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New scenarios for safe mobility in urban areas

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Post-Covid cities and mobility
A proposal for an antifragile strategy in Rome

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Abstract
Mobility is considered a central topic for urban regeneration in metropolitan cities, in relation to the impact on traffic congestion, air pollution, public space quality, social inclusion. During the Covid-19 pandemic, mobility patterns have been strongly affected by the spread of the virus and the social distancing measures. In the last months, many cities have adopted mobility strategies for urban resilience, to face the crisis by the reorganization of infrastructures and networks with a glance at a prevention of an unsustainable return to private transport in the post-covid phase. In this context, the research illustrated in this paper, developed within a collaboration between Sapienza University of Rome and Roma Tre University, aims to propose an "anti-fragile" strategy for "post covid Rome", adaptable to other contexts of European cities, starting from an integrated approach to urban planning and mobility. The research methodology has articulated the activities into three phases. The phase of analysis of the phenomena and the main scientific references relating to urban resilience and antifragility, highlighting the the relationship between urban form and mobility models. The second phase relates to the study of the main ongoing strategies and practices in some European metropolitan cities. The third phase proposes an operational hypothesis of an antifragile strategy for Rome highlighting the relevance of mobility transition. In the conclusion, the paper defines guidelines for urban regeneration combining the results of the case studies and the experimentation.

Keywords
Mobility; Covid; Regeneration.

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1. COVID and mobility in large cities. Goals and methodology of the research

Since March 2020 we have been experiencing a pandemic which has been having a long series of indirect effects, in addition to the direct consequences sadly reported in the news in terms of hospitalizations in intensive care and deaths. In the last months, the most effective remedy, together with the vaccine, seems to be the social distancing strategy, in order to reduce the virus and enable the decrees of contagions.

In this framework, mobility in large cities has been strongly affected by the spread of the virus and the social distancing measures. In the last months, many cities have adopted mobility strategies for urban resilience, even implemented by tactical urbanism interventions, to face the crisis by the reorganization of urban mobility infrastructures and flows with a glance at a prevention of a massive and unsustainable return to private transport in the post-covid phase.

The rethinking of urban mobility has thus raised a new awareness of authorities and citizens on a necessary "paradigm shift" on mobility systems, in order to overcome the cultural and technical references that have conditioned the "forms" of our cities, the ways of living them, and especially the ways of moving (Cerasoli et al., 2021).

We are now projected into a post (post) COVID phase that will bring us to a "new" normal. In the post (post)-crisis, it will be necessary to seize the opportunity for an urban and social transformation capable of strengthening and rebalancing that "complex system" which is the City.

In this context, the research illustrated in this paper, developed in the framework of a collaboration between Sapienza University of Rome and Roma Tre University, aims to propose an "antifragile" strategy for Rome post (post) Covid phase. This proposal is considered adaptable to other contexts of large Italian and European cities, starting from an integrated approach to urban planning and mobility within the broader urban regeneration strategy.

The research methodology has articulated the activities into three phases. The phase of analysis of the phenomena and the main scientific references relating to urban resilience and antifragility, highlighting the importance to promote new relationships between urban form and mobility models in order to adapt to global and climate changes and to foster sustainable lifestyles. The second phase relates to the study of the main practices on mobility in the European context, both pre and post Covid. These practices showed that there is a convergence on regeneration models, which focus on sustainable mobility, on the construction of new "geographies of proximity", and on the re-appropriation of public space from cars. This is starting with Barcelona's *Superilles*, which have already been experimented in other Spanish contexts such as Victoria Gasteiz, or tactical urbanism and models such as the French *Ville du quart d'heure* (Moreno, 2020), which are increasingly becoming a guide for temporary interventions in the public spaces of some cities, as in the case of the "Piazze Aperte" project of the Municipality of Milan or the interventions in Bologna and Reggio Emilia for the safety of school accesses. The third phase illustrates an operational hypothesis of an antifragile strategy for the city of Rome which outlines some reorganization and regeneration models, starting from the study of the different types of settlement forms.

In the closing reflections, the paper proposes some general guidelines for the existing city, in consistency with the references on resilience and anti-fragility, pointing out goals and actions for the regeneration of settlements forms, supported by the practices deepened in the second phase and the experimentation on the roman case study developed in the third phase.

1.1 Pre-covid cultural and socio-economic paradigms

We know that since 2006 the world urban population exceeded the rural one and today is just over 55%. In fact, during the Twentieth Century, we left those entire populations were concentrated in urban areas with more and more extreme density. In the same process, this polarization has fostered the abandonment of

entire territories (the so-called "inner areas") and, with them, the decline of all those activities historically linked to the historic territory.
Furthermore, the suburbanization processes that have affected Western countries since the 1960s, according to the North American and consumerist and car-centred settlement model, have produced the phenomena of "urban sprawl" with low density and high land consumption, highly dependent on the use of private cars without that public and common dimension that characterizes the contexts of the dense city.
In the process of metropolisation of the territory (Indovina, 2008), these low-density territories have merged with the more compact nineteenth-twentieth-century urban suburbs and historic centers, generating a multiplicity of contiguous settlement forms, with different levels of density of uses and flows of people and goods. This complex and stratified settlement system is characterized by increasing air pollution and energy consumption, by the rise in urban temperature, by the reduction of public space in favour of spaces for mobility and parking. These pathologies require a general strategy of urban and metropolitan regeneration, aimed at common sustainability goals and at the same time specific solutions for the resilience of different urban contexts based on the forms of settlement and the relationship with the mobility systems (Poli & Ravagnan, 2017). Now, the post (post) COVID scenario offers us the opportunity – that we cannot ignore – to change these unsustainable paradigms.
It should be emphasized that the perspective of a new model of equitable and ecologically oriented development should not be a long-term option, to be entrusted to a world that is now completely pacified but must take advantage of the role that crises have in shaking models and visions hinged in our society, encouraging changes that move towards a sustainable and above all anti-fragile urban model.

1.2 New references between resilience and anti-fragility

In the framework of the cultural, political, and scientific debate (Taleb, 2008; OECD, 2020a, 2020b; UN-habitat, 2020), resilience is an answer to urban complexity and interactions, guiding cities and communities across times of financial, environmental, and health crisis that need to be faced in the short phases of emergency as well as in long-lasting evolutions (Ravagnan, 2019; Ravagnan & Amato, 2021). "Urban Resilience is the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience" (Rockefeller Foundation, '100 Resilient Cities' initiative).
Moreover, resilience, deepened in the framework of an ecosystemic perspective (Acerno, 2015), is related to the concept of anti-fragility (Taleb, 2007; Blecic & Cecchini, 2016) that fosters the capability of adaptation to external perturbations, facing vulnerability and preventing risks, offering multiple and coordinated actions and ways of interventions that enable improvements of systems within rapid stresses and long-lasting changes. This concept thus fosters a proactive character of dynamism and adaptation of transformation choices to environmental, economic, and socio-cultural changes and pays attention to the uncertainty of the scenarios, the vulnerability of urban systems, and the scarcity of resources as well as the need for flexibility and reversibility of the network's organization. At the same time, it affirms the importance of being rooted in the *milieu* focusing on place-based approaches, to enhance the overall and multi-scale quality of the physical, cultural, economic, and social networks. To this end, it is evident that urban resilience requires an integrated innovation between material networks (infrastructures and transports as well as public spaces and green corridors) and immaterial networks (ICT, regulated social interactions, and institutional cooperation) considered strategic vectors for a 'smart city' (Lauri, 2021) and the 'right to the city' (Amato et al., 2019).

1.3 "Forms" of the city, ways to live, ways to move

In this perspective, we can point out that there are "socio-cultural" interrelations between City Form and Mobility Modes. The Compact City is linked to collective transport while in the Diffused City (the peripheral

urban and metropolitan fringes) mobility is based on individual mobility. In the middle, we can find soft mobility, suitable for both Cities - if made efficient and safe.

Today four "forms" of the city are recognizable in Rome: the Historic Centre, the Consolidated City, the Modernist City, and the Diffused or Spread City. Each of them represents the synthesis between settlement models (ways of living) and mobility models (ways of moving).

This settlement complexity in Rome, together with archaeological constraints of the city, hamper public transports organization, which is also heavily penalized by a very high number of vehicles on the roads (1,758,578 cars, 612 per 1,000 inhabitants, 393,669 scooters, 137 scooters per 1,000 inhabitants).

The issue of mobility in contemporary historical contexts is complex and linked to the phenomena that in recent decades have been characterizing these barycentres in terms of importance and representativeness, where the main commercial, cultural and recreational initiatives, and most of the city's social activities are concentrated.

These elements are associated with processes of abandonment and disposal of spaces, complexes, and equipment that are no longer functional or no longer congruent with the context in which they are inserted (large hospitals, markets, theaters, cinemas, meeting places, and spaces for relationships), due to the emptying of the catchment area, structural obsolescence or difficult accessibility.

In these contexts, the effects of the exponential increase in cars have been more visible than elsewhere, since they were built before the development of car mobility and configured for pedestrians; the effects of the overuse of means of transport powered by fossil fuels in an urban small, precious and unchangeable context, but at the same time so coveted, bring congestion, both in terms of loss of pedestrian walkability and in terms of pollution and urban decay.

Besides, the consolidated city has very diversified characters, corresponding to different urban development periods, as well as to the tools and rules that oversaw its formation (Poli, 2020). The consolidated city is that portion of the existing city that was formed starting from the end of the nineteenth century, in particular in the phase of urban expansion of the twentieth century, as an implementation of urban planning tools. Most of the consolidated city is characterized by a uniformity of settlement principles and building typologies; it is a compact city that largely presents forms of degradation due to the high population densities, the lack of public space, services, and infrastructures. It is a city that grew up with the myth of the automobile, where public transport was relegated into an anachronistic and secondary role in the city. Today's situation of great congestion is a direct consequence of this.

Finally, the most widespread type of settlement, characterized by a low density is mainly located in the recent peripheral areas of the large (Italian) cities, including those that arose informally, outside the scope of the former urban plans. Typologies relate to limited groups of small residential buildings with private gardens, which are linked to the supposed freedom of movement linked to car mobility (Cerasoli, 2011).

In these contexts, the private mobility model from a dream of freedom has turned into a "mandatory" means of transport (Cerasoli, 2015), and due to its morphological conformation, the public space has lost its role of urban framework, dominated by cars. Streets are characterized by large parking lots and oversized areas for mobility, forgetting walkability and the role of the pedestrian, often with configurations without sidewalks or dedicated signs. From the spread and monofunctional city, every day a huge number of workers move towards the workplaces concentrated in the historic city, using private means of transport, congesting the great road axes that penetrate consolidated urban fabrics and consequently the entire city (Petruccelli, 2017).

2. Post-covid pratices of mobility strategies in European cities

In the emergency context, strategies and actions have been put in place to face the problems arising from the social distancing and pandemic containment measures (OECD, 2020a; Un-habitat, 2020; OECD, 2020b; Saatchian, 2021; Katrakazas, 2021).

In this perspective, the Italian National Institute of Urban Planning (INU), drew up a document in May 2020, focusing on the relevance of urban governance in this phase, suggesting guidelines to answer the health, economic and social emergency (INU, 2020). Among the proposed interventions, the document points out the issues of accessibility, sustainable mobility, and the quality of public spaces. In fact, according to an opinion shared by various institutions, the lines of action of the new mobility strategy in the post-covid phase should converge, on the one hand, on the reorganization and strengthening of public transport and sustainable mobility infrastructures. On the other hand, a relevant issue is the reconfiguration of mobility spaces, including low-cost tactical urban design practices characterized by temporary, extendable, and replicable uses of spaces and transport lines (Cerasoli & Ravagnan, 2020).
According to some of the most recent studies, the search for an answer to the demands of the Right to Mobility raises the question of mobility as an issue considered transversal to the main regeneration strategies. These strategies foster integrated ways for the construction of a polycentric city, with specific reference to the strategies of *Transit-Oriented Development*, of modulation of building capacity and functional mix concerning the accessibility of the city, and through interventions on the model of the Spanish *Superilles* or the French *Ville du quart d'heure*, focusing on practices of *désenclavement* of the neighborhoods and revitalization of the network of public spaces interpreting the infrastructure as an integrated ecological connector for a complex of smart mobility and intermodal actions (Amato, 2021).
In this sense, the reflections and strategies proposed in the emergency and subsequent phase also follow these three strands, requiring an assessment of the concepts of a dense city, public space, and sustainable mobility and their role in the construction of an "anti-fragile" strategy.

2.1 Dense and polycentric city. The case of Barcelona

Within the reflection on the historic and consolidated city, it should be pointed out that some analyses of the impact of the pandemic have concluded that the highest incidence of the disease occurs in dense urban areas. A more careful analysis would probably be needed to determine how the quantity of this incidence of the virus is a direct consequence of the density or is simply related to interaction in urban centers because of the concentration of services. In the same way, we should evaluate the relations with the socio-economic level of the population, which often concentrates the most disadvantaged groups in the most deprived neighborhoods of large cities.
The *Pla Director Urbanístic Metropolità* of Barcelona, in the drafting phase for final approval, conducted an extensive reflection, led by the Urban Policy Development Area of the AMB that drafted in July of 2020 a document "The PDU, Covid 19 and the healthy city".
The goal of the document is to legitimize, in the face of the emergency, the choices of the Plan, which states that "the metropolitan urban model that inspires the PDU is a polycentric model whose initial premise is to respond to needs based on the capabilities of the territory, focusing precisely on the "dense city" as the best choice for urban transformation ".
This practice looks an interesting example since the city of Barcelona represents a model concerning the "right density"; the Plan of Cerdà but also the newest expansions have maintained morphological and formal criteria that have shaped a city of quality, flexibility, where a revolution on public space and mobility has been implemented starting from the *Superilles* to the other parts of the city.
The conclusions reached by the document "absolve" the model of the dense city, confirming these necessary criteria for urban quality, even in the era of pandemic. Density must be considered a goal of planning in post Covid, first of all for the ability to respond to crises, since the cohesive and complex city of proximity, with accessible local facilities has been able to give a rapid and effective response to the health demand. Furthermore, from the point of view of sustainability, the dense city avoids land consumption, high individual mobility based on motorized means of transport, greater consumption of water and energy, as well as the

fragmentation of the natural and agricultural environments. On the contrary, these are the pathologies of the widespread city model which fosters also a greater need for infrastructures, damaging the territory.

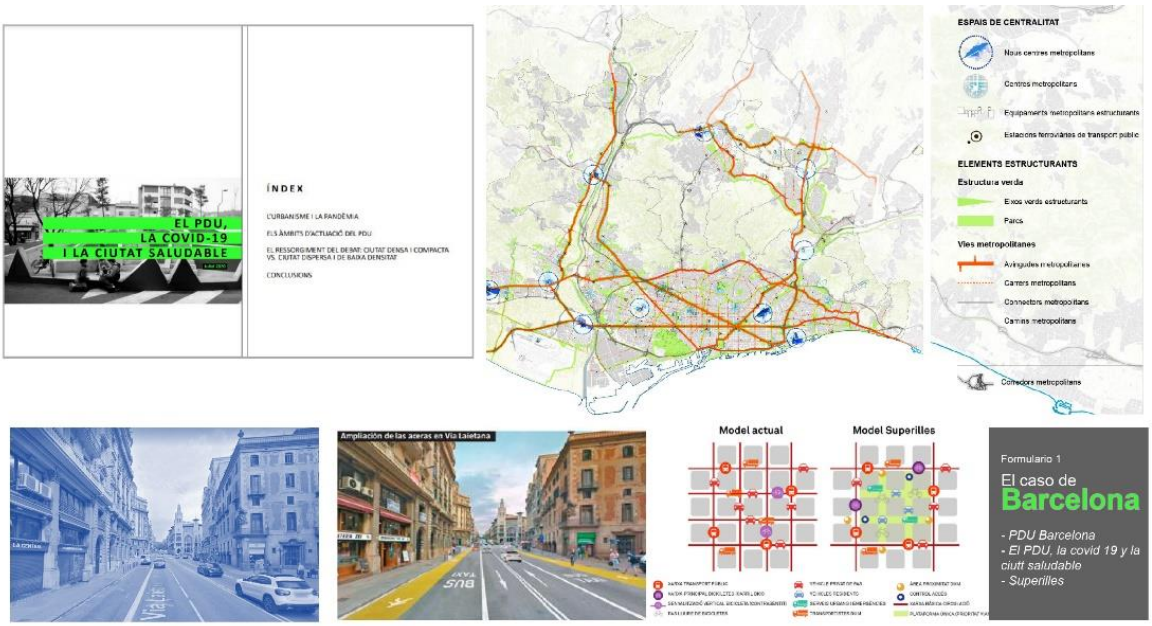

Fig.1 Form 1. The case of Barcelona. Source: own re-elaboration from https://www.amb.cat/s/home.html

2.2 Inclusive public space. The case of Milan

The state of emergency following the Covid 19 crisis had as its main and clearest guideline the confinement of the population at home. At the same time, the social distancing and air quality measures have fostered the delocalization of some activities in open spaces, with particular references to sport and recreational activities, art exhibitions, social relations, walking and soft mobility, healthcare interventions (covid tests), consumption of food and drink.

In this context, public spaces have been the subject of debate and experimentation, as they are considered the spaces where some of the activities that before the pandemic took place in closed spaces can be transferred.

It seems useful to point out also some Italian cities for their programmatic approach to the emergency, in particular Milan, with the document "*Milano 2020. Strategia di adattamento*" [1], a document open to the city's contributions that provided a vision supported by strategies and actions. In particular, concerning the topic of "Public Space", the Municipality intends to regain the space for physical activity through a series of actions: adaptation of pavements to social distancing measures and identification of "protected" paths for the vulnerable groups of citizens, a temporary and widespread pedestrianization (Play Streets for children) in the neighborhoods with lacks of green spaces, the reconfiguration of traffic flows in parks, the adaptation, and extension of open spaces for commercial activities, including on parking areas. This topic also involves the use of public open spaces for cultural and sport events, providing facilities, and simplification of procedures to allow organizers to comply with the criteria and quotas for the use of open spaces and manage it without excessive costs. The document highlights for each theme some priority actions of immediate feasibility, i.e. for the topic "Public space" the "reactivation of parks, centers, and sports facilities", "Open squares in every neighborhood" and "open spaces for commercial activities and catering".

[1] Available at: https://www.comune.milano.it/aree-tematiche/partecipazione/milano-2020 (accessed: 26/11/2020).

Furthermore, concerning the "Mobility" topic, the Municipality envisages a series of actions to decrease trips, acting on the mobility demand by favoring smart working and intervening on the city's timetables, improving and diversifying the mobility offer, in particular public transport and sharing mobility. It also introduces restrictions for the presence on public transport and fosters walking by implementing *30 km/h zones*, establishing residential streets and developing tactical urban planning projects. In addition, the introduction of innovative methods of access to the different mobility services is planned, by integrating LPT and other systems (Mobility as a Service model) which flexibly facilitates individual travel planning. Concerning this topic, the priorities are those related to public transport quota, mobility measures (updating rules on traffic and parking policies), the promotion of the *Strade Aperte* (open roads), and the systemic cycling program.

Fig.2 Form 2. The case of Milan. Source: own re-elaboration from https://www.comune.milano.it

2.3 Sustainable city and mobility. The cases of Bologna and Turin

In the framework of the debate on sustainable mobility, three major issues concern mobility planning in cities as a result of the Covid-19 phase: the change in the modal distribution of travel, the possible decrease in mobility flows due to remote working measures and an increasing flexibility in professional activities in person. Probably the most important point offered by the situation created by Covid-19 lies on these three axe that express the increasing awareness of citizens in relation to the benefits and the need for a new model of mobility. The perception that another use of urban space is possible if the mobility models change, that air quality can be improved, that the release of surfaces used for vehicular traffic can improve environmental conditions, has meant that a large part of the population began to show the will to give up routines that until now they had seen irreplaceable in favor of a better quality of life. Urban planning has the task of assisting, guiding and strengthening this transformation process.

On the other hand, mobility was one of the sectors most affected by the pandemic. Social distancing measures have highlighted the chronic weaknesses of public transport and have brought a state of crisis the Italian mobility urban systems. The social distancing measures and a lot of mistrust also fostered the use of individual means of transport. And if on the one hand the use of bicycles, and soft mobility in general, has registered a significant increase in many cities, on the other, local railways, subways, tramways, trolleyways and buses have suffered due to the reduced capacity of passengers admitted on board (initially 50% of normal, recently increased to 80%) and the (scarcely justifiable) reduction in frequencies.

Some municipalities are distinguished by a programmatic approach to the theme of sustainable mobility and public transport. The Municipality of Bologna has drawn up the *Piano per la mobilità ciclabile emergenziale*

and the *Piano della pedonalità emergenziale*, containing all the measures to overcome the public transport crisis, clearly aware that the city cannot afford to take a step backward in the fight against pollution and car use. Within the *Piano per la mobilità ciclabile emergenziale*, the Municipality of Bologna clarifies that "the adoption of appropriate corrective measures is necessary to allow a restart of the mobility system, to enable an adequate physical distance between people by re-configuring spaces and modes of travel, but intending to grasp relevant additional benefits, i.e. the reduction of pollution, the strengthening of proximity mobility and local networks, as well as the increase of quality and quantity of widespread public spaces". The fields of action have been identified, distinguishing the different components of mobility, which should not be treated separately but in an integrated manner, in order to present users with a wide range of alternatives to the choice of private transport. The main themes of the strategy are the "relaunch of public transport" to boost demand, the "limitation of journeys at peak times", spreading them throughout the day with the collaboration of the area Mobility Managers with the institutions, in agreement with companies and schools, traffic regulation measures, emphasizing that during "phase 1" there was no suspension of traffic regulation measures, unlike in many other Italian cities, the "acceleration of the spread of active mobility", by means of infrastructural interventions and incentive policies and the "enhancement of other types of mobility". Based on these contents, the Plan envisages many structuring interventions, defining the Ways of Intervention, the Design, the Implementation, and the Guidelines for Intervention.

Finally, the City of Turin has drawn up the *"Grande Piano per la mobilità – Fase 2"*, designed to reshape mobility based on new needs and protect collective health, avoiding a massive return to the car and thus pollution and congestion. The adopted strategies refer to a collaboration with the government and other bodies, the reduction, and redistribution of urban mobility and urban space in favor of sustainable, shared, and electric mobility, adapting local public transport standards to the new covid-19 regulations, monitoring these interventions, traffic levels, congestion, and modal shift.

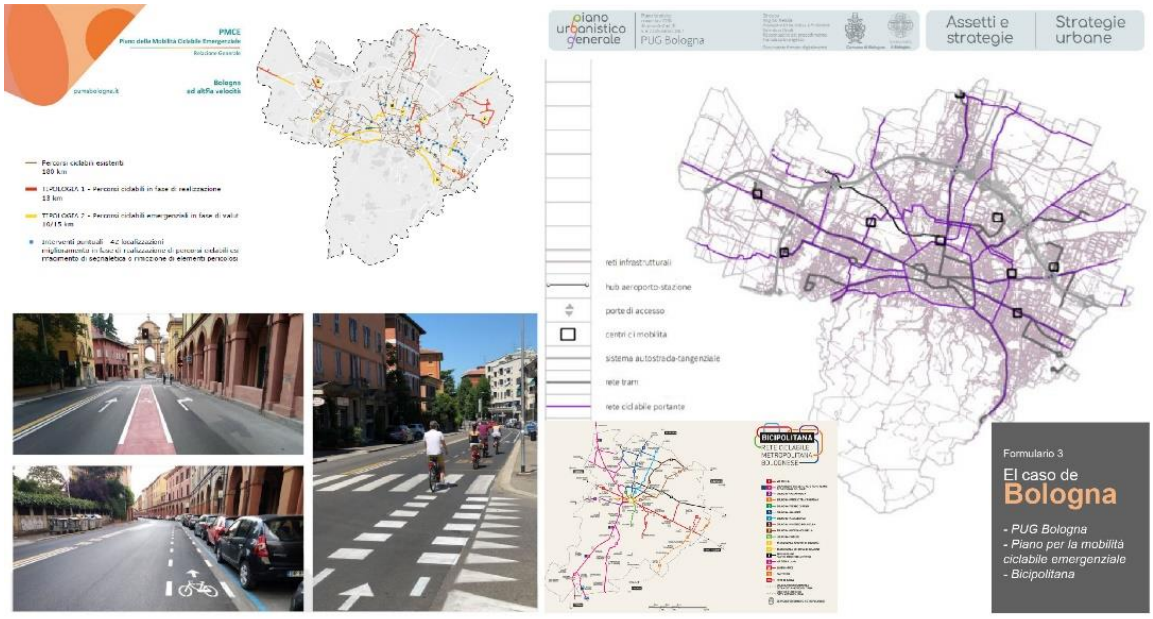

Fig.3 Form 3. The case of Bologna. Source: own re-elaboration from https://www.comune.bologna.it/home

For these cities, as well as for other Italian and European cities, that have undertaken emergency measures related to mobility, the experimentation has focused on three common lines of interventions. The first concerns private and public transport, i.e. the management of LTZs and paid parking and the quota of LPT. The second concerns pedestrian and bicycle mobility, which have taken on a major role in daily mobility, leading to more or less temporary interventions, linked in some cases to planned interventions and in others to new ones linked to emergencies (Lock, 2020). The third involves the new alternative means of transport, such as electric

scooters, electric bicycles, as well as the funding policies for their purchase and use (starting with the MIT decree for the "*bonus mobilità*") (Amato & Cerasoli, 2020).

3. Rome. An anti-fragile hypothesis for a new "grammar" for the Roman mobility

In this context, the strategies put in place by the Municipality of Rome have been developed to enhance individual zero-impact travel solutions through the spread of soft mobility and micro-mobility, also supported by national funds for the purchase of vehicles. In particular, the Administration has approved a new extraordinary plan of 150 km of "transitional" cycle paths in 2020, alongside the creation of new sharing services, the increase of bike racks in public places, the development of the plan for electric charging stations, and the strengthening of mobility management in Roman companies and schools.

The Cycle Plan is consistent with the SUMP (Sustainable Urban Mobility Plans) approved in 2019 and the Biciplan. The pandemic also represented an important phase for a paradigm shift towards intermodality, with particular reference to bike-friendly public transport (metro, regional trains, buses, and trams), which is very underdeveloped in the Italian context, and in particular in the Roman context.

As pointed out through the main ongoing practices in European cities, it is possible to address the post (post) Covid scenarios, counteracting the return to the (ab)use of private vehicles, which would have negative effects on air pollution and road accidents facing the complexity of the urban forms and flows.

The current high levels of smart working and e-learning in schools and universities must not represent a temporary contingency, indispensable only for the management of COVID, but turn in an opportunity for a – also cultural - revision of mobility practices, reducing the plethora of unnecessary trips and, at the same time, encouraging all forms of sustainable mobility.

Thus passing from the emergency to the normality of long-term scenarios.

In this phase, we can build an urban resilience strategy around mobility policies based on "anti-fragile" scenarios (Thaleb, 2007; Blecic & Cecchini, 2016). This will change the usage maps of our cities, enabling an economic rebalancing based on the equal access to equipment and centralities, the mitigation of environmental pollution and the reconfiguration of public space, fostering social cohesion and safe interactions. And the task that urban planning and city government today must take on is to identify the appropriate strategies to manage this transition.

To face the post-Covid challenges, it is essential to put in place an overall strategy for Roman mobility, which can be easily transformed from emergency into ordinary, using ordinary and extraordinary financial resources for post-COVID.

The following hypothesis is the result of a joint research between Roma Tre University and Sapienza University, in part already anticipated at the beginning of May 2020 (Cerasoli & Ravagnan, 2020).

The main lines of action of an anti-fragile strategy for post (post) Covid mobility in Rome are the reorganization and strengthening of public transport and infrastructures for sustainable mobility and the reorganization of mobility spaces.

As for the reorganization of the "hierarchy" of the mobility, the most qualified reference is the Barcelona experience.

Pedestrian mobility must represent the primary form of mobility in the city, to be privileged and guaranteed, given the rediscovered value of "proximity".

Soft mobility (bicycles, scooters, etc.) can and must represent the main alternative, especially in the most sprawled parts of the city, thanks to the use of spaces previously dedicated to the transit and parking of private vehicles.

Local public transport (buses, trolleybuses, trams; subways, regional railways) and taxis must catalyse medium and long-distance trips, between different neighbourhoods or from municipalities in the metropolitan area or the rest of the region. A dense network of public transport "corridors" will therefore have to be designed.
Taxis and car-sharing will complete the public transport offer, also thanks to a redefinition of fare policies.
The use of private cars will thus be progressively limited according to the areas of the city and to concentric circles starting from the historic centre to the farthest areas of the city, where instead it will have to provide the necessary support for public transport.
In relation to the "forms" of settlement in Rome, the declination of the modes of mobility will be the following.
The Historic Centre, in which all urban functions coexist and integrate, must become the City to Walk, where everything can be reached by walking and where the pedestrian must be protected, bicycle encouraged, public transport well organized and cars progressively excluded.
In the Consolidated city, characterized by a rich variety of functions and services and by the regular road network, we must apply an "urban grammar", schematized in the "theoretical grid" (from an intuition of Marcello Vittorini in 1987). Grammar which we have been experimenting and perfecting ever since in the Department of Architecture of the Roma Tre University.
The logic behind the "theoretical grid" is the functional and morphological division into two mobility systems (primary collective mobility and complementary individual mobility), minimizing interference between the two systems.
Based on the preliminary delimitation of "urban rooms" (the "elementary urban units", corresponding to neighbourhoods), the "grammar" identifies the primary network of public transport and soft mobility that crosses the various elementary urban units thanks to a network of "protected corridors", connecting the nuclei of the different "urban rooms" and giving shape to the system of central places (Cerasoli & Pandoli, 2019; Colarossi & Piroddi, 2019).

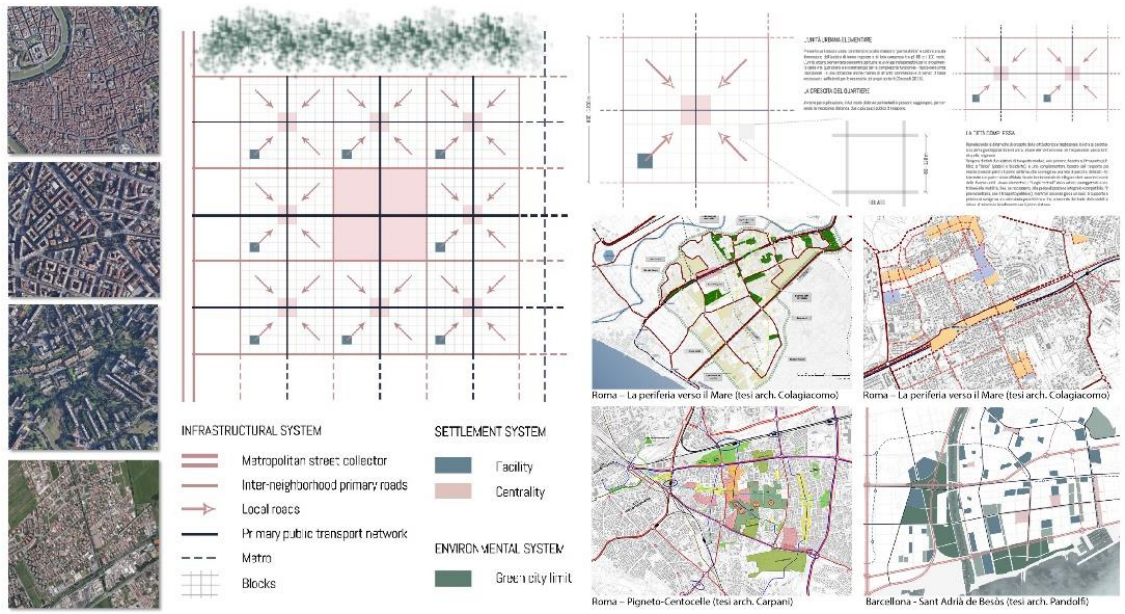

Fig.4 The "theoretical grid" and the new "grammar" for Roman mobility. Source: own re-elaboration from Cerasoli & Pandoli, 2019

It identifies the network for complementary individual mobility, which is based on a "fluid" roads system that flows outside the "urban rooms", within which "zones 30" (or even 15) are identified to safeguard the pedestrian and bicycle mobility and to maintain acceptable levels of atmospheric and noise pollution.
In the Modernist City, characterized by dilated distances and often unnecessarily intricate roads, the combination of soft mobility and public transport - on which bicycles, scooters, etc. will be able to travel all the time - must represent the great alternative to using the car. By applying the same criteria of the "theoretical

grid" to this part of the city as well, it will be necessary to identify protected routes for bicycles that must intercept the "corridors" of public transport - such as to guarantee trips lasting no more than 15 minutes.
In the Peripheral urban fringes, in the vast suburbs surrounding the city, thanks to the application of the "theoretical grid", it will be possible to rationalize the circulation of private cars, identifying the complementary network of "fluid" roads. To reduce the direct flows of cars to the city centre, it will be necessary to identify some public transport "corridors", which guarantee an effective increase of accessibility to the "central places" of the peripheral districts, while strengthening intermodality through the creation of interchange nodes between cars, metropolitan railway lines, and the public transport network carried out by buses.

4. Mobility Guidelines for a antifragile urban regeneration strategy

In the last decades, in line with the new disciplinary and cultural references, the debate on metropolitan cities has developed approaches that reinterpret the existing city as a system articulated in multiple settlement forms corresponding to the subsequent periods of urbanization, different lifestyles and various mobility models.
These approaches give answer to the need of declining and specifying the contemporary city in the plurality of spatial identifications (D'Onofrio & Talia, 2016) and the need of coordinating the sectoral approaches to services and mobility planning with urban planning.
In this framework, the paper proposes an articulation of the existing metropolitan contexts as a result of the research activities, defining specific goals of urban regeneration to be implemented through integrated actions on mobility and public spaces.
The articulation relates to four settlement forms: historic centre, consolidated city, modernist city, peripheral urban fringes, starting from the case study of Rome, that represents an emblematic case study for its wide territorial scope and spatial complexity.
As a result of the study, and in consistency with other research paths developed by authors (in particular cf. Amato, 2021), for each settlement form it is possible to propose general goals and specific actions supported by the case studies illustrated in the paper.
The proposal is therefore divided into four synthetic descriptive-interpretative and planning macro-categories, declining goals and actions as described in the following paragraphs and table (Tab.1).
The goals for the historic centres focus on the preservation of historic urban fabrics and open spaces, removing cars and other form of transport not compatible with the urban morphology of pre-industrial urban contexts, enhancing public space as the heart of a pedestrian-oriented network extended from here to the whole city (as in the case of Milan). Public space thus become an opportunity to return spaces to citizenship living in historic centers, fostering uses and activities linked to culture and social interactions, in order to recreate social cohesion and a sense of belonging.
The proposal for a mobility strategy in the consolidated city focuses on the goals of urban and environmental sustainability, giving answer to the specific problems of density, congestion and pollution combining metropolitan strategies and tactical urbanism, based on a new hierachisation of mobility and on the creation of accessible urban centralities (as in the case of Barcelona).
The proposal for a mobility strategy in the modernist city is mainly aimed at overcoming the isolation of these settlements through an improvement of the scarce network of public spaces that involves the abandoned areas, integrating the sustainable mobility system with the environmental system, pointing out the role of cycle paths as a structure for urban regeneration (as in the case of Bologna).
Finally, the proposal for a mobility strategy on urban fringes focuses on intermodality based on a system of interchanges and points out the role of mobility and public space networks in the mending of the fragmented urban forms (as in the case of the PDU of Barcelona).

	Urban regeneration goals	Actions on mobility systems and public spaces	Case studies
Historic centres	Connect the historic centre to other settlement forms to recreate social cohesion	• Improve buses, trolleybuses, tram services to and from the interchange nodes, • Build a network of cycle paths that connect the center to the peripheries; • Encourage the use of forms of sharing micro-mobility at the accesses of the historic centres and in the mobility hubs;	Milan
	Encourage forms of mobility compatible with historic urban fabrics	• Remove the cars from public space; • Create Restricted Traffic Zones; • Elimination of car parking lots along streets; • Structure the public space with paths reserved for bicycles, scooters • Enhance stations with cultural and community-led functions	Barcelona
Consolidated city	Redefine the space to rebalance mobility models toward environmental and urban sustainability	• Renew road spaces in terms of rebalancing space for cars, LPT corridors, cycle paths, sidewalks, with particular attention to vulnerable categories of users; • Encourage new democratic uses of public space through tactical and temporary interventions and 30 km/h zones; • Reduce surface parking areas and create underground parking lots;	Barcelona
	Rethink the role of interchange nodes, stations, mobility hubs as centralities.	• Increase of functional mix of stations, • Enhanced stations with cultural and community functions. • Consolidate interchange nodes at the city border;	Barcelona
Modernist city	Bring marginal urban areas out of isolation;	• Strengthen the TPL for those enclaves isolated from the rest of the city; • Increase the connections to interchange nodes; • Rethink the principal infrastructures in terms of multimodal corridors and ecological connections;	Barcelona
	Integrate the sustainable mobility system with the environmental system.	• Integrate the green frame on the micro scale with the connections of soft mobility; • Renew road spaces in terms of environmental quality, through de-sealing and greening actions; • Connect parks and urban green areas with the soft mobility network; • Foster electric mobility.	Bologna
Peripheral urban fringes	Mend the fragmented city with a public network	• Connect parks and urban green areas with the soft mobility network; • Create support paths only for active mobility to relate urban fabrics with their environment, recovering historical traces. • Extend and integrate the backbone of the urban and extra-urban cycle network • Rebuild a network of public spaces that connect the main centers scattered throughout the territory; • Create, through the building densification, of squares as places of centrality; • Encourage the creation of neighbourhood services and commercial activities along the network of public spaces and squares;	Barcelona
	Create an intermodal and sustainable mobility system	• Rethink the principal infrastructures in terms of multimodal corridors and ecological connections; • Increase services and activities around interchange nodes; • Enhance the infrastructural nodes as gates to the city; • Enhance the stations with cultural and social functions; • Develop shared mobility services and technologies in urban hubs.	Milan

Tab.1 Guidelines for anti-fragile urban regeneration strategy based on mobility

These guidelines represent a framework for an integrated approach to an anti-fragile urban regeneration focused on the intervention on mobility and public spaces. Guidelines that can be integrated with other ongoing best practices and declined in relation to specific contexts.

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