street users in general, of when they enter and exit a 30 zone;
2. Ensuring that the footways are comfortable and clearly marked;
3. Ensuring that amenities, urban furniture (like bollards) and other traffic signs do not impede pedestrians in crossing the roadway at any point;
4. Favouring a pedestrian atmosphere by using specific surface materials for footways and roadways and by limiting as much as possible the use of crosswalks.

An example of the implementation of 30 zones can be also found at:
http://www.eltis.org/index.php?id=13&lang1=en&study_id=1323 - Traffic calming measures and 30 zones in Graz, Austria.

### 4.1.3 Shared Space

The "Shared Space" method operates on the principle that all modes of transport must equitably share the street space and become aware of the surrounding traffic. Contrary to the traffic control measures implemented in the 1980s, the Shared Space method is done by removing all traffic signs, lights and other traffic control devices from the street space. The former are replaced by a streetscape that "speaks" to the driver through surface materials, building enclosure, on-street parking, trees and shrubs, art and decoration. Thus, the daily traffic is regulated by informal social-street rules and responsible travel behaviour. The aim of this approach, developed by the Dutch engineer Hans Monderman, is to enable common use of the available street space.

While a certain element of disorder results from this method, it inevitably becomes a slow-down disorder: there is a drastic reduction in traffic accidents. The shared space concept rests on the idea that taking away traffic regulation elements generates a certain feeling of insecurity, which is assumed to lead to a higher attention level and thus to safer street user behavior. As one assessment of the method concludes,

> *"It is clear that Shared Space primarily is a design philosophy. Urban areas should be designed in participative processes such that all functionalities are balanced out and that motor vehicle drivers are just tolerated as 'guests'. Shared Spaces tries to integrate the three functions of connectivity, access and sojourn in one design clearly related to local environmental characteristics, without splitting up street space into specific user zones." (Methorst, R., Gerlach, J., Boenke, D., Leven, J. "Shared Space: Safe or Dangerous? A contribution to objectification of a popular design philosophy", WALK21 conference, 2007)*

In the past decade, under the influence of street erosion and street safety approaches, the principles of Shared Space have been introduced across Europe. The Woonerf, play areas, Shopping Erfs, traffic calm neighbourhoods, home zones and bicycle boulevards are just some examples. These are further elaborated below..

An interesting classic example of Shared Space can be found at: http://www.eltis.org/index.php?id=13&lang1=en&study_id=440 - Traffic calming and shared space also considering cyclists: Copenhagen, Denmark.

## a. The Wonnerf

The "wonnerf" was created at the beginning of the 1970s in **the residential neighbourhoods of the Dutch city of Delft.** During the 1980s, it was adopted at the national level by the Netherlands Ministry of Transport and Public Works. The wonnerf was both part of a reaction against the increased number of cars on the streets and a way to regain street space for children's play and leisure activities.
In a wonnerf:

- **Pedestrians have priority and can use all the street space including the roadway**;
- **Children's games are allowed to take place in the street**;
- **The volume of motorised traffic should not exceed 300 cars per hour during the peak period.**

The design features of the wonnerf are:

- The **sharing of the street space between vehicles and pedestrians**. This is attained by **eliminating curb distinctions between the footways and the street pavement**;
- **Conveying the impression that the whole street space is usable by pedestrians**. To obtain this effect, abrupt changes in path direction have been removed and, vertical features, surface changes, planting and street furniture have been **designed as obstacles to motorised vehicles and to create a residential atmosphere.**

The real power of the wonnerf area lies in the traffic rules. Each wonnerf is clearly marked at the entrance with a special wonnerf sign. Some extracts from the 1978 wonnerf rules are listed below:

"Art 88a. Pedestrians may use the full width of the road within an area defined as a "wonnerf"; **playing on the roadway is also permitted**.

Figure 35 - Wonnerf in Delft – The semi-private character is essential for the appearance and respect of the residential area (Source: Zones de rencontre: trois ans d'expérience, quel bilan?, Rue de l'avenir, no.4/2005)

Art 88b. **Drivers within a "wonnerf" may not drive faster than a walking pace**. They must make allowance for the possible presence of pedestrians, children at play, unmarked objects, irregularities in the road surface and the alignment of the roadway.

Art 88c. […] Traffic approaching from the right (at whatever speed) always has priority:

1. Drivers may not impede pedestrians in a wonnerf;
2. Pedestrians may not unnecessarily hinder the progress of drivers;

This concept of a residential area, although widely accepted, could lose momentum because:

- The increase in traffic is threatening protected spaces;
- The need for on-street parking spaces distorts the initial design;
- Authorities sometimes prefer to develop 30 zones due to the costs and redesign works required for the wonnerf.

Figure 36 - Wonnerf in Delft – semi-private alley between the rows of houses (Source: Zones de rencontre: trois ans d'expérience, quel bilan?, Rue de l'avenir, no.4/2005)

Videos about wonnerfs can be seen at:
http://www.youtube.com/watch?v=jSoHJFIrJGU
http://www.youtube.com/watch?v=j_EsQagvid4&feature=related
http://www.youtube.com/watch?v=U_NV_Hkxvq8&feature=related

## b. Home zones and other wonnerfs

In Great Britain the concept of "home zones" was implemented in the early 1990s. **In a home zone, local administrations are authorised by law to create zones with restricted speed limits**. They can also set up regulations that make street space available for purposes other than the passing of motorised traffic.

Figure 37 - The Northmoor home zone in Manchester – the neighbourhood liveability and quality was visibly improved after designation as a home zone (Source: Zones de rencontre: trois ans d'expérience, quel bilan?, Rue de l'avenir, no.4/2005)

Drivers are required to exercise increased vigilance in home zones. However, because the home zone status is not defined by the regulations, the behaviour of the driver is not specified either. Thus **home zones have different designs and characteristics**. Some put the footways and roadway on the same level, while others do not. Speed limits also differ between home zones. T**here is no change in priority as in the case of the wonnerf;** pedestrians do not have priority over motorised traffic.

Some of the relevant features of home zones are:

- Public transport is prohibited;
- Traffic should not exceed 100 vehicles per hour during peak hours;
- Visibility is limited to 12m;
- Risk and uncertainty are utilised as traffic calming devices.

An important aspect of the home zones is that **they are not only seen as a traffic management or traffic calming tools but also play the role of an urban revitalisation tool**. In most home zone projects, **local inhabitants or stakeholders are involved and play a major role in developing and designing the area.**

An example of a home zone is “Methleys”, the first UK pilot home zone. More relevant information about this can be found at: http://www.eltis.org/index.php?id=13&lang1=en&study_id=1366

An example of a home zone which applies the same principles as the wonnerf and transforms the neighbourhood streets into shared spaces and safe play areas for children is the famous Freiburg model. A video case study about Freiburg can be seen at: http://www.eltis.org/index.php?ID1=7&id=61&video_id=96


Figure 38 – The wonnerf and shared space principles applied in Freiburg (Source: www.eltis.org)

## c. Begegnungszonen – Encounter zone – Zone de rencontre

The English translation of the Swiss - German “Begegnungzonen” means more than simply “meeting zone”. In Swiss-German, “begegnung” is comprised also of **the notion of encounter**, some lingering, or **engagement with the people one meets**. The Swiss site dedicated to “begegnungzonen” proposes the term “encounter zones” for English and “zone de rencontre” for French.


The encounter zone is defined as **an area where pedestrians have priority over other transport modes (except trams).** In an encounter zone, pedestrians have total freedom of movement and are thus able to use all the street space for **activities such as playing,**

**shopping, talking, sitting, "flâner" or meeting.** City areas that can be converted into encounter zones are residential, commercial or business areas, or areas near stations or around schools.

To ensure the equitable sharing of space between all users, **the speed of vehicles is limited to 20km/h.** Furthermore, except in special circumstances, all the streets in an encounter zone are **two-way for cyclists**. **Parking is not authorised except in dedicated areas** marked for this use. Although pedestrians in encounter zones can cross the street in any direction, they should not obstruct vehicles while passing.

Begegnungzonen have been permitted under Swiss law since January 2002 and are governed by the "Ordinance on road signs" and the "Ordinance on 30 zones and encounter zones". These define the circumstances and rules of implementation, and recommend that begegnungzonen are developed on secondary arteries in residential and commercial areas.

In France "la zone de rencontre" was introduced in 2008 by "The road code" (Le Code de la route). This legal recognition completes and modifies the two other tools proposed to local administrations to develop zones with calmed traffic, namely the 30 zone and the pedestrian zone.

The encounter zone is the only model that **allows a total mix of users in the street space**. Its design aim is to create **an urban atmosphere different from a conventional street** and also **to equilibrate the usages at both quantitative and qualitative levels**.

Figure 39 – Encounter zone in Biel, Swithzerland (Source: Zones de rencontre: trois ans d'expérience, quel bilan ? in « Rue de l'avenir », no.4/2005)

The roadway of an encounter zone **is at one uniform level and the surface is covered in visually contrasting materials**. This alerts **the drivers to the fact that they are no longer in a motorised traffic priority area.**

The begegnungzonen can cover different areas, from a street to a square or a network of streets. Its overall size **is relatively small in order to make possible a strong speed constraint for vehicles and also sustained attention to pedestrian priority on the part of drivers**.
An encounter zone should be designed:

- to **encourage pedestrians to take possession of the entire street space**, their behaviour being supported by the street amenities, vegetation, urban furniture, surface, etc. and by **the limitation of the "wall effect" produced by on-street parking, barriers, bollards**, etc., and;

- **to maintain a detectable distinction between spaces, especially between the movement space for vehicles and the rest of the street space, without giving the impression of a lane reserved for cars**.

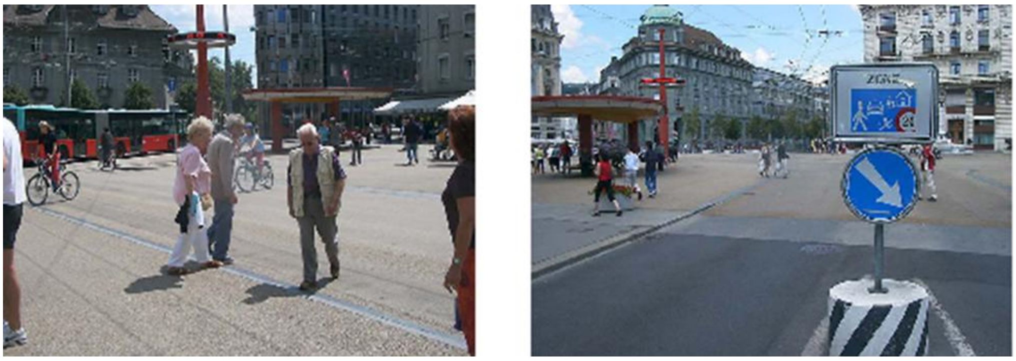


Figure 40 – Encounter zone in Biel, Switzerland (Source: Practical exemples: zones with restrictions of speed, T. Schweizer, 2004)

An example of an encounter zone is the one of Gleistaetten, Austria, the first designed in this country. More information can be found at:
http://www.youtube.com/watch?v=G70t6DIeJkE and
http://www.eltis.org/index.php?ID1=5&id=8&news_id=2065

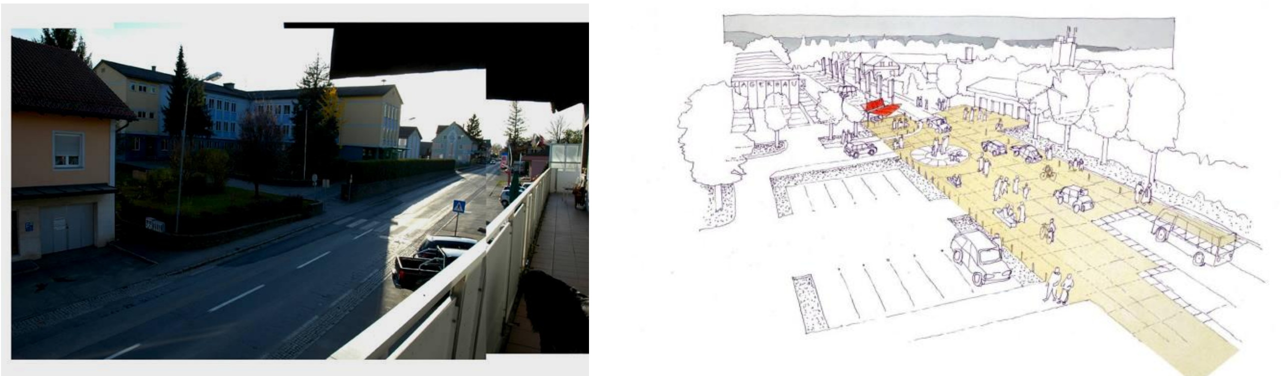


Figure 41 – Encounter zone in Gleinstaeteen, Austria (Source: Claus Koellinger, FGM - AMOR, 2012)

## d. The berner model

The Berner model was developed in 1978 in a project in Zollikofen. The Bernsstrasse, a **major arterial which split the city centre in half,** was used on a daily basis by 20000 cars. The project was implemented in several steps between 1991 and 1998 **to better integrate the major thoroughfare with the places crossed and to (re)establish compatibility with the surrounding context, mainly through redesign of the roadway space**.

For the first time in a Bren canton the principle of "sharing instead of domination" was applied on a major traffic arterial. The main features of the model are:

- Managing the traffic at intersections by **replacing traffic lights with roundabouts that allow functioning based on self-regulation**;

- **Mixing all modes of transport in versatile lanes** instead of separating the different street users;
- **Designing the appearance of the entire area/street to attenuate the separation between the different street users**.

In order to function, this model requires **limitations on the speed of cars** and **design features to make the drivers aware that street it is no longer their territory.**

After their success, the Berner model principles were applied in other streets, squares and intersections in the Bern canton (Neuhausplatz and Schwarzenburgstrasse in Köniz, Seftigenstrasse in Wabern, etc.). However, it should be noted that for each new (re)development, **the Berner model was adapted to the local situation and the specific constraints imposed by each major thoroughfare.**

Figure 42 – Berner model principles applied in Köniz canton for the central area and Schwarzenburgstrasse (left: before right: after) (Source: Etes-vous satisfaits du nouveau centre ?, Commune de Köniz, Office des ponts et chaussées du canton de Berne, 2010)

After each redevelopment phase of the Berner model the effects and experiences were analysed for the benefit of future planning steps. In Zollikofen, the changes brought by the new design of the street were analysed from the perspective of traffic emissions. In the case of Seftigenstrasse in Wabern, Bern University analysed the benefits for slow traffic and for shops. B**oth analyses concluded that sharing the street space between all users improved the quality of life and safety of the whole area and also diminished noise pollution and the negative effects of emissions. Additionally, conditions improved for shopping activities.**

Another important aspect of the Berner model is the **involvement and participation of stakeholders.** At the inception of the project, and during design and planning phase, **great importance is given to potential barriers and conflicts, and open debates involving the people affected are organised.** A Commission is instituted to represent the different "political" interests of stakeholders and manage the participation process. The Commission members are named by the local authority and, besides being constantly involved in the project development by giving ideas and feedback, also play the role of project ambassadors to endorse the project to the public.

## e. Bicycle Boulevard

"Bicycle Boulevard" refers **to a street where bicycles and motor vehicles share the street space.** Such streets are **low-volume, low-speed and have been optimised for bicycle travel through special treatments** (such as traffic calming and traffic reduction). They allow through movements for cyclists but discourage through trips by non-local motorised traffic. Motor vehicle access to properties along the route is maintained.
Most often Bicycle Boulevards are **set up for local or collector streets with low volumes of traffic.**

# 4.2 Low cost and easy to implement measures

In the streets where an intensive effort is being made to provide a quality space for pedestrians and cyclists, greater design creativity could be allowed. Two types of interventions are possible:

1. **Measures that alter the physical appearance of the street in a more or less permanent way**;
2. **Measures that change the street atmosphere and appearance for a short period of time such as during events or when the street is being used for specific activities.**

1. The Australian street philosopher and author of "Reclaiming your street", David Engwicht, has proposed a range of ways in which streets can be turned into interesting and friendly places. **His principal message is that many inexpensive and easy-to-implement methods of changing a street design can be explored.** These methods **allow the involvement of the local residents** in designing and creating the places in which they live or walk every day. Engwicht has also noted that sometimes when traditional measures are applied to reduce the through traffic and there is no positive, regained space to fill the gap, the result is that more space is available for cars. Thus, the conditions must be established to allow for a bustling street life and community exchange in order to encourage a more permanent and positive change to streets.

Achieving this may require a method as simple as adding colour and decorative objects to the street:

- Putting different furniture or artworks on the street (Painted mini-roundabout to promote safety and traffic calming in Chorzów (Poland) at: http://www.eltis.org/index.php?id=13&study_id=2893);
- Hanging banners across the street;
- Painting designs or patterns on the street.

Figure 43 – Temporary alterations in street design that aim to change drivers' behaviour (Source: www.eltis.org)

For example, an interesting sculpture or three-dimensional artwork in the middle of the road will both make the street in question more interesting for pedestrians, cyclists and motorists, and provide a curiosity to cause the driver to slow down. It has been demonstrated that various colours and objects influence drivers' behaviour, producing noticeable results in a reduction of speed.

Furthermore, the residents of a street or neighbourhood who work together to (re)design the street and to create a new atmosphere can enjoy spending time on those streets and increased safety. To keep things interesting and to ensure that drivers do not become too used to the obstacles, some changes should be made to the temporary street design.

2. This category of interventions includes:

- **Car free days** – for a short period of time (from 2 days to a couple of weeks) the street is closed to traffic and is dedicated to other more active and interactive uses like street festivals, active travel activities and competitions for different age categories (children, youngsters, the elderly, etc).
- **Temporary changes in use for parking spaces** – during Mobility Week, Environment Day, or other city events, on-street parking is temporarily removed and the area is covered in grass or other colourful materials; if done in a commercial area, the shops bordering the street are encouraged to extend their commercial activity into the street space by placing their stands in the parking places or by converting them into a restaurant terrace.

**The purpose** of these temporary changes in street use/activity **is to draw attention to their potential as a shared space, a traffic calming zone, an encounter zone, or a pedestrian street.** Though these changes are not permanent the neighbourhood inhabitants will become aware of the possibility of having more attractive, less noisy and less polluted streets and environments. Thus **these interventions prepare the ground for permanent changes; if they are organised regularly, they may lead to a permanent change in use.**


Figure 44 – Temporary changes of use of the parking places in Berlin, Germany – series of events taking place between 15 June and 29 July, 2012 and reclaiming the street space (source: www. thisbigcity.net)

# Annexes

## Annex I – Livable  Streets – study and survey diagrams

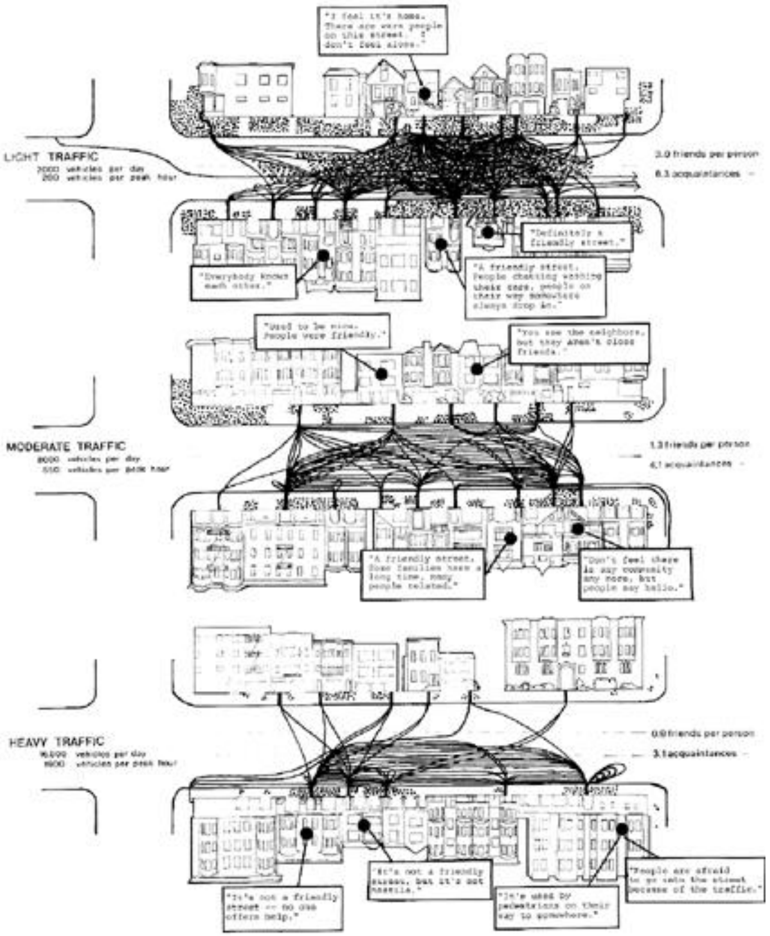



Figure 46 – San Francisco. Neighbouring and visiting on three streets: lines show where people said they have friends or acquaintances. Dots show where people said that they gather.

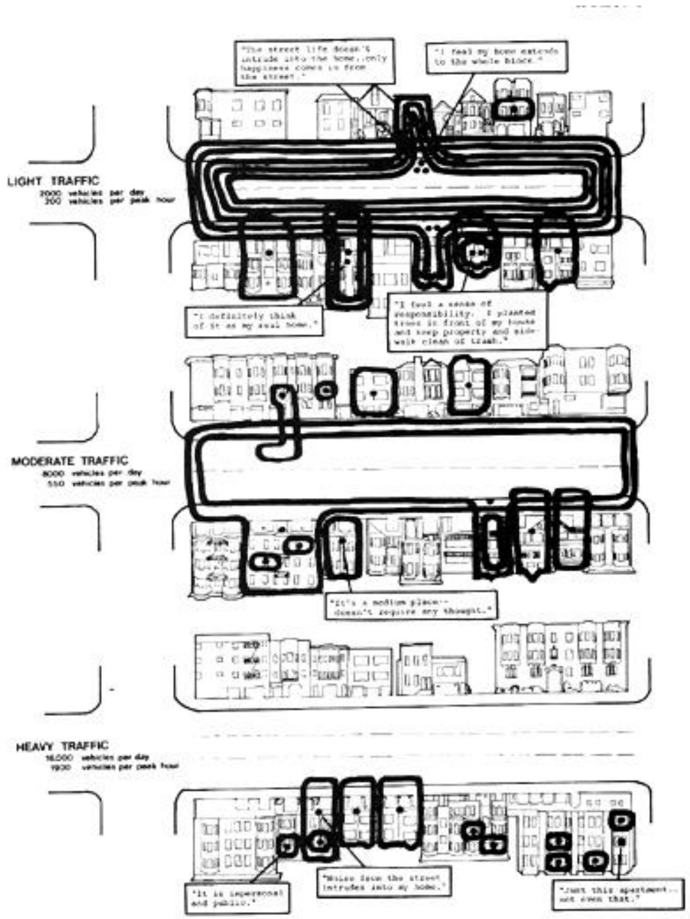



Figure 45 – San Francisco. Home territory on three streets: lines show areas people indicated as their “home territory”.

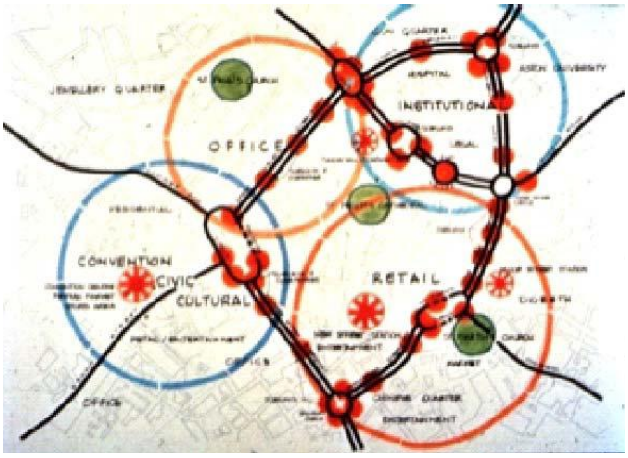
# Annex II – The concrete collar, Birmingham, UK

Birmingham is a typical example of a European former industrial centre confronted with post-modernist economic changes, globalisation and increased competition challenges. It was also the first British city to have a high speed urban transport system implemented (in the mid-1950s), to be demounted only 30 years later as a consequence of changing community values.

With a population of almost 1 million inhabitants, Birmingham is the second largest city in the UK after London. It is located at the crossroads of some of the main national motorways and railways, and has largely flourished due to its industrial activities. The prosperity of the 20th century led to increased motorisation and subsequent important investments were made in transport infrastructure. Consequently, between 1950 and 1960, Birmingham transfigured from a traditional old style European city into an avant-garde settlement dominated by urban motorways. The most impressive interventions were the 3 concentric beltways: the Inner Ring Road (called Queensway and latter dubbed the Concrete Collar), the Middle Ring Road and the Outer Ring Road. Planned by Herbert Manzoni from 1943, the construction of the Inner Ring started in 1958 but was not completed until 1971. Intended to liberate the city centre of the heavy traffic, this huge transport infrastructure totalling 3.5 miles (5.6 km) surrounded the old urban core, its junctions with the main radial ways being provided with roundabouts or interchanges via slip roads. Besides altering the urban continuity, the concrete collar decidedly discouraged non-motorised means of transport. Initially thought of as a major and obvious improvement, this operation soon proved to have introduced an inscrutable barrier, isolating the centre from the other parts of the city and leading to its accelerated decay. Many residents migrated to the peripheries or suburbs, while some areas remained unused with buildings laying empty or in ruins, and the unemployment rate increased substantially.


Figure 47 - **Plan and photo of Birmingham's Concrete Collar**
Left - The Concrete Collar (figured in red) and the network of streets and motorways leading to the city's central area (in green – motorways, in orange – regional or local importance ways) – scheme O. Stepan
Right – The interchange via slip roads constructed between the Central Ring and one of the median roads conforming to Manzoni's - Source: Walk 21, R. Tolley

Given this steep decline, in 1985, Birmingham's local administration initiated a large rehabilitation program to increase the level of liveability and to change the image of the city centre into a positive one, while augmenting the weight of tourism at the level of the urban development strategy. The central road infrastructure interventions played an essential role to the success of the general positive transformation, the most remarkable of these being:



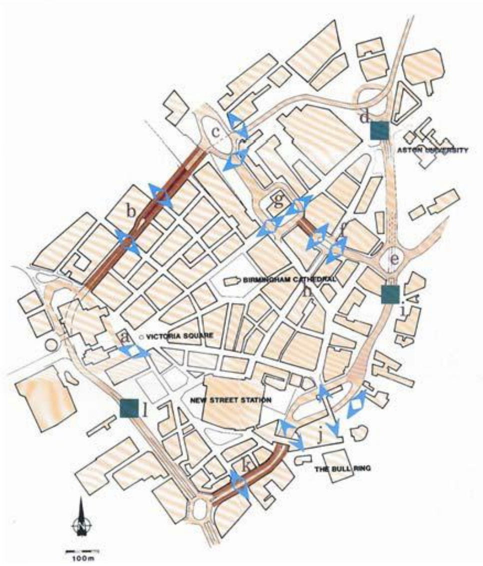




Figure 48 - Schemes and photos: the Concrete Ring boring (Source: Walk 21, R. Tolley & Birmingham City Council's webpage - Big City Plan)

Left up - "Ring boring" scheme with proposed zoning, interest points and accents

Right up – Scheme: new pedestrian links and public spaces

Left down - the Concrete Ring boring

1. **The Inner Ring Road boring** – acknowledging the importance of physical and visual links between various parts of the city previously blocked by the 1960s traffic system, the interchanges via slip roads were replaced by normal crossroads, while the underground walking passages were substituted by open air pedestrian areas;
2. **Pedestrian areas** – Areas of the centre previously dedicated to motorised traffic, such as Centenary Square and Victoria Square, were reorganised as pedestrian zones. This opened views to the representative buildings of the city's core *(ICC and Hyatt hotel from Centenary Square, Town Hall and Council House from Victoria Square)*. Decorated with dedicated urban art, these spaces become the stages of the main civic events.
3. **Rehabilitation of the channels network from the central area** – the new bridges, access points and landscape facilities were joined by the revitalisation of the adjacent areas through multi-functional use promotion (the Brindleyplace scheme was initiated in 1994 and is still in progress).

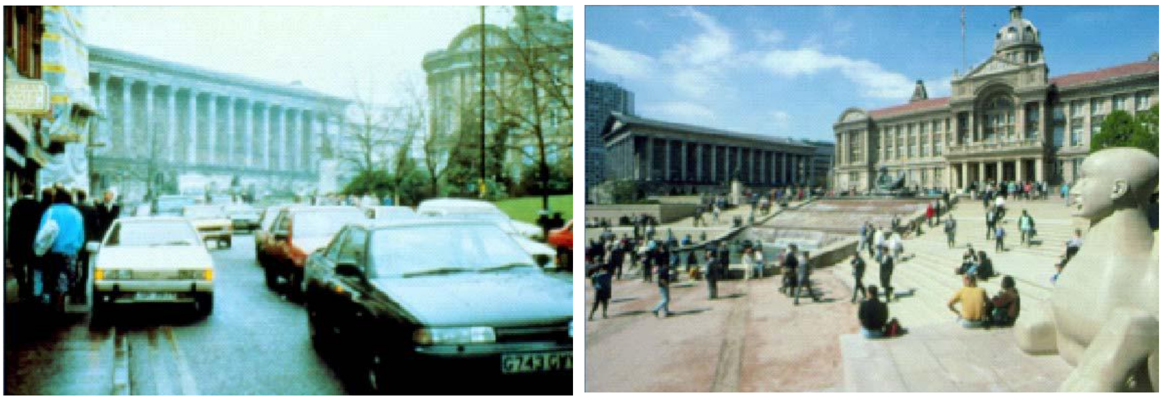


Figure 49 - Centenary Square area in 1990 before and in 2000 after the concrete ring boring (Source: Walk 21)

Proof of the success of this rehabilitation operation is the fact that, since the late 1990s, public investments have decreased substantially and most of the projects now continue with private or external (including EU) funding, while the local authorities are playing the role of facilitators preparing the spatial planning strategy and mediating the various interests. Due to the increase in the number of visitors, the tourist sector registered significant growth. The city ascended from 13$^{th}$ place in the top British commercial destinations before the intervention to the 2$^{nd}$ or 3$^{rd}$ position after London, in tight competition with Glasgow (Birmingham City Council - Big City Plan Website). This image change process also supported the city's redefinition as an international conference centre so that Birmingham hosted the G8 Summit, as well as many other events of international or European importance.

The initial strategy, based on active mobility supported by the creation of a pleasant pedestrian environment, has been continued by **The Big City Plan** which aims to drive Birmingham to 20$^{th}$ place in the world's most sustainable, pleasant and liveable cities. Besides strengthening the newly created image, the present efforts are oriented to the extension of the central area to the Middle Ring Road (Birmingham City Council - Big City Plan Website).

Imposed because of the discontinuities created by the Inner Ring Road and its negative effects on the urban structure, mobility and image, Birmingham's central district rehabilitation was possible through adjustment of the traffic management policies. The image and ambience offered encouraged the adoption of non-polluting means of transport, thus rendering walking and cycling the most pleasant and easy modes of travel in the area. As car drivers achieved better perception of the space and encountered a more diverse situation, they eventually became more careful.

# Annex III - Case studies - European Boulevards

Reconfigured to regain the street's social value and to readjust the connection between the pedestrian and the motorised traffic spaces, the Haussmannian boulevards illustrate the present French philosophy concerning mobility infrastructure reorganisation. Their actual design and image made it possible to accommodate multiple travel modes, while being urban public spaces with high qualities in terms of conviviality and interest captivation.

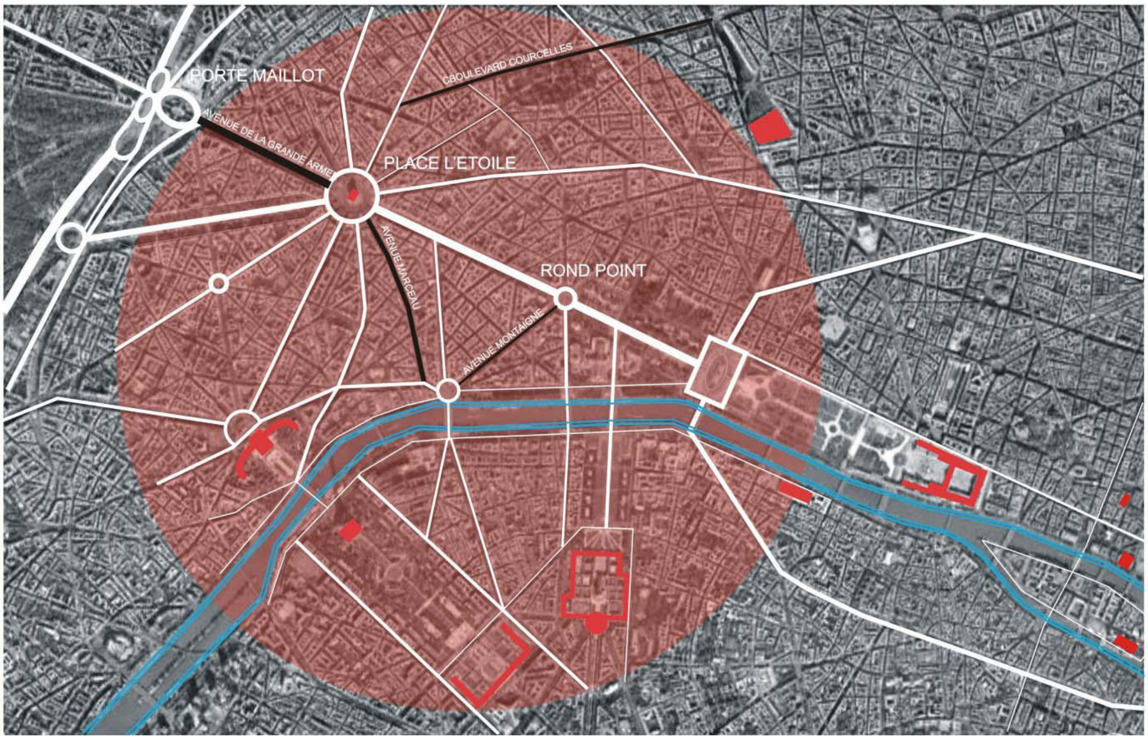



Figure 50 - Haussmannian Boulevards in Place l'Etoile – Concorde area (Source: Google Earth, editing: O. Stepan)

## Avenue Montaigne, Paris, France[2]

*Location and brief history*

Located in the north-western part of Paris' central area, between Champs Elysées and the Seine River, Avenue Montaigne is one of the most famous roads of the French capital. The road is the result of the modernisation and rebuilding operations initiated by Napoleon III under the supervision of the prefect Georges Haussmann. A simple country road in the 16th C, in 1770 it became one of the favourite places for balls. From 1880 it was transformed into a real avenue, along with Avenue George V, Avenue Franklin Roosevelt and the 12 boulevards streaming from Place l'Etoile. These new arteries were built not only for sanitation and delinquency reduction purposes, but also as a response to the aspirations of the new bourgeoisie eager to ameliorate its stature and living conditions. Bordered by stylish buildings equipped with shops, restaurants and coffee shops, the boulevards soon become Paris's most popular promenade places.

*Role at urban level*

[2] Inspired from the *"Boulevard Book"* (2002) written by Allan Jacobs, Elizabeth MacDonald and Yodan Rofé,

Avenue Montaigne was created as part of the grid guiding the urban extension. It also assumed a role for the decongestion and reconfiguration of the old neighbourhoods. Nowadays, it is still an important structuring element, connecting high interest areas (the Rond Point on Champs Elysées and Alma Bridge on the Seine River).

*Configuration (plan layout, longitudinal and cross sections)*

Avenue Montaigne has a straight trajectory, with a slight descendant slope to the Seine, a length of 610 m and a width of 38.5 m between the opposite fronts. Only one street (Rue François 1er) crosses it; the others create T-junctions. Its central roadway is 12.8 m wide and contains 4 lanes. Each of its side medians is approximately 2 m wide and equipped with a dense row of chestnuts (with a distance of 4.5-5 m between trees) as well as benches, bus stops and taxi ranks. The widths of the access lanes and the footways are variable. In some parts the access belt has one traffic lane and 2 parking rows (totalling 6.7 m), while the footway has a width of 4.2 m; in other parts, the distribution is vice versa, the access belts having the traffic lane and just one parking row to a total width of 4.2 m, while the adjacent footway extends to 6.7m. In some cases, the front gardens reduce the footway width to 3m. A common aspect of French streets is the difference in level between the three parts of the street. In this case, the access lanes are 4 cm higher than the roadway and 4 cm lower than the footway.

The fronts are formed by elegant six- or seven-storey buildings which date back to the 19th and 20th C.

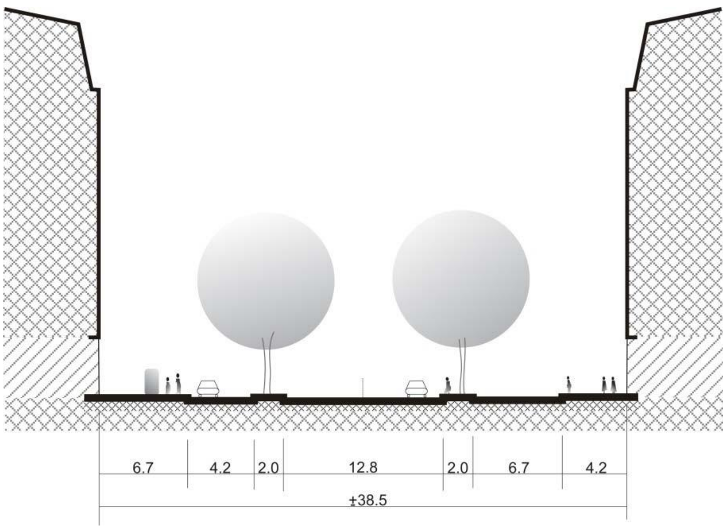



Figure 52 - Cross section Avenue Montaigne

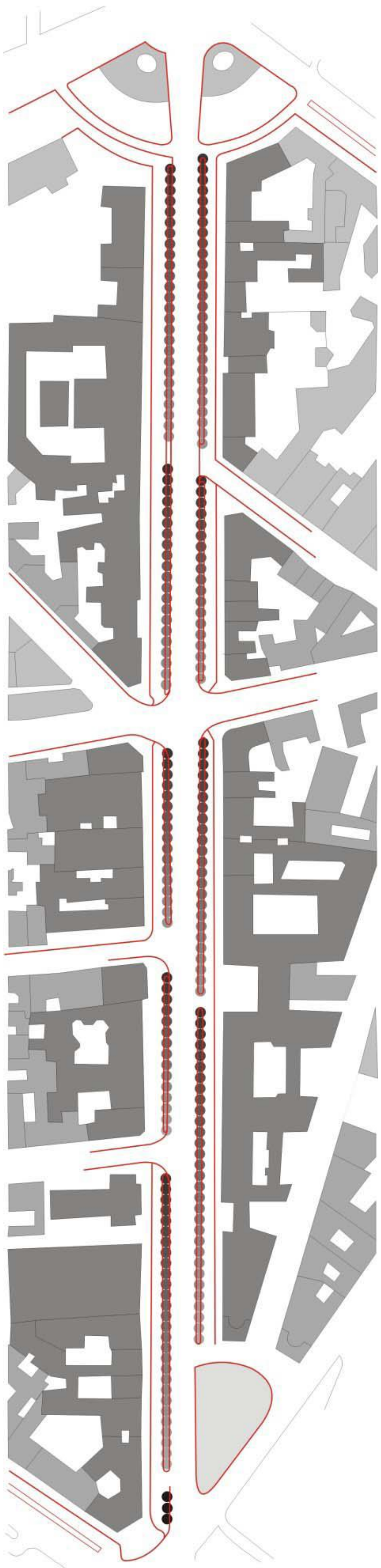


Figure 51 – plan Avenue Montaigne

*Functions*

The boulevard houses the most prestigious fashion companies in Paris, coffee shops, bistros and banks, as well as one hotel and one embassy.

*Mobility modes*

Besides walking and car mobility, the boulevard has 2 bus lines (buses 42 and 80) crossing it in one direction (from the Round Point to the Seine). It has metro stations (Line 9) at both its ends. Despite the absence of bike lanes, cyclists are quite frequent, using the access belts or the public transport parts. In the immediate vicinity there are 2 Velib bike renting centres (one in Rue Francois 1er at approx. 30 m distance and the other at the junction with Pont de l'Alma). There is also a paid car park with 544 spaces at the crossroads with Rue Francois 1er.

*Traffic*

The public transport and taxis have a dedicated line, while the motorised traffic can only travel one way (from the Round Point to the Seine River). The traffic is quite dense. In an average day, 850 vehicles/hour have been counted on the central roadway, 115 on the public transport lane and 42 on the access belts. The pedestrian flow is also high. In an average hour, 1330 people can be observed walking on the footways and 1200 crossing Avenue Montaigne.

*Design effects upon the image and use of street space*

Avenue Montaigne mainly serves motorised traffic and pedestrians. As in other similar cases, the car speed on the access lanes is lower than that on the central roadway, partially because of the width variations in the access lanes, the difference in level between these and the other components of the road section, and the occasional pedestrians using it. Usually, the access lane is used by drivers searching for a parking spot, unloading commercial goods or waiting for somebody. Irregular manoeuvres are frequent enough to confuse any unadvised observer.

*Conclusions*

Despite its narrowness compared to other arteries of the same category, Avenue Montaigne functions well. The average speed is 50km/h on the central roadway, and 30km/h on the access lanes, and traffic jams are quite scarce. There are no conflicts between the motorised and pedestrian flows. The access lanes are used by diverse categories of people, from car drivers to older people and mothers with baby carriages. The benches tend to be used by people waiting for public transport. Crossing the avenue is quite easy and is frequently done in two sequences: the first to the median and the second from the median to the other side. Regardless of its reduced dimensions, Avenue Montaigne includes a considerable diversity of physical elements (lanes for various speeds and uses, planted medians, footways, front gardens, benches, public transport stops), enabling the comfortable cohabitation of various transport modes, activities and people with different needs and preferences. All these elements create a functional structure principally divided into the high speed central area and the side slow zones (from the exterior of the medians to the building facades), rendering this boulevard a lively and pleasant urban place.

# Kensington High Street, UK

*Location and brief history*

Stretching between Central and Greater London, Kensington Street has one end to the western limit of Hyde Park and the other in front of Holland Park. It was developed during the Victorian era as a commercial and service axis for the adjoining neighbourhoods. In 1970, the first subway station (High Street Kensington Underground Station) was opened in the area.

*Role at urban level*

Besides collecting and distributing the local traffic, Kensington High Street connects Central London to Greater London, making it an intensively used artery with high transport flows.


Figure 53 – Kensington High Street - the footway near the metro station entrance (Source: O. Stepan)

*Configuration (plan layout, longitudinal and cross sections)*

Kensington High Street has the following profile:

- a 12-14 m width central roadway including 4 lanes (2 for each direction);
- a 2.5 - 3 m median separating the 2 directions of traffic. and enclosing pedestrian refuges, and rows of trees alternated with bike racks;
- footways, the south one with a constant width of 5 m and the north one varying between 4.5 m and 6.5 m (it is narrower especially at Hyde Park in front of some buildings).

Some of the footways are lined with trees and lamp posts. Even if dissonant with Victorian architecture that characterises the area, the lamps illuminate the footway and alert the traffic to the presence of pedestrians.

The fronts are continuous, primarily composed of 3-4 storey Victorian buildings, often with red brick facings. There are also a few Art Deco edifices.

*Functions*

The eastern part of the boulevard is dominated by commercial units, while the western one facing Holland Park has shops on the ground floor and residences on the upper ones. This functional mix means that there are many pedestrians, making the first half of the street more animated and used than the second half.

Figure 54 – Kensington High Street – the roadway bus lane used also by cyclists (Source: O. Stepan)

*Mobility modes*

The street is served by 10 bus lines, by Circle and District subway lines and indirectly by Central and Piccadilly tubes. To these can be added the Kensington Phillimore Gardens bike station (which belongs to “Barclays Cycle Superhighways”, London’s cycle hire system). London maps for pedestrian orientation are placed in the bike station as well as at other key points along the boulevard.

*Traffic*
The roadway has a total width of 15 m of which 3 m are occupied by the central median, leaving only 12 m available for the four traffic lanes. Cars, buses and bikes all travel fluently in these lanes. An hourly flow of 3000 motor vehicles and 1000 cyclists has been measured at the crossroads with Wright's Street. The pedestrian traffic varies along the boulevard. The commercial area and the vicinity of the tube station is crossed by about 4800 pedestrians per hour, while the western part (near the crossroads with Hornton Street) has 3 times less people. Even if Kensington High Street is not included into the "congestion tax area", being just 1.5 km from it, the street has benefited from this measure in terms of a decrease in the hourly flow of cars between 7 am and 6.30pm in favour of bicycles and motor scooters (Bendinxson, 2003).

*Design effects upon the image and use of street space*
This area is of the 35 commercial zones of Greater London, but **its popularity is not owed only to this function**. The dynamic image and the convenient cohabitation of the car flows with the public transport, cyclists and pedestrians **are the result of changes over the last 30 years changes at the level of street design and traffic organisation**. In the 1950s, the local administration adopted a program to ameliorate the image and the chances of this boulevard. **The central idea was to recover the Victorian aspect of this artery, while keeping the equilibrium between the traffic light times allocated to cars and respectively to pedestrians.**


Figure 55 – Kensington High Street - design of the central median - trees and parking places for bicycles (Source: O. Stepan)

**The main measures adopted were:**
- the displacement of handrails and plastic bollards;
- the highest possible reduction of signals, poles and devices designated for traffic guidance;
- implementation of continuous ramps clearly demarcating the footways;
- clearing the pedestrian refuges of handrails and any redundant urban furniture, and;
- the replacement of the bitumen finishing of the footways with granite plates.

*Conclusions*
**Although the successive modifications of this boulevard were mostly at a superficial level, they sufficed to change its image, popularity and use.**

# Passeig de Gràcia, Barcelona, Spain[3]


Figure 56 - Plan: Barcelona's central area with its main boulevards (Source: Google Earth, editing: O. Stepan)

*Location and brief history*
Passeig de Gràcia starts at Placa de Catalunya  and continues north-west along l'Eixample neighbourhood until Avinguda Diagonal. It is one of the main boulevards structuring the city extension proposed by Ildefonso Cerda after 1854. It was designed in the image of a former country path, having a slight leaning compared to Cerda's orthogonal grid. Its width is 61 m, making it larger than the previous road that it replaced and 6 m narrower than the Champs Elysées. In 1994, because of the traffic increase and the need for more parking spaces, the medians were narrowed and the access belts enlarged by cutting one of the rows of trees.

*Role at urban level*
Through its location and the connections it enabled, Passeig de Gràcia was considered to be one of the main routes of a growing city. It linked the old city with the new parts constructed after the WWII.

*Configuration (plan layout, longitudinal and cross sections)*
With a total length of 1.6 km, Passeig de Gràcia crosses 2 major transversals and has many junctions with one-way streets of local importance. The bevelling of the edges at the crossroads enables good accessibility to the side quarters. Its central roadway is 18 m wide with four lanes heading to Placa Catalunya and two lanes going to Avenida Diagonal. One lane in each direction is reserved for public transport and cabs. This central part is bordered on each side by 21 m wide zones containing a median (of 4.8 m), an access lane, and the footway. The medians are equipped with a row of plane trees spaced at 7.3 m, bus stops, benches and pedestrian accesses to the underground parking and to subways. Due to their width, they also allow walking. The access lanes have a variable width to accommodate one or two traffic lanes and various types of parking with the accesses to the underground car parks. Even if they are physically separated, the medians and the access lanes

[3] Inspired from the *"Boulevard Book"* (2002) written by Allan Jacobs, Elizabeth MacDonald and Yodan Rofé,

function as a system. The design maintains some constants: the row of trees (evenly aligned and distanced), the type of lamp posts and the ramp line. The generous 11 m wide footways allow comfortable walking, while simultaneously hosting the terraces of restaurants, coffee shops and bars, numerous bookstalls and temporary exhibitions or fairs.

*Fronts*
The buildings bordering Passeig de Gràcia have a relative uniform height of 5-6 storeys with a continuous cornice line. The facades are rich in decorations and the windows are often made of colourful stained glass.

*Functions*
Passeig de Gràcia is characterised by a large variety of functions: shops, offices, hotels, theatres, restaurants, coffee shops, bars and dwellings.

*Mobility modes*
Besides the car and pedestrian flows, the artery is served by four bus lines, a subway and some underground regional and national trains. Although there are no bike lanes, there are public cycle hire stations ("Bicing") in the immediate vicinity (Placa Catalunya and the crossroad with Gran via de les Corts Gatalans).

*Traffic*
Compared to the traffic on the transversal one-way routes, the motorised flows on Passeig de Gràcia are low. The junction with Carrrer d'Arago is very busy with an average of 3560 vehicles per hour in the east-west direction but only 1950 along Passeig de Gràcia at the same time. The boulevard presents some traffic restrictions including a no left turn. Despite the relatively high speed of traffic (about 30km/h) on the access belts, these are frequently used or crossed by pedestrians as well. All day and even late at night, Passeig de Gràcia is transited by a large number of pedestrians, exceeding the number of cars crossing the same street section. For instance, in an hour while 3300 pedestrian passed on both footpath of the same section, only 1800 cars crossed the road way and the access belts.

*Design effects upon the image and use of street space*
Due to its location, configuration and design details, Passieg de Gràcia became the most elegant commercial road in Barcelona. The high pedestrian flows make it a particularly vibrant space. However, some elements could lead to its urban erosion over time: the speed of the cars on the access belts and their intensive use (mainly caused by the asymmetrical distribution of the flows on the central roadway and by the no left turn rule).

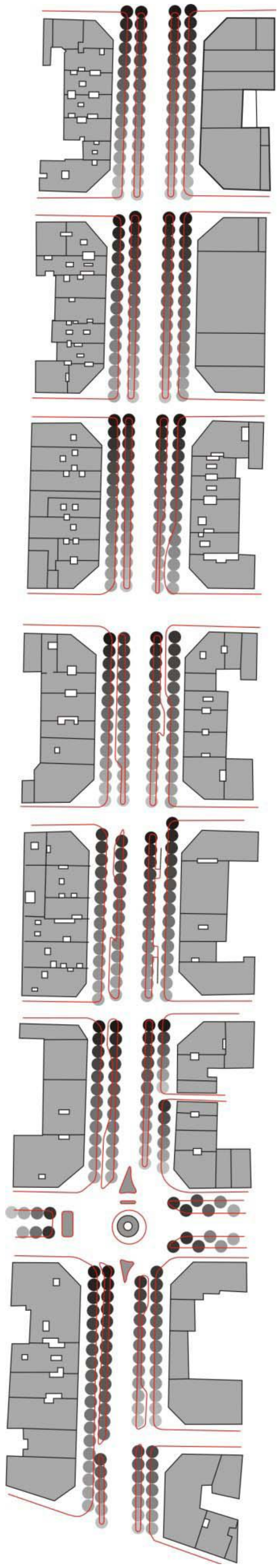


Figure 57 - Passeig de Gràcia Site Plan

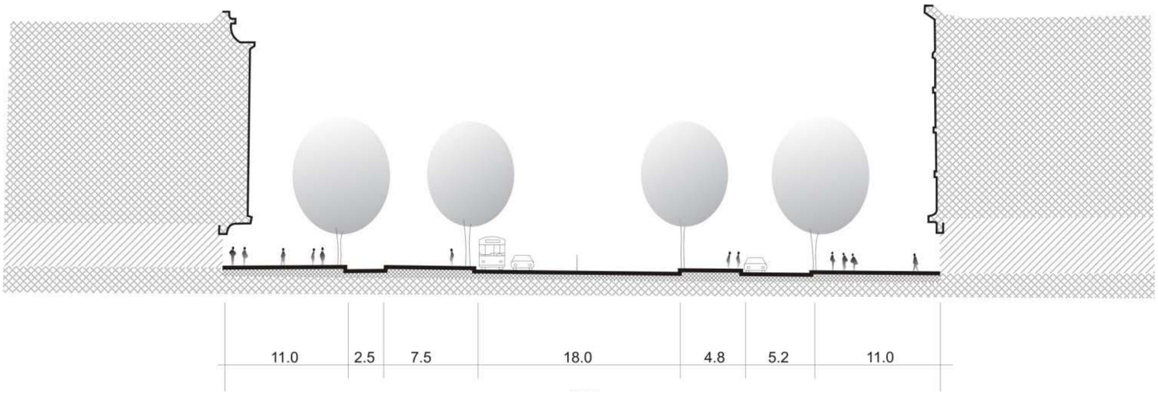



Figure 58 – Passeig de Gracia cross section

*Conclusions*

**The changes made during the past 20 years have not modified the essential features of this boulevard, but tended to alter its character as a promenade road. However, it remained a vibrant multifunctional street serving the local users and the transit traffic; pedestrians and car drivers or public transport travellers.**

# Annex IV- Comparative analysis between different European boulevards

| | PARIS | | | | | | BARCELONA | | LONDON | | BUCHAREST |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Av. de la Grande Armée * | Av. Montaigne* | Av. Marceau | Bd. Saint-Michel | Bd. Beaumarchais | Bd. Courcelles (section along the park) | Passeig de Gracia * | Avinguada Diagonal * | Regent Street | Kensington High Street | Bd. N. Balcescu and Gh. Magheru |
| **CONFIGURATION** | | | | | | | | | | | |
| distance between facades / total width (m) | 70,0 | 38,5 | 41,0 | 30,0 | 35,0 | 36,0 | 60,0 | 50,0 | 27,0 | 25,5 | 45,0 to 50,0 |
| roadway width (m) | 27,0 | 12,8 | 14,0 | 15,0 | 15,0 | 12,2 | 18,0 | 15,0 | 15,0 | 14,0 | 21,0 |
| no. of lanes on the roadway | 10 | 4 | 6 | 5 | 4 | 4 | 6 | 4 | 4 | 4 | 7 |
| no. of parking lanes on the roadway | - | - | 2 | - | - | 2 | - | - | - | - | - |
| no. of PT lanes on the roadway | - | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | - | 2 |
| no. of cylcing lanes on the roadway | - | - | 2 (with PT) | 2 (with PT) | - | 1 (on the access lane) | - | 1 (on the medians) | 2 (with TP) | 2 (with PT) | - |
| percent of roadway width in total width | 39% | 33% | 34% | 50% | 43% | 34% | 30% | 30% | 56% | 55% | 47% to 42% |
| access lane(s) width (m) | 7,6 | 6,7 | 7,3 | - | 8,0 | 8,2 | 5,2 | 5,2 | - | | 7,5 (only on the west side) |
| no. of movement lanes on the access lanes | 1 | 1 | 1 | - | 1 | 1 | 1 or 2 | 2 | - | | 1 |
| no. of parking lanes on the access lanes | 2 | 2 | 2 | - | 1 | 1 | 1 or 2 | 0 | - | | 2 |
| median width (m) | 2,6 | 2,0 | 2,7 | - | - | - | 4,8 | 9 | 3,0 | 3,0 | 6,5 to 11,5 (only on the west side) |
| sidewalk width (m) | 11,2 | 4,2 | 3,6 | 7,5 | 10,0 | 3,6 | 11,0 | 3,2 | 6,0 | 5,0 to 6,5 | 5,0 |
| percent of pedestrain area width in total width | 61% | 67% | 66% | 50% | 57% | 66% | 70% | 70% | 44% | 45% | 53% to 58% |
| **TRAFFIC** | | | | | | | | | | | |
| mediu daily traffic | 110 000 | 16112 | - | - | - | - | 39870 | 94256 | - | - | - |
| traffic volume / hour | 9240 | 850 | 3100 | 3300 | 4800 | 3000 | 1800 | 2420 | 2400 | 3000 | 6000 |
| traffic volume on the access lanes / hour | 600 | 42 | 370 | - | - | 120 | 512 | 871 | - | - | - |
| percent traffic volume on the access lanes in total traffic volume | 6% | 5% | 12% | | | 4% | 28% | 36% | - | - | - |
| **PEDESTRIAN TRAFFIC** | | | | | | | | | | | |
| no. of pedestrains walking along the bd./ hour | - | 1330 | 620 | 9500 | - | - | 3300 | 480 | 10500 | - | - |
| no. of pedestrains crossing the bd. / hour | 600 | 1200 | 240 | 3200 | 1000 | 3800 | - | - | 1010 | 1600 | 6500 |
| no. of pedestrans on medians / hour | - | 200 | - | - | - | - | - | - | - | - | - |

* based on traffic masurements and data from *"The Boulevard Book"*, Jacobs, A., Macdonald, E., Rofè, Y. (2002)