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Re-designing the Built Environment as a Strategic Tool for Anticipating Emergency Situations: The Greek Strategy for Dealing with COVID-19 Crisis

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Abstract
In recent years, there has been an exponential increase of hazards that may threat humanity in a global basis – depicting the correlation of climate crisis with the frequency and intensity of large-scale natural disasters recorded worldwide, like mega-fires, floods and hurricanes, with social, economic and environmental devastating consequences. However, apart from the aforementioned natural disasters and any possible technological hazards, humanity was recently threatened by the COVID-19 pandemic, facing the most challenging sanitary crisis of the latest years. Cities on a global scale need to adapt directly to the new extraordinary conditions, in order to meet the various challenges and minimize losses. The sudden and severe crisis of COVID-19 pandemic has highlighted the need for rapid adaptive measures in order to increase societies' coping capacity and strengthen urban resilience. In this paper, planning and re-designing of the existing built environment is proposed as a tool for anticipating a number of emergency situations that may arise in urban areas, including epidemic crises, whereby the case study presented concerns on Athens Metropolitan Area (AMA), in Greece. In this context, a number of pilot interventions have been proposed for the built environment in order to combat COVID-19 spreading, such as pop-up bike lanes, or pedestrian movement pathways, under the perspective of using less mass transportation means, supporting the "green transportation" of citizens, fostering well-being, securing undisrupted mobility of the supply chain, etc. All the above interventions could be seen as proposed good practices for cities' adaption to extreme conditions, tailor-made to their specific needs. However, the challenge that remains is how to easily apply measures that could be proven useful in any type of emergencies in ensuring sustainable urban resilience, e.g. use a pop-up bike lane initially designed to anticipate a lockdown, as an emergency lane for ambulances in case that a mass casualty earthquake strikes, among others.

Keywords: Built environment, crisis management, COVID-19, active mobility, urban resilience

1.0 INTRODUCTION

During the last decades, the recorded global climate deregulation has led to various hazards of the human and natural environment; the increasing severity and frequency of the observed extreme weather events, namely extended droughts, mega fires, flash floods etc., have been correlated to global warming, resulting to relevant emergency situations. However, recently humanity had to cope with an emerging emergency created by biological hazards: the global sanitary crisis due to COVID-19 pandemic that according to literature (Patsavoudi, 2020) is also correlated with climate change and the disturbance of the environmental balance.

Coronavirus outbreak forced the communities to horizontal lockdowns with the respective social and financial impacts; there was no prior experience in managing such a global emergency due to a novel virus. Emergency measures were immediately taken amidst the global lockdown, such as the use of protective equipment, social distancing, reducing the use of mass transportation means etc., according to the epidemiologists' guidelines (WHO, 2020). Obviously, such "isolation" measures and social distancing were more difficult to be applied to urban areas with dense population.

This paper proposes the planning and re-designing of the built environment as a crisis management tool for coping with emergency situations that may arise in urban areas, in order to encounter the challenge of creating resilient communities upon future hazards, including epidemic crises. Specifically, under the framework of a concrete national mobility strategic plan, a number of pilot interventions to the existing built environment are proposed to fight COVID-19 spreading, with the potential of their future re-enforcement under any type of urgent circumstances that may arise due to natural or man-made disasters. For example, the design of pop-up bike lanes and accessible pedestrian pathways could be used in case of pandemic, but also can generally contribute to Athens resilience strategy against future hazards, e.g. earthquakes, by securing the undisrupted mobility of the supply chain, ambulances movement etc. Moreover, the

proposed solutions are compatible with the "green transportation" and sustainable mobility concept for the citizens and the use of less mass transportation means, in line with the perspectives and goals set by the Hellenic Ministry of Environment and Energy.

The paper is structured as follows: Section 2 describes the background (the characteristics of the built environment and transport issues in Greece, as well as the role of sustainable urban mobility for making a city resistant upon disaster risks); Section 3 discusses the proposed methodology of pilot interventions for rendering cities resilient; Section 4 presents the case study of the city of Athens (application of the proposed methodology); Section 5 concludes the paper.

■2.0 BACKGROUND

2.1 Characteristics of the Built Environment and Transport Issues in Greece: The Athens Metropolitan Area

According to a survey by the United Nations (UN, 2014) almost 4% of the world's population now lives in urban areas. This number is expected to increase to 66% by 2050; forecasts show that urbanization combined with global population growth could add an additional 2.5 billion people to urban areas over the next thirty years, and by 2030 (Siountri & Vergados, 2019; UN, 2020). Focusing on Greece, the Hellenic Statistical Authority (ELSTAT, 2020) shows a 4.6% increase in Athens' urbanization rates during the decade 1990-2000.

Based on the urban forms and the respective characteristics described in literature (Milder, 2012), the majority of Greek cities resemble to diffused cities, combining features of multinuclear cities and marginal ones, mainly because they were formed in the absence of urban planning (only during the last three decades urban planning policies have been adopted), with many and long-lasting problems. More specifically, the structured environment in Greece is characterized a) by densely populated central areas with dense and high constructions, narrow street width, increased car traffic and lack of green spaces and b) by the diffusion of the suburbs with more loosely structured web with extensive on-street parking areas; lack of open spaces, low level of aesthetics in the building stock, degradation of the cultural heritage of historic centers, traffic congestion etc.

Zooming into Athens, the primary public transport network consists of fixed track media; urban and suburban lines, act as a tool for organizing the site, to support and stimulate relatively high residential densities and poles of attraction of mass movements. The network is divided into three sub-networks: Suburban Railway Network - Metro Network - Tram Network. There are currently three main metro lines while there are plans for two more. In some of the key transit hubs there are park & ride areas that in many cases are proven not sufficient to serve the users. In conjunction with the metro, the tram network covers the interconnection of the center of Athens with the coastal avenue and the development of a coastal line from Piraeus Port to southern suburbs.

The pedestrian network in Athens Metropolitan Area (AMA) can be characterized as problematic, as there are few pedestrian streets and insufficient or even non-existent sidewalks, discouraging people to walk. The inadequate sidewalk widths in Athens also create a sense of discomfort and unsafety. Similarly, bicycle lane networks exist in a few municipalities while a small part of the metropolitan bicycle network is developed. Like the pedestrian streets, these networks are not connected to each other and at the same time there are many individual sections resulting in large discontinuities.

Athens is generally a highly car-dependent city. Although a number of transport infrastructures have been built the last 15 years, like Attiki Odos (the mayor peri-urban highway), there are still serious mobility and accessibility issues since there was no consideration of integrating sustainable urban mobility plans (SUMPs) (Bakogiannis & Siti, 2014). Encouragingly though, in 2012 the "strategic plan for transportation and sustainable mobility in Athens" was introduced for the first time as part of the strategic plan of Athens, and in 2013, a bike sharing system in the Municipality of Athens was strongly debated. Towards the implementation of such plans, there is a need of transformations in regard to the management of public transport, the development of an extended cycling network, the systematic upgrade of public spaces and the establishment of an integrated pedestrian network; though, the change of planning mentality and development of priorities is considered the more critical aspect. The expected benefits from the application of SUMP, apart from the energy saving, reduce in mobility costs and increase in social cohesion, is also the increased capacity of a city against exceptional conditions, like the ones that arise in case of emergencies; the latter will be analyzed in this paper.

2.2 Coping Capacity of Cities upon Emerging Risks: The Role of Sustainable Urban Mobility

According to the World Health Organization (WHO), "emergencies are situations that arise out of disasters, in which the affected community's ability to cope has been overwhelmed, and where rapid and effective action is required to prevent further loss of life and livelihood", although both emergencies and disasters demand fast responses, one can be prepared for emergencies but not for disasters. The United Nations Office for Disaster Risk Reduction defines disasters as "a result of the combination of the exposure to a hazard, the conditions of vulnerability that are present and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation" (UNISDR, 2015). According to a recent report by the UN Office for Disaster Risk Reduction (UNISDR, 2015) natural disasters have killed 1.3 million people over the last 20 years and left a further 4.4 billion injured, homeless or in need of emergency assistance; earthquakes and tsunamis, floods, storms, droughts, heatwaves and other extreme weather events (Wallemacq, 2018). It seems that making cities and human settlements inclusive, safe, resilient and sustainable seems the main challenge of these days, considering also the recent pandemic crisis.

Specifically, the population density of an urban area along with the specific characteristics of the built environment are considered crucial for the coping capacity of urban and suburban areas against disaster risks. According to a survey by the United Nations, it seems that 54% of the world's population now lives in urban areas and this number is expected to increase to 66% by 2050; rapid urbanization is

resulting into a growing number of overburdened infrastructure and services, air pollution elevation and unplanned urban dispersion (see UN, 2020). The rapid growth and inadequate urban planning make cities more vulnerable to disasters, e.g. a significant number of catastrophic wildland urban interface (WUI) fires have been recorded in a global level the last five years with many casualties and property losses (Karma et al., 2019); estimates suggest that by 2050, urban population exposed to cyclones will increase from 310 million to 680 million while exposure to major earthquake will increase from 370 million to 870 million (UNDRR, 2020). In that context, urban resilience is directly correlated with the city shape, in terms of presence or absence of urban planning (Stead & Nadin, 2008). Strengthening the local capacity by appropriate housing, disaster-preparedness, infrastructure and livelihoods is substantial for improving civic resilience to disasters (Pelling, 2003). It should be emphasized that vulnerable groups of population, such as people with disabilities face higher risks in case a disaster strikes since in most cases they are not well prepared for disasters, i.e. evacuation of buildings in case of an earthquake or a fire (Karma et al., 2016); there are still a lot of issues to consider in order to improve emergency preparedness for people with disabilities (Alexander & Sagramola, 2014); accessibility of the built environment is a key element for inclusive prevention and mitigation.

Based on the experience of the recent COVID-19 outbreak, the functionalities of public spaces, such as gatherings and social activities have been disturbed; during the quarantine, restrictive measures banning traffic and suspending the operation of businesses, as well as any form of social and cultural activity were taken horizontally in Greece, like many other countries around the world, in order to combat the infectious disease based on the WHO guidelines. Specific measures were taken like (a) limited transportations; citizens should minimize car trips with restricted number of passengers (b) restrictions in public transport systems (c) limitations in food and medicine deliveries (d) limitations in the operation of public services, health units and schools (e) social distancing; the two meters distance proved mandatory among individuals and at the same time access to crowded meeting places was limited, i.e. parks, basketball courts, playgrounds, beaches, etc. However, the urban areas are usually less flexible for adaptation to new extraordinary conditions, as those set out by COVID-19 pandemic. In most of them, the management of the sudden change of inhabitants' lifestyle and the organization of their functionalities in terms of using public spaces, transport network, socializing etc., due to their specific structural characteristics is critical; people still feel the need to visit open spaces, go to work or get entertained.

After most epidemics or similar disasters, the city fabric changes, the quarantine sanitization alters the cities and in several cases such phenomena have shaped the modern metropolis and the density standards we apply. As Hooper (2018) argues, there is a correlation between urban density perceptions with respect to hygienic primes. Similarly, transportation trends alter the way we move through and work, and as Shenker (2020) notes some are wondering which of these adjustments will endure beyond the end of the pandemic. During the recent quarantine, many citizens chose the "active transport" alternative, i.e. cycling and walking, instead of using public transportation means. This different type of transportation that is against the dominant car-centric culture of the last decades, seems also to have been proved beneficial for the environment, since it contributed to air pollution reduction in a global basis (Enoch & Warren, 2020; Hernandez, 2020). Hence, a policy shift towards active mobility could prevent the "freezing" of a city's activities and at the same time may endorse its coping capacity against emerging risks. Davies (2020) considers that the pandemic could be an opportunity to remake cities and many urbanists see a chance to save city dwellers not just from the sweep of a pandemic, but from the auto-centric culture that has dominated urban life for decades.

Since the built environment is already structured, the redesigning of the public space seems a substantial solution in order to achieve whenever needed active transport; create pedestrian and bicycle traffic networks without discontinuities and difficulties; connect main nodes and open spaces with critical infrastructures like hospitals and health units etc. This redesigning concept that will be presented in this paper actually has a dual benefit: (a) It can increase the urban resilience in case of emergency (b) the pattern of movement and transportation can change depending on how a city returns to "normal" after a lockdown. The main challenge though, is to reserve the active mobility functionality of a city even after the end of the emergency, as it contributes to overall health and environmental benefits. In the following paragraphs a number of proposed solutions for making a city adaptable to emergency conditions are described, based on the transport characteristics of the majority of the Greek cities described above.

2.2.1 The Solution of Temporary Bicycle Lanes and the Expected Benefits

In Greece, bicycle transportation is extremely limited due to a variety of problems related to the lack of infrastructure, the extended occupation of public space by motor traffic, the high traffic speeds and the deficient public transport networks that leads to car dependence; limited pro-cycling culture of the citizens. Moreover, many Greek Municipalities have only master plans for bicycle networks, without mature studies for their implementation. Significant additional problems arise from the current technical specifications of the bike lanes, which require geometric features that are almost impossible to integrate into the small widths of most Greek roads.

The measure of "social distancing" among citizens, which was imposed due to COVID-19 pandemic, discouraged many commuters to use public transport or shared travel by car. Active mobility, like walking and cycling was favored instead, during the lockdown period; active mobility is considered environmentally friendly, particularly economical compared to other modes of transport and at the same time promotes the public health; as evidenced by numerous studies it has a positive impact on local economies and contributes to the good health (such as heart disease, stroke, cancer, obesity and type 2 diabetes etc.), as well as the psychology and social cohesion of citizens (Avila-Palencia et al., 2017; NICE, 2012),. It also leads to the reduction of pollution since it is considered environmental friendly, as it was also proved during the first pandemic outbreak (Enoch & Warren, 2020; Hernandez, 2020).

In this direction, the solution of popup bike lanes may serve to enhance bicycle use, both for movement and leisure, with the prospect of becoming permanent after proper modifications and adjustment to the urban environment special characteristics. Emergency interventions for boosting bicycle transportation through low-cost infrastructure, may guarantee safe bicycle travel and at the same time it can "educate" the commuters to support their future integration into the daily operation of the city. Many cities in the world decided to create such pop-up bike infrastructure with Berlin, Milan, Paris, Bogota and Lisbon being the exemplar showcases. In this direction a

number of technical resources and design guides were issued to support the quick-built solutions (NACTO, 2020; SenUVK, 2020). In particular, the development of emergency bike lanes on major highways is expected to decongest urban centers and make cycling more attractive and recognizable to new users. The integration of lanes into local roads with the abolition of parking lanes is expected to give a significant boost to the efficiency of road space for the benefit of active commuting. Additional benefits of cycling infrastructure include: (a) reducing congestion and illegal parking; (b) reducing air and noise pollution; and (c) improving the mobility of vulnerable users, like wheelchair users and impaired people.

Such contemporary pop-up lanes have been applied before in numerous cities in the world following the tactical urbanism approaches and activating cities and neighborhoods, as argued in a book by Lydon and Garcia (2015). The most important thing is that pop-up bike lanes can contribute to the undisrupted mobility inside the urban environment and hence, be leveraged in any type of emergency, including possible future lockdowns. Specifically, the bicycle lanes can be used as emergency channels for the evacuation of people and for reaching safe places and shelters to anticipate any types of hazards and threats; unobstructed movement of ambulances for the admission of victims to hospitals after a disaster strikes; smooth transportation of goods and equipment. All the above benefits of bike-lanes confirm the necessity of their integration to the urban environment; permanence of such temporal interventions seems substantial for the cities' adaptability to disasters risks, as well as for their sustainability.

2.2.2 The Solution of Temporary Pedestrian Lanes

During the first coronavirus outbreak, the public "attention" was turned to the city neighborhoods. Indeed, the inmates didn't use their car but they went out instead for short walks in the neighborhood, they discovered new places and new neighbors. They also found that walking is a very difficult exercise when the sidewalks are narrow, but since there were few vehicles they found the solution to walk on the street. Now, after the lockdown in Greece the cars have started circulating again and the sidewalks obviously remain the same.

In case of emergency, extending the width of the existing sidewalks seems to be the better solution in order to manage population flows, since it provides with enough space for the pedestrians to evacuate; walking might be the only alternative for transportation in case of a disaster, e.g. in case of an earthquake, since the traffic network is usually stuck. In the above context, temporary pedestrian lanes could be a solution; for example, pop-up pedestrian corridors could be formulated by using part of the road function. Another solution could be the coexistence of pedestrians and vehicles after traffic calming measures and new speed limits (30 km/h).

■3.0 PROPOSED METHODOLOGY FOR PILOT INTERVENTIONS TO COMBAT DISASTER RISKS

As already mentioned the recent global outbreak of the Coronavirus Disease (COVID-19) led the Hellenic Authorities to impose strict measures in order to reduce the effects of the pandemic, to protect public health and to better manage the available resources. As far as it concerns the public transportation, the real challenge at this stage was to improve the quality of the public space for the pedestrians and cyclists, as well as to encourage active mobility in comparison of public transportation, where there is a greater risk for infectious diseases as people sit or stand in proximity, in a closed environment (Peeri et al., 2020).

Under the extraordinary conditions of a crisis, such as the Covid-19 pandemic, new forms of organization of spatial, thematic and quality networks of "urban space" are necessary. Specifically, the Department of Spatial Planning and Urban Environment of the Hellenic Ministry of Environment and Energy, which is the responsible authority for urban planning, has promoted the completion of spatial planning at all levels, from spatial to urban; recently the drafting of Local Urban Plans has been intensified. However, this design and implementation takes time, and the problems posed by the pandemic have created the demand for fast, cost-effective, and at the same time feasible and attractive solutions. The goal to be achieved is a realistic action plan to strengthen urban resilience, so that Greek cities as a whole, residents, communities, institutions, businesses and structures can survive, adapt and evolve regardless of chronic pressures and emergencies.

Urban resilience is inextricably linked to the crucial role that public space plays in dominant urban policies. The fact that a large part of the daily commutes concerns short and medium distances (especially in small and medium cities) strengthened the feasibility of such an action plan by the Ministry of Environment and Energy focusing on the redesign of the street space. The benefits of a number of related interventions that have been implemented in many cities internationally against COVID-19 spreading are various, covering a wide range of environmental, economic and social benefits, e.g. the pop up "corona cycle way" in Paris (Reid, 2020), the transformation of roads into bike lanes in Germany to help people keep their distance from one another during the coronavirus lockdown (Lovett, 2020) and others of the ilk.

The transformation of urban mobility aiming at sustainable urban resilience can be used as a strategic tool for encountering virus pandemics or other emergencies. For the above reason, the local authorities have been endorsed towards making changes in the urban environment, with a series of easy, cost-free, quick-built and flexible interventions in their public space, in order to give more space to pedestrians and cyclists, fostering at the same time the expansion of green areas. The "Technical Instructions for the development of temporary pedestrian corridors, temporary bicycle lanes and temporary creation of traffic calmed areas or traffic calmed roads with a reduction of the speed limit to thirty (30) km/h, on local roads or in residential areas" was a new guide that was published after the Ministerial Decision of Hellenic Ministry of Environment and Energy 2448/B/19-6-2020, in order to set the relevant guidelines, following the international practice of similar guides in Berlin and in the USA (NACTO, 2020; SenUVK, 2020).

The aforementioned Technical Instructions aim to function as a particularly useful tool that will provide with a new perspective for greener and more sustainable cities, which may help the inhabitants recover from the problems caused by the Corona Virus. Also, these guidelines may be used as an additional tool for facing the climate deregulation impacts.

In the following paragraph, the specific methodology for preparing and implementing the pilot interventions towards urban resilience are described; the proposed criteria are based on the Technical Instructions issued by the Hellenic Ministry of Environment and Energy.

Specifically, a methodology has been proposed in order the local authorities to be able to develop and implement a specific redesigning strategic plan; the exact steps to follow are resumed in Figure 1.

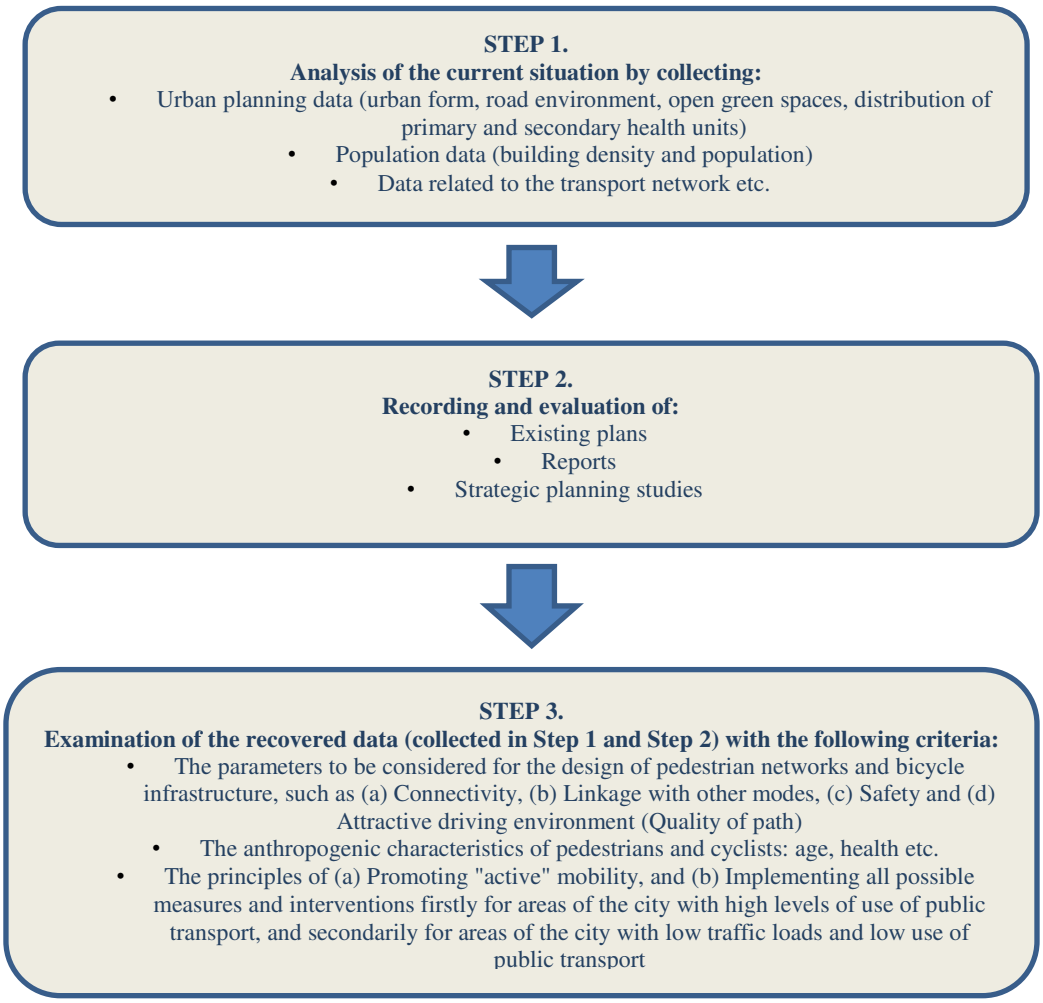

Figure 1 Flowchart of the methodology proposed by the Hellenic Ministry of Environment and Energy for preparing pilot interventions in order to increase adaptability of the cities upon emerging risks

At the beginning, (Step 1) analysis of the current situation is required, such as collection of urban planning data (urban form, road environment, open green spaces, distribution of primary and secondary health units), population data (building density and population) and data related to the transport network etc. Then follows the recording and evaluation of all existing plans, reports and strategic planning studies and adoption of relevant proposals (Step 2). At the end, (Step 3) there must be an examination of the recovered data (collected in Step 1 and Step 2), taking into consideration of the subsequent criteria:

a. The parameters to be considered for the design of pedestrian networks and bicycle infrastructure, such as (a) Connectivity, which is achieved by adequate space, network continuity and lack of barriers, (b) Linkage with other modes, (c) Safety and (d) Attractive driving environment (Quality of path).

b. The anthropogenic characteristics of pedestrians and cyclists: age, health, physical condition and resistance to adverse conditions, height, reflexes, visual perception, concentration, balance, perception of the speed of passing vehicles.

c. The principles of (a) Promoting "active" mobility, and (b) Implementing all possible measures and interventions firstly for areas of the city with high levels of use of public transport, and secondarily for areas of the city with low traffic loads and low use of public transport.

However, the question that arises is where it is possible to find the required space for the necessary interventions, without demolition of the buildings, taking into deep consideration the absence of the necessary spaces and the lack of data of their specific characteristics. The answer to the above is to reserve space that is currently used by the car (movement and parking), taking into account to avoid causing serious traffic jams, or risking the road safety, ensuring the unimpeded movement of all road network users.

At the same time, a strategic plan must create pedestrian and cyclist traffic networks without discontinuities´combined with stops of means of public transport, transfer nodes, free open public spaces and access to primary and secondary health units etc.

The space required for pedestrian and bicycle mobility can be saved in the following ways:

- Temporary removal of individual parking spaces or a parking lane.

- Limiting the width of the lanes
- Removal of stopping places - loading and unloading away from the sidewalk in combination with occupying parking spaces
- Reduction of speed limits on local roads in order to increase their use by pedestrians who are forced to walk on the road
- Exclusion of the entire traffic lane or the entire road from the car traffic.

Depending on the width of the road and the traffic data, there are three main types of road network redesign methods: The first case concerns one-way or two-way roads, or streets with more than one lane in each direction. The acquisition of space is carried out by removing a traffic lane 3-3.5m wide which is assigned for use either only to pedestrians, or only to cyclists, or both. It is not considered appropriate to apply for part of the lane (i.e. the two meters of a lane), as the remaining width is considered to give impetus to cars to increase their speed or even park illegally, and is therefore considered dangerous. The second case concerns two-way roads with one lane in each direction. The acquisition of space is managed by the convention of the street to one-way. The lane of the abolished direction is assigned to pedestrians or cyclists or to both. The third case concerns one-way streets with parking zone on one or both sides. Regardless of the available width of the road destined to motorized traffic, the coexistence of bicycles with other vehicles is allowed. If the width of the road is greater than 3.5m when a car appears behind bicycles, they move to the side to give the car space to overtake them. If the width is less than 3.5m or designed accordingly, then the road is defined as a 'cycling street' and cars are required to follow the leading bicycle. A precondition for the above is the institutionalization of the road on a road with light traffic with a speed limit of 30 km / h or less.

The advantages of the proposed interventions include the low cost, the speed of implementation, the flexibility of the constructions - interventions and the possibility of their periodic transfer and adaptability according to the needs. It is also advisable to combine the proposed interventions (a) with any strategic mobility plan e.g. Sustainable Urban Mobility Plan (SUMP) (Bakogiannis et al., 2019), or urban regeneration - urban revitalization program, (b) with simultaneous and immediate change of the speed limit to 30km / h or less at local roads and urban areas where there is increased interaction between vehicles and vulnerable users, and (c) with traffic regulations in areas with heavy traffic of pedestrians and especially children, the elderly, parents with prams, travelers etc. and (d) with elements separating the area of the movement for pedestrians and cyclists from the area of motorized traffic, as far as it is possible.

The above planning of pilot interventions prepared and proposed by the Hellenic Ministry of Environment and Energy in terms of development of temporary bicycle lanes, temporary extensions of sidewalks & pedestrian lanes, as well as of traffic calmed streets and neighborhoods, could be considered as suggested good practice for coping with emergency situations; they can be tailormade to the specific needs of each city that has to be redesigned in order to become more resilient upon disaster risks; a number of tools and practices to promote walking and walkability can also be found in literature (Alvanides, 2018; Dannenberg et al., 2017).

■4.0 CASE STUDY: THE EXAMPLE OF ATHENS METROPOLITAN AREA (AMA)

The case study on the Athens Metropolitan Area (AMA) that will be presented in this section is partially based on the methodology described in Section 3, as well as on the basic principles of the Athens Master Plan (AMP) - AMP is known as the Regulatory (or Strategic) Plan of Athens (Law No. 4277/2014 – refer to https://www.taxheaven.gr/law/4277/2014) that constitutes a set of objectives, policy guidelines, priorities, measures and programs provided by this law as necessary for the spatial, urban and residential organization of Attica and the protection of the environment, within the framework of the principle of sustainable development. Its scope is the entire Region of Attica, as defined by Law 3852/2010, which is defined as the Metropolitan Area of Athens. The last institutionalized Master Plan dates back to 2014 and the Draft Law on the updated Master Plan for 2021 is completed. According to AMP, "*Athens / Attica as the main metropolitan center of the country plays an expanded role in the context of the international economic environment and seeks to function as a lever for development and improvement of competitiveness for the entire national space*". In addition, an action plan is foreseen for the redesigning of high-risk areas due to their vulnerability upon natural, technological or other risks.

Priority is given to urban centers with insufficient infrastructure, areas with old building stock, declining uses of the secondary sector, with high density and intense traffic and parking problems; adapting the operation of the transport system, including ports and airports, to emergency operations due to natural or man-made disasters etc.; e.g. preparation of vulnerability maps to anticipate flood risks (see Law No. 4277/2014 New Master Plan of Athens - Attica and other provisions [https://www.taxheaven.gr/law/4277/2014]). In the above context and following the guidelines presented at Step 1 of the methodology in Section 3 (Figure 1), the redesigning strategic plan that was prepared of the AMA is resumed below; analysis of the current situation by collecting urban planning data, population data, data related to the transport network etc.

4.1 Urban Planning, Population and Building Density Data

The form of the metropolitan complex of Athens can be described as "multipolar" as it has two main major poles; Athens and Piraeus and at least ten medium-sized inter-municipal centers. The five Regional Units include municipalities with similar characteristics, due to their geographical distribution as well as their socio-economic data.

The population size of AMA, based on ESTATS's 2011 record, amounts to 3,828,434 inhabitants, but the municipalities of individual municipalities differ significantly from each other. By comparison, the Municipality of Athens has 664,046 inhabitants, while in some municipalities/communities that are more remote from the center (e.g. North Attica) the population does not exceed 2,000 inhabitants (Prastakos & Lagaris, 2019).

However, the distribution of residents is not homogeneous; the differences in the building density from region to region are very significant. Overall, in AMA the average population density reaches 7,506,55m/sq km. The population density of Attica is 47

inhabitants/ha of a built area (ha). In Central, Western and Southern Athens and Piraeus, however, the population densities exceed 100 inhabitants/ha. The density is significantly lower in Northern Athens (64 inhabitants/ha), while in peri-urban areas the density does not exceed 16 inhabitants/ha (Prastakos & Lagaris, 2019).

The building density is analogue to population density. Thus, in the Central, Western and Southern Sector of Athens and Piraeus the urban fabric has a very dense structure that reaches about 100%. The corresponding percentage in the North Sector of Athens is 50%.

Similarly, the characteristics of the dwellings in the eleven (11) spatial units defined in the Master Plan are varied in terms of the time and quality of construction. Two out of three (65% in total) of Attica's houses are located in the four more densely built areas and they comprise 72% of urban constructions.

4.2 Transport – Mobility – Network Data

As already mentioned in Section 2.1, Athens is generally considered as a highly car-dependent city, with a lot of problems in terms of mobility and accessibility; the lack of sustainable urban mobility strategic plans (SUMPs) until the year 2012, has significantly contributed to the current city shape. In terms of public transport network and policies, there are proposals still pending regarding the expansion of the existing bus network, the modernization of operating systems with telematics, etc.; the underground infrastructures, e.g. metro, seem to be favored compared to ground infrastructures, e.g. tram and bus network (Bakogiannis & Siti, 2014). Regarding cycling, it seems that there is a slow progress with a number of municipalities acting pro cycling, though encountering a number of administration issues.

In total, transport infrastructure covers 20% of the structured surface of each spatial unit of the Master Plan. The road network serving the main traffic flows is prioritized in (a) axes of interregional interest and primary axes of Metropolitan interest, which act as main distributors for the main entrance flows to the core of the urban complex perimeter rings, as well as to the central area, (b) secondary axes of Metropolitan interest , which constitute the basic network of further distribution of movements between individual urban units and centers of the Spatial Unit of Athens and the Piraeus Port, (c) urban avenues which include arteries that axially form a sequence of central districts or areas (MPA, 2014).

The sidewalks of the capital's metropolitan complex, as described in Section 2.2.2, for the most part, except for some large axes (e.g. the center of Athens) do not meet the criteria of an accessible and walkable city. This means that the majority of them do not meet the requirement of free pedestrian roads, with a width of at least 1,50m net and free from all kinds of obstacles, or of structures that ensure accessibility (disabled ramps, blind roads, signage for all categories of disabled people, pedestrian crossings, etc.), that would require a large proportion of roads to be devoid for pavement use.

Also, the potential for the development of large on-street bike lanes and the coexistence of bicycles with motor vehicles in cycle streets or traffic calmed routes, as well as the development of bicycle parking spaces, have not been exploited. Indicatively, the following graph (Figure 2) shows the width of the sidewalks in the Municipality of Athens.

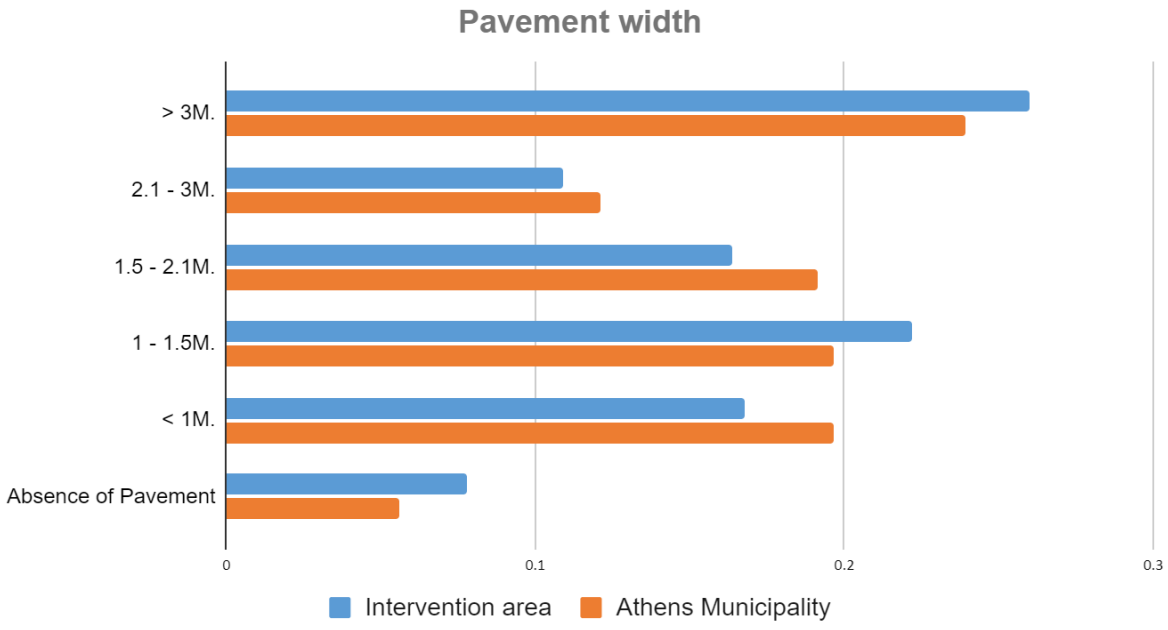

Figure 2 Sidewalks' width data in the Municipality of Athens (red) and in AMA (blue)
(Source: Sustainable Mobility Unit (n.d.))

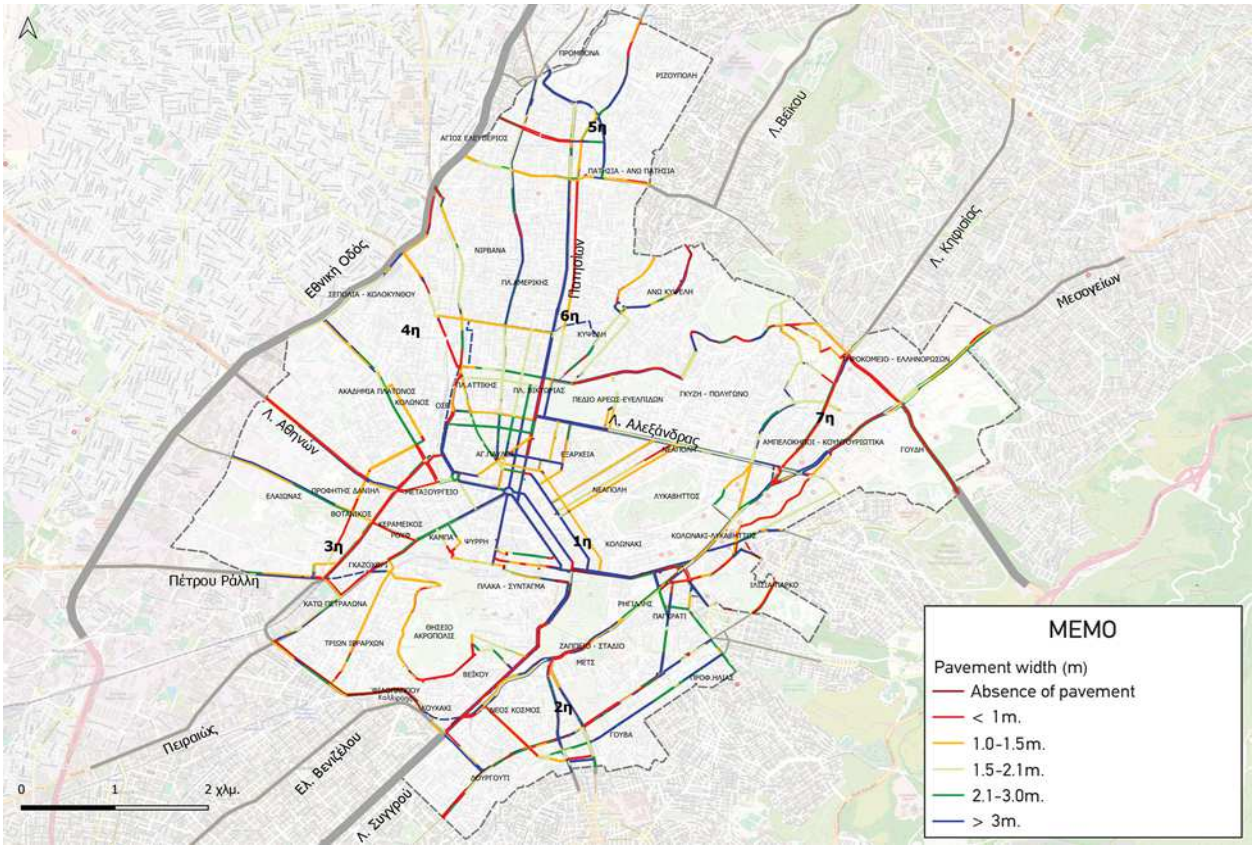

Figure 3 Indicative map of Athens Municipality Area presenting the widths of existing pedestrian lanes in different colors: red (<1m); orange (1.0-1.5m); green (1.5-3.0m); blue (>3m)
(Source: Sustainable Mobility Unit (n.d.))

In Figure 3, there is an indicative map of Athens Municipality Area, where the widths of existing pedestrian lanes are highlighted; the red and orange ones (below 1-1.5 m) need to be broadened; the green and blue ones (2-3 m or >3m) could be used as escape routes that may lead to safe places e.g. nearby green areas (see Figure 4), in case of emergency.

4.3 Open Public Spaces - Green Areas

The urban squares within the AMA are also limited in both size and number. The recording of the open public spaces (shares spaces) carried out by the Research Programme of the Urban Environment Laboratory of the School of Architecture, National Technical University of Athens entitled "Protection and upgrading of green spaces in metropolitan Athens" (http://www.arch.ntua.gr/en/node/853) shows that in almost all municipalities there are at least one to two urban squares; in several there is also a third, and in a few exceptions, there is none. The majority of the squares (almost 70%) are in size ranging from 1-10 acres, while the rest have a size ranging from 10-100 acres. Sizes greater than 100 acres concern green spaces along the coastal areas, though few in number. According to Belavilas et al. (2012), the green areas within the AMA include:

- urban parks and gardens, linked to the archaeological zone and the green hill range of central Athens,
- district groves and parks built in the 30s or 40s,
- district groves and parks built after 1975 in former industrial of military sites,
- large landscaped or under development metropolitan parks of the last phase of the 20th century and the "Olympic" period.

In total, the registered free spaces currently account for 2.95% of Athens' urban conurbation and yield approximately 3.84 m2 of free spaces/ resident.

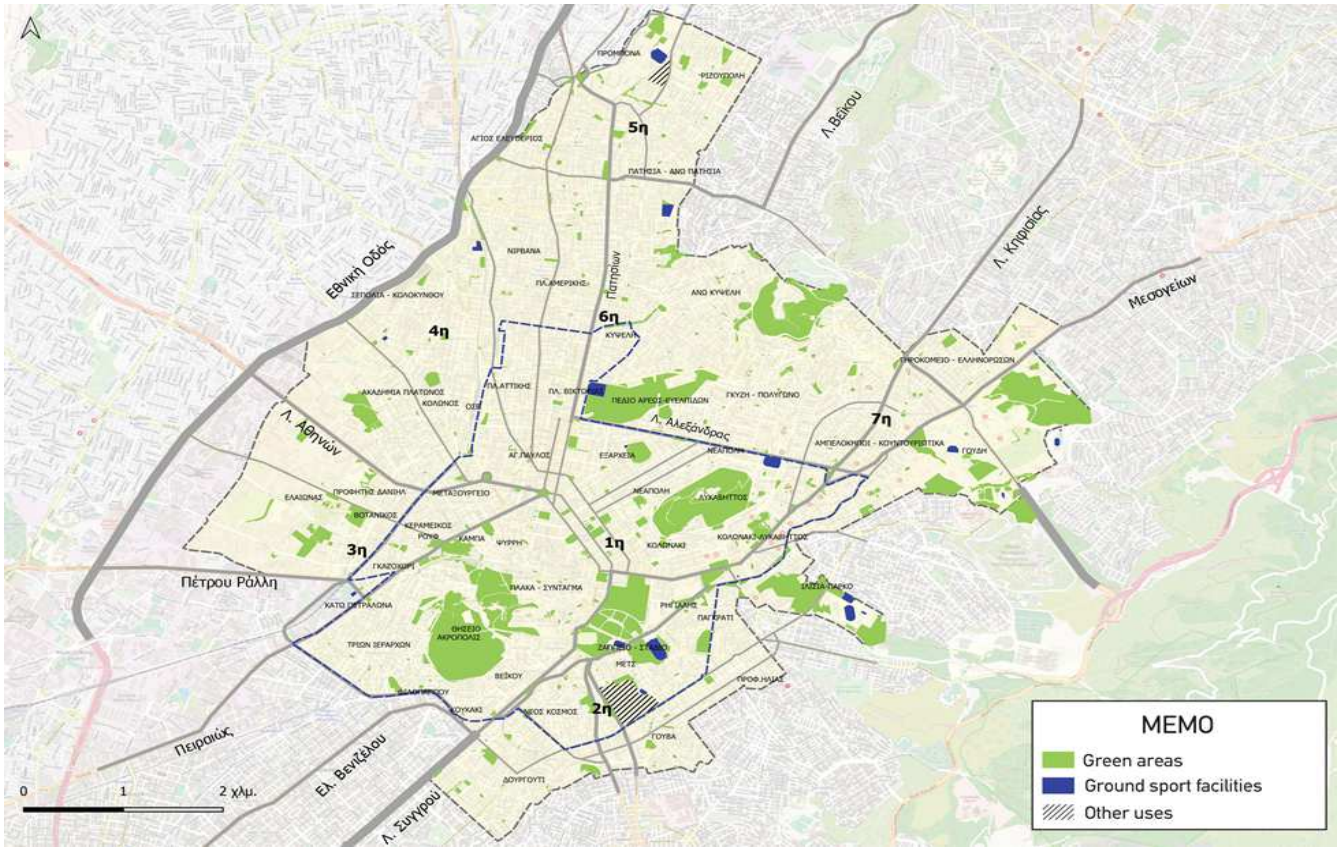

Figure 4 Green areas and outdoor sport facilities in Athens Municipality Area that can be used in case of emergency as shelters or refugee areas
(Source: Sustainable Mobility Unit (n.d.))

Generally, the use of open public spaces and green areas is crucial in case of an emergency; they are considered as refuge areas or shelters e.g. after an earthquake; they can be utilized for temporary accommodation and rescue activities during disaster situations (Wei et al, 2020). In Figure 4, the green areas (in green color) and open public spaces (outdoor sports facilities in blue color) are indicated for the Athens Municipality Area.

It should be emphasized that the accessibility of such places is vital aligned with the design for all perspective; inclusive safe sheltering in case of an emergency.

4.4 Health Infrastructure

As of 2017, according to the Hellenic Ministry of Health, the Region of Attica counts approximately 14 Health Centers and 11 regional dispensaries, while the capacity of its hospitals amounts to 14,775 beds. The spatial distribution of the major health service providers focuses mainly on the main urban area; some of the spatial sub-sections of Attica are also covered (e.g. through the Elefsina Hospital). However, the largest hospitals are located in Athens and Piraeus.

4.5 Draft Assessment of the Data Recorded for the AMA

The above data file recorded for the AMA provides with useful information for planning and re-designing of the Athens built environment; although the present case study focuses on the COVID-19 case it has to be emphasized that it could be used as a strategic template for anticipating any type of emergency situations in the future. The main achievement is the sustainable active mobility through interventions that ensure alternative types of movement, like walking or biking, having also a number of secondary benefits; the most important is the air quality improvement which is crucial especially for the citizens of populated cities with a lot of traffic jam, like Athens.

AMA data recording provided with significant information regarding possible shelters and refuge areas that could be utilized in case of emergency in Athens; specific characteristics in terms of transport network, sidewalks and pavements can also be utilized for planning the relevant proposed interventions; e.g. pop-up bike lanes, temporary pavements etc. Moreover, accessibility to hospital units is crucial for handling an emergency. According to the above, urban planning should be considered as integral part of disaster risk reduction strategy; the main goal is to create safer cities for all.

■5.0 CONCLUSION

Although, the issues of "consolidation" and development of compact cities have been the driving force for the urban planning so far, today the need for redesigning urban areas is highlighted in order to make them more resilient upon disaster risks; the compact city model as we know it cannot be effective in case that lockdown measures should be applied. Recently, the humanity faced one of the greatest challenges in managing a global sanitary crisis due to COVID-19. According to this paper concept, the redesigning of a city with mobility and accessibility criteria could be a valuable tool for managing any type of disaster crisis, in terms of (a) dealing with the sudden large number of the victims and (b) keeping the city life as normal as possible after the lockdown.

Specifically, ensuring of active mobility can be a milestone towards sustainable urban resilience and for copying with emergency situations; development of undisrupted transport networks interconnected with open outdoor spaces, such as urban squares, green areas that can function as waiting and shelter areas, or with hubs of the public transport network, as well as with critical infrastructures, like hospitals etc. Besides, promotion of the “active transport” instead of using cars in the urban areas through specific interventions to the built environment, e.g. bike lanes or sidewalks, may contribute to the air pollution reduction and the wellbeing of the dwellers.

Under this framework, the case study presented here is relevant to the redesigning of the Athens Metropolitan Area for anticipating the lockdown restrictions, namely the social distancing, limited transportation, etc. Specifically, the technical instructions issued by the Ministry of Environment and Energy have been applied using a specific methodology; development of temporary pedestrian corridors, as well as of temporary bicycle lanes and traffic calmed areas, or traffic calmed roads with a reduction of the speed limit. Moreover, for the specific case study, the Athens Strategic Plan has also been particularly useful.

The methodology presented in this paper can be generally used as a basis for the preparation of pilot interventions to the existing built environments in order to formulate a strategic plan for crisis management tailormade to the specific needs of a city; this is a significant challenge since most of the cities are already structured and hence, any intervention should be easily applicable and designed with flexibility criteria so that to be compatible with the urgent conditions arise under different types of emergencies, e.g. diseases, earthquakes, fires etc. The main goal is to achieve more resilient communities; greener, healthier and more human cities which will make the inhabitants more optimistic so that to successfully cope with climate change or other types of risks in the future.

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