The cycling as a driver of a renewed design and use of public space within the neighborhoods

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Abstract

A great contribution both to the energy consumption and to the air pollution results from road transport and mainly from travels in urban areas. The great number of trips occurring into the urban areas is certainly due to the increase of people in the cities, which will increase in the future representing thus a large proportion of the world population. Therefore, it is most influential the reference of the urbanization model and related transport model. In fact, for different historical periods, the shape of cities was depending on transportation technologies. The massive use of the cars has induced the extension of the urban areas in all directions without a prevalent priority, it has encouraged the private motorized mobility with respect to the widespread accessibility and it has allowed the separation of urban functions. As a consequence a reduced quality of life, social segregation - especially for people with a low level of self-sufficiency, and a reduced sense of community of residents are occurring. This led to a progressive impoverishment of the neighbourhoods that instead represent places of interaction for the individual well-being, community cohesion and urban vitality.

The study area is the 13th District (Ostia) of Rome – Italy, where it has been carried out a design laboratory in the frame of an European project"VillemiZero". This area has been urbanized after 1960 and it is representative of low-density settlements separated by agricultural enclaves. Infact this District has a population density of 13.6 inhabitants per hectare, one of the lowest of Rome. The collective transport can not support these density so low that instead are supported by private motorized transport.

A plan that encourages a higher urban density and mixed land use can have significant benefits in terms of provision of basic urban services that would allow a reduction in car use and as a consequent of GHG emissions and traffic congestion, increasing at the same time, the efficiency of the public transport and slow mobility. However, it is difficult to act on the density in urban areas already built. As a consequence we can act on the transportation modes used on the distance of proximity or short haul

According to these conception a reduction of use of the car and, consequently, of the traffic congestion and GHG emissions , can be achieved by increasing the component of slow mobility for travel within and among close neighbourhoods can be achieved through the increase of slow mobility for travels occurring within and among neighbourhoods. Finally, this paper aims to highlight the role of cycling as an important carrier for a renewed layout and use of public space inside of neighbourhoods.

Transport technology, urban morphology, GHGs emissions and energy consumption

Actual transport system has a very important role for the internal market and quality of citizens's life. If it is sustainable and effective then it can be helpful for economic growth and employment. Global, European and national contextes show that mobility has become increasingly necessary: between 1990 and 2007 the EU-27 road transport is increased by 29% and the car ownership, in the same time, is increased by 34% (EEA, 2010).

This transport model is accountable for 23% of energy consumed in Europe, and about three quarters of which depends on road transport (IPCC, 2007). It is estimated that energy consumption in this sector will increase around 80% for 2030. (IPCC, 2007). In this sector, the energy consumed originates of 96% from oil and its products (IPCC, 2007, EC, 2011; Lerch, 2011). A very strong dependence on oil that may also have important consequences on the resource supply and mobility of citizens for the next decades (EC, 2011; U.S. Joint Forces Command, 2010). Furthermore this high use of energy from fossil fuels produces large amounts of greenhouse gases and other emissions harmful to human health and the environment (U.S. EPA, 2010). Consequently, the transport system represents a significant and growing source of greenhouse gas (GHG) emissions. The European Commission shows that in this sector we need a reduction of at least 60% of these emissions compared to 1990 levels. By 2030, the objective of the transport sector is a reduction in GHG emissions by 20% compared to 2008 levels. Having regard to the considerable increase of GHG emissions in this sector over the past 20 years, it This data would be 8% above 1990 levels (EC, 2011).

This reduction could take place through gradual removal of vehicles powered by fossil fuels from the cities (EC, 2011). In fact, in the urban areas great part of energy consumption and air pollution is given from road transport. The important role of the road transport is certainly due to the fact that cities are becoming the places where a large proportion of the world population is focused on, and it will continue to focus on in the future (UN Population Division, 2007). At the same time it is of great importance to take in consideration the pattern of urbanization and the related transport model. In fact, for different historical periods, the shape of cities was depending on transportation technologies. The compact city of the 18th century owed their compactness at the prevalent pedestrian mobility (Glaeser & Kahn, 2003). In the 19th century the increase of use of the omnibus and tramways induced an urban development towards a less dense settlements, away from the city centre but distributed along the public transport lines (Glaeser & Kahn, 2003; Greene, 2004). Later, in the 20th century, two phases of urbanization occurred. In detail, the second one resulted in a greater growth and change than in the past , and it was characterised by the urban sprawl, which was began in the late 50's (Insolera, 1993; Antrop, 2004; Antrop, 2000a). The majority of new urbanized areas are characterized by low densities (Salvati et al, 2012), a reduction of the natural and semi-natural areas and a high fragmentation (EEA, 2011; Antrop, 2004; Cappuccitti, 2006). The widespread use of private cars has considerably contributed to the success of this urban model and it has represented the beginning of a new era of mobility, shape of public space and land use (Antrop, 2004; Rusk, 1999; Glaeser & Kahn , 2003). The massive use of the cars has a more pronounced effect on the shape of the city and the layout of public space with respect to the other transportation modes, because it eliminates almost totally the walking on. Moreover, the prevalent use of the car has induced the extension of the urban areas in all directions without a prevalent priority, it has encouraged the private motorized mobility with respect to the widespread accessibility and it has allowed the separation of functions. According to the ISFORT survey (2011), in the cities of central Italy, the share of proximity journeys lower of 2 km were just about 24.9% of the total, while for the short-haul journeys having a distance included between 3 and 5 km they were 22.9% of the total (Table 1).

In Municipalities with more than 250,000 inhabitants (i.e. Rome) in 2011, the proximity journeys were 31.1% and those of short-haul 25.8% (Table 2).

Therefore it is clear that even among proximity and short-range movements predominate the private motorized mobility. As a consequence, a reduced quality of life, social segregation – especially for people with a low level of self-sufficiency, and a reduced sense of community of residents are occurring (UN-HABITAT,2009; Appleyard,1981). Furthermore, the road network lost all hierarchical differentiations, standardizing itself on a model focused on movement and parking of motor vehicles, consequently reducing the degree of accessibility for the slow mobility. This led to a progressive impoverishment of the neighbourhoods that instead represent places of interaction for the individual well-being, community cohesion and urban vitality (Jacobs, 1961; Castells, 1997; Butler & Robson, 2003; Karsten, 2003; Danyluk & Ley, 2007; Raffestin, 1984).

Aim of paper

According to these analyses, we can think that a reduction of the car use is possible. This reduction could allow the reduction of the GHG emissions and traffic congestion. Moreover, it can be achieved the increase of slow mobility for travels occurring within and among neighbourhoods. Finally, this paper aims to highlight the role of cycling as an important carrier for a renewed layout and use of public space inside of neighbourhoods, in a way that neighbourhoods are more friendly and able to endure at the different needs of people.

Road Network as urban "vascular system"

Several studies highlighted four characteristics influencing the increase or reduction of the component of cycling mobility and walking: 1) functional aspects related to the structure of the settlement, 2) safety, 3) pleasure and 4) destination (Pikora, 2003). If we refer to the movement of proximity and short-haul, in order to give greater strength to walking and cycling mobility and, consequently, encouraging the public

Table 1 – Radius of mobility (journeys subdivided on the base of the path length - percentage value) (ISFORT, 2011).

	Prossimity (up to 2 km)	Short-haul (3-5 km)	Local (6-10 km)	Mid distance (11-50 km)	Long distance (more than 50 km)
Central Italy	24.90%	22.9%	22.08.00	26.3%	3.10%

Table 2 – Radius of mobility related to the demographic width of the cities (ISFORT, 2011).

Inhabitant number	Proximity (up to 2 km)	Short-haul (3-5 km)	Local (6-10 km)	Mid distance (11-50 km)	Long distance (more than 50 km)
Up to 5.000	21.7	15.5	22.1	37.0	3.7
From 5.001 to 20.000	7.4	20.1	21.1	28.2	3.3
From 20.001 to 50.000	32.4	23.3	20.6	20.5	3.2
From 50.001 to 250.000	31.7	27.2	20.6	18.2	2.3
Above 250.000	31.1	25.8	23.1	18.0	2.0

transport, it becomes crucial to give new and greater importance to public space of the neighbourhoods (Jacobs, 1961; Wellman, 1996; Castells, 1997). In fact, local dimensions allows to meet all the daily necessities of residents without the use of motor vehicles, seeking also relationships of greater proximity and effectiveness. The theme of accessibility can be treated considering both resources and residents distributions (Hansen, 1959; Horner, 2004; Krizek, 2005; Kwan et al., 2003), but it is equally important to consider the urban tissue characteristics, other than structures of the public space and road network. As in an organic body, the cardiovascular system distributes energy and materials to the cells, a road network (which is the major component of the public space) distributes energy, materials, and people in different places (Samaniego & Moses, 2008). If the space required for these transfers is not effective, the movements and relationships will not be effective (Samaniego & Moses, 2008). Analysing and working about the network space that connects people and places is thus a significant starting point to improve accessibility.

According to Allometry and Metabolic Scaling Theory (MST) in biology (Banavar et al.,1999; Brown et al.,2004; West et al.,1997) the characteristics of vascular networks determine, in an organism, its volume (Banavar et al.,1999; West et al.,1997), the velocity of the flows of energy and materials, growth (Moses et at.,2008; West et al.,2001), the duration of life (West & Brown, 2005) and other key features of the functioning of organisms (Brown & West,2000). Furthermore, Samaniego and Moses (2008) shows similarities existing among cities and organisms regarding metabolism, size of the system, network size, density and scale of prediction. The road network is equaled to the vascular system of organisms. This distributes energy to the cells as well as the road network distributes materials, people and energy in different urban places. As a consequence, to reconfigure the vehicular space can have a positive impact on the characteristics (i.e. social, economical and environmental ones) of the entire system. Samaniego and Moses (2008) points out that according to the MTS, the networks distributing energy are characterized by hierarchical branching. Similarly, urban road networks should distribute cars and people in the city through a hierarchical structure (Samaniego & Moses, 2008). The hierarchy of the parties is one of the network's characteristics, making thus it more effective. If characteristics, such as continuity, capillarity and recognizable hierarchy, are not fully included in a planning of the road network then this network will be low efficiency, with more energy consumption and harmful emissions. In addition, the economy decline is linked to the reduction of quality and accessibility of streetscapes (Hamilton-Ballie, 2008). The road network has lost all hierarchical rank mainly in the neighbourhoods and it is standardised towards a model that allows for a greater car-based mobility, but at the same time, it has reduced its accessibility. Thus searching for a high level of accessibility for the road network can be a starting point for reconnecting the broken linkages and increasing the overall connectivity. This systemic reconnection can help to ameliorate the well-being of communities and individuals.

Study area

The study area is the 13th District (Ostia) of Rome – Italy, where it has been carried out a design laboratory in the frame of an European project"VillemiZero". This is area has been urbanized after 1960 and it is representative of low-density settlements separated by agricultural enclaves (Figure 1). The 13th District covers an area of 15,064.27 hectares and it has a population density of 13.6 inhabitants per hectare, one of the lowest of Rome. It is connected to the city centre by an urban railway line, which is not adequate to sustain actual transport demand, favouring thus the use of private cars. In fact, data regarding to vehicles on the road show high levels of car ownership in Rome (Figs 2 and 3) that, proportionally, are typical of the 13th district too. The public space is largely vehicle space, without any continuity in walking routes and bicycle routes and spaces for public relationships are almost absent. Inside the 13th District is not traceable neither a well-defined structure of the public spaces system nor a widespread distribution of public services and commercial.

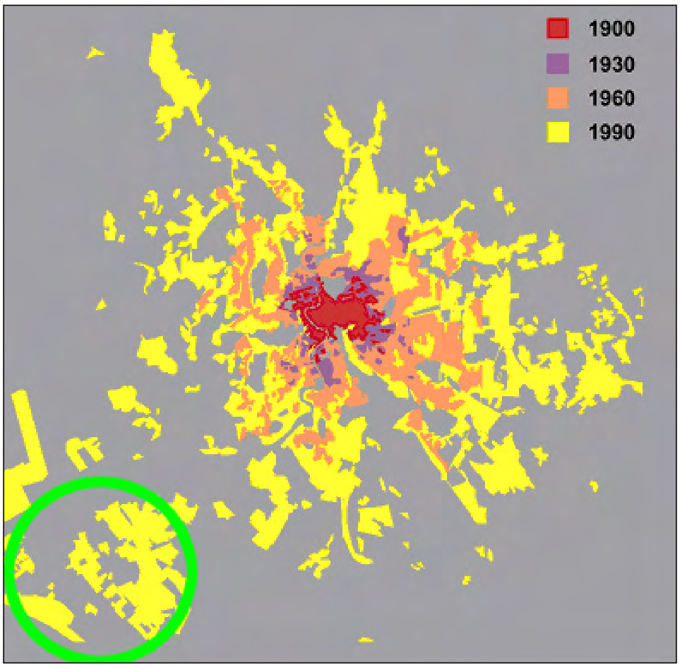

Figure 1 – Rome, urban growth between 1900 and 1990. Localization of the study area.

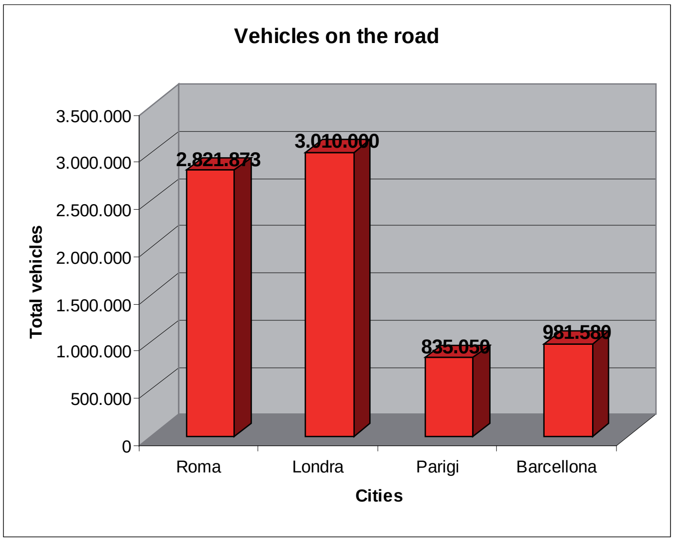

Figure 2 – Vehicles on the road; Source: Roma Capitale, 2011.

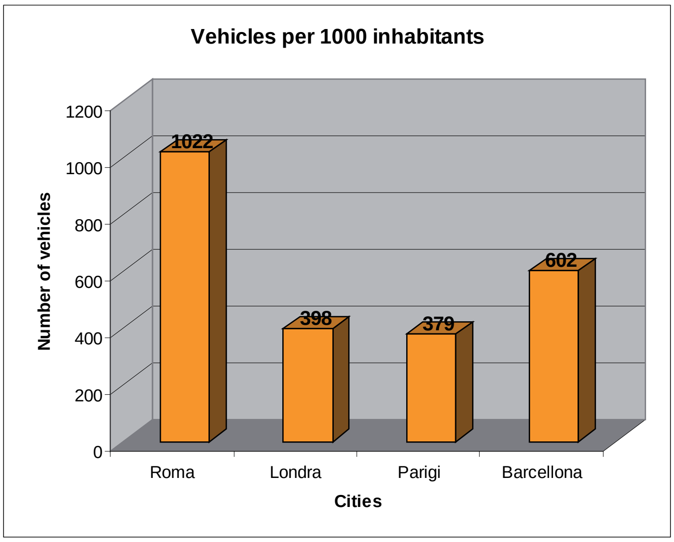

Figure 3 – Vehicles per 1000 inhabitants; Source: Roma Capitale, 2011.

Results and Discussions

The city of Rome has a road network of 8,752 kilometers inside the GRA (GRA), of which only a very small part is classified and belonging as main road (Table 3).

Table 3 – Existing road classification.

Existing road classification	
Main road	Highways
	High speed urban roads
	Inter-district roads
	District roads
	Inter-zonal roads
Local street	Local streets

The absence of capillarity and recognizability is confirmed by analysis of the road sections: technique (Figure 4) and perceptual analysis (Figures 5a, 5b, 5c). In relation to different uses of the road, the design of the spaces does not change, with great predominance to the needs of motorized vehicles. In this way, functional relationships among slow mobility, motorized mobility and social relationships needs are invariant, regardless of the different uses and functions of the urban space. On the other hand, these functional relationships are certainly different in the main streets and in local ones occurring as residential function. The main streets support high speeds, so they are used for movements of great magnitude. For these reasons, they have great dimension and width of roads. The difference between the speeds of the different transportation modalities is evident, therefore, it should prevail the flows separation. The local streets cover shorter distances, the width of road is reduced and the speeds are lower. Consequently, it should prevail the rule of space sharing among various traffic modalities . The reduction of traffic and speed levels is the better condition for increasing of the roads comfort and for sharing of the space (Harkey et al., 1998; Pikora et al., 2003). Furthermore, the reduction of the speeds makes possible a progressive diminution of the space required for the motorized vehicles' movement. This space could be used to give immediacy and continuity to the pedestrian and bicycle network (Burden et al., 1999; Pikota, 2003).In the frame of the pattern of movements, the main road represents the first level of the network, characterised by a reduced capillarity respect to the next levels and it can be constituted from different road types (these are also characterized by a certain hierarchy), which are recognizable among them and designed in accord to the needs, in order to accommodate the high speed traffic (protecting the near neighbourhoods) and the routes of public transport.

The traffic model of the road network inside the main routes, proper to the neighbourhoods, represents, instead, the secondary level. The latter is constituted by different levels with more and more capillarities and it is characterized by a less invasive and fast vehicular traffic, prevalence of slow mobility, more accessible spaces, a design of the road space more difficult to be used for the motorized vehicles, and liveable for the people.

This classification, however, has no value if it is not part of the road space design. A fundamental criteria for getting a resilient urban mobility system is that the road space have to influence the choice of the transportation modality (DfT, 2007). A capillary road hierarchy is characterised by a design that highlights roads with different uses and needs, their binding, and recognisable each to other.

The importance of a capillary road hierarchy is especially noticeable if the data of night accidents are analysed. In Rome, the 40% of all deaths occurred between 9 pm and 6 am, although the number of trips is much lower than during the day (Roma Capitale, 2011). These data show that in absence of a recognisable hierarchical network the speed limits are dictated by vehicle numbers on the road instead by the road shape. Moreover, the extensive use of the road signs does not ameliorate the safety on the roads. During the day, in the time frame of the systematic trips (home-school/work) there are less serious accidents, although these occur with great frequency. In fact, the circulating vehicles are numerous, the space available is less, as a consequence the speed is reduced and the gravity of accidents too.

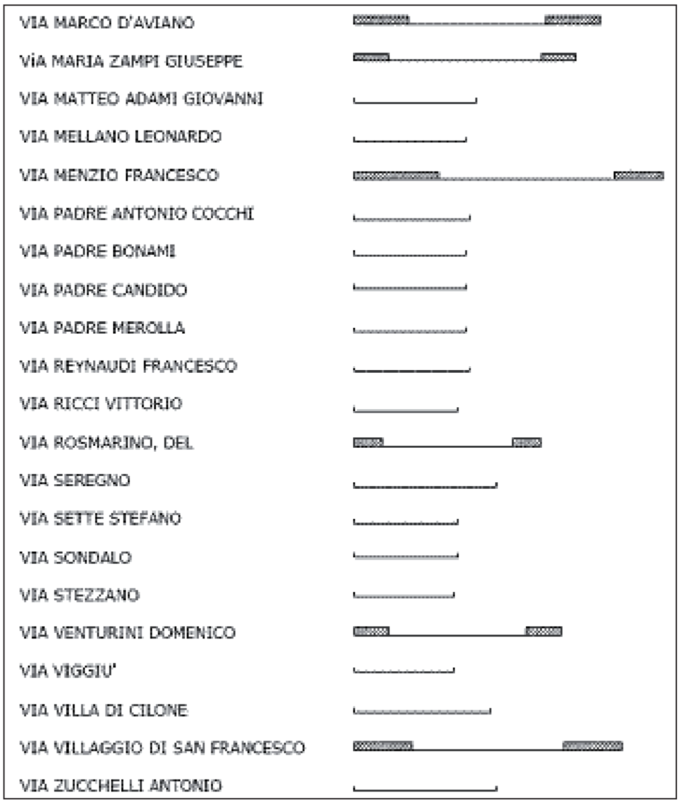

Figure 4 – Road sections of some local streets.

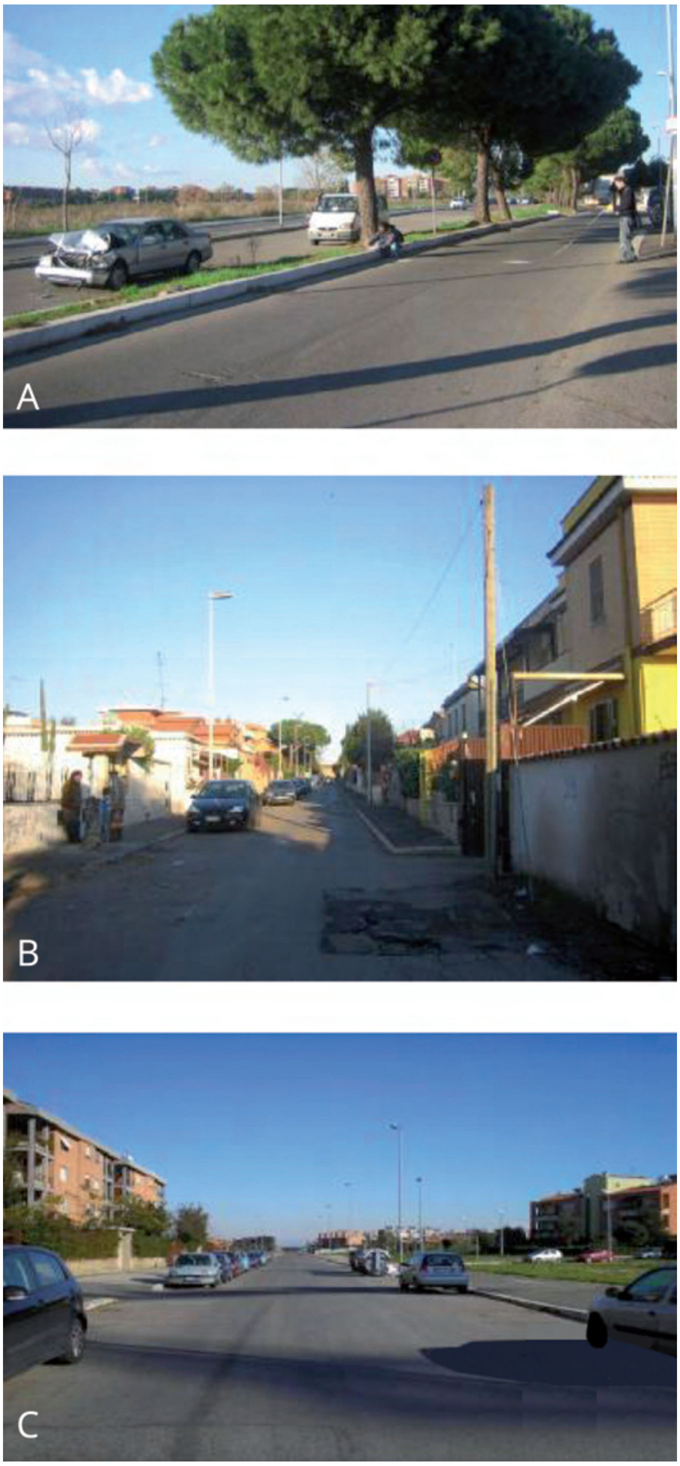

Figure 5 – A) Scrolling road; B) Interzonal road; C) Local street.

Generally, the design of the road should be aimed at ensuring the necessary space to all transportation modalities, but giving much more attention modalities with greater autonomy, low fuel consumption and emissions and low operational and management costs (Table 4).

Table 4 – Hierarchy of users of road space.

1	Pedestrians (spaces for moving and socialization/meeting)
2	Cyclists (spaces for moving and for parking)
3	Collective public transport
4	Service vehicles (Emergency vehicles, vehicles for waste collection, etc.)
5	Other transport modes (private cars, motorcycles, car-sharing, car-pooling, taxis, etc..)

This hierarchy should serve as a general remark and, on the basis of road section, traffic flows, existing services and equipment on the road, it should be planned urban spaces according to this hierarchy. Considering both road classification and different typologies of road users, the spaces for different traffic modes will be certainly different, ensuring that the design of the road space will be different and, therefore, recognizable. Under these conditions, the road space will have a higher level of attractiveness for pedestrians and cyclists. Consequently, the use of public transport will increase. In fact, a road network for the slow mobility will become most connected, permeable and continues. The latter encourages the pedestrian and cycling mobilities (Burden et al., 1999; Pikora, 2003), leading to a better distribution of motorized traffic throughout the road network (DfT, 2007), reducing the risk of accidents (York et al., 2007; DfT, 2007) and also resulting in a globally reduction of the urban pollution (Hawthorne, 1989). The increased travel by bike, as well as obviously those on foot, and with the public transport allows significant savings in greenhouse gas emissions. In fact, even if neither cycling nor the public transport are free from the production of carbon, these modes of transport produce approximately the 13.5 % of the emissions resulting from individual motorized transport (ECF, 2011).

In an interesting study, the ECF (2011) has calculated the impact of the production stages, maintenance, operation and fuel production for four different modes of transport: bicycle, assisted bicycles (*pedelec*), private car and bus. This represents a data relevant to allow assessment of the ability of reducing GHG emissions (Table 5).

The plan carried out on the territory of the 13th Districts of Rome has led to a classification of all roads in the District neighborhoods and reduce the percentage of travel by motorized vehicles on the distance of proximity or short haul. This reduction can contribute significantly to the reduction of energy consumption and GHG emissions thereby increasing the overall quality of the urban environment. Further changes that such interventions can bring concerns the revitalization of the local economy and social relations of proximity (Appleyard, 1981).

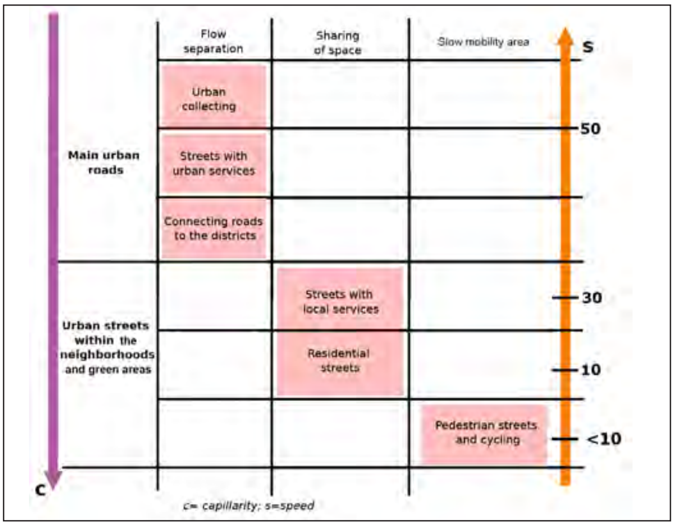

Figure 6 – Traffic pattern.

Table 5 – GhG emissions for the four different transport modes.

	Production and Maintenance phase	Operation and fuel production phase	Total
Bicycle	5 grams CO2e/km	16 grams CO2e/km	21 grams CO2e/km
Pedelec	16 grams CO2e/km	6 grams CO2e/km	22 grams CO2e/km
Car	42 g CO2e/km	229g CO2e/ passenger-kilometre	271g CO2e/passenger-kilometre
Bus	6g CO2e/ passenger-kilometre	95g CO2e/ passenger-kilometre	101g CO2e/passenger-kilometre

formulated according to the diagram shown in Figure 6. Although there are no central places (Colarossi, 2008; Cerasoli, 2008) it was possible to identify a continuous network, capillary and recognizable both on the cycling mobility (Figure 7).

Among the four characteristics that influence the increase or reduction of the component cycling and pedestrian, we have chosen to work on the functional feature, related to the structure of the settlement, safety and pleasure. In relation to the destination and hence to the dislocation of trade places, services and equipment to carry out daily life was not proposed any intervention because such proposals are not just about the sphere of spatial planning but also other relevant areas such as economic and social.

We have planned continuos networks for walking and cycling trips. So local services and equipment will be reached, however, in a more comfortable way and safe even if placed at a longer distance. These paths can be useful also as paths of adduction to public transport.

The main objective was to increase the accessibility inside the

Through actions that affecting layout and use of public space, without changing the density, with the aim of a change in the modal split in relation to the movement of proximity and short-range, in existing neighborhoods, it is possible a reduction of use of the car, the traffic congestion and, consequently, of the GHG emissions. Increases, at the same time, the efficiency of other modes of transport: collective public transport and slow mobility.

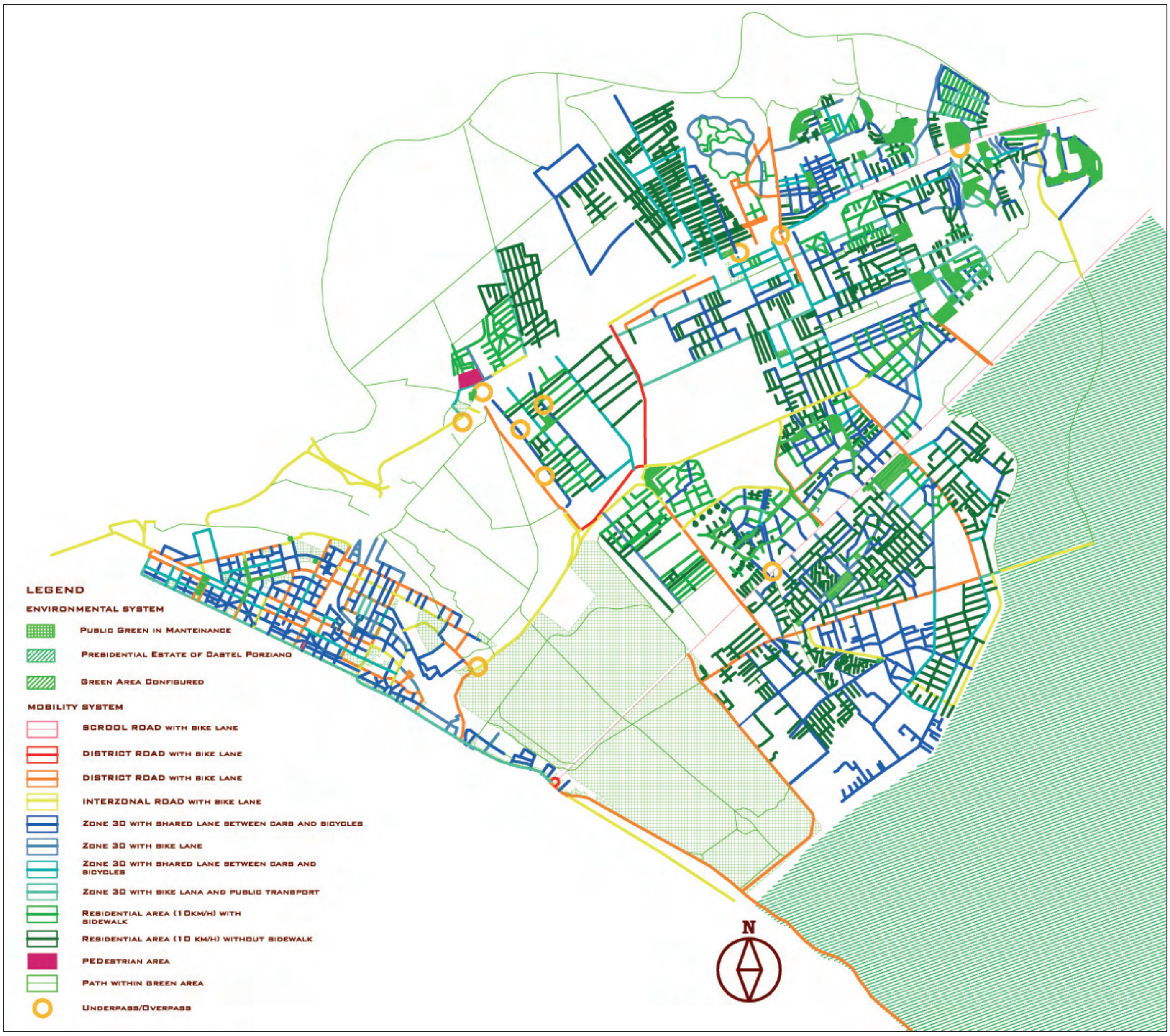

Figure 7 – Cycle network.

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