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Regenerative Streets: Pathways towards the Post-Automobile City

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Abstract: The subject of the paper is the street, seen as a structuring and emblematic element of urban settlement. The topic is addressed from the lens of regenerative design, whose underlying whole-system, multi-scalar, and dynamic approach can find urban connections to be a fruitful field of experimentation from the perspective of the post-automobile city. The first part of the paper traces the stages of the transport mechanization process and related impacts on urban patterns, emphasizing the voices critical of reducing streets to mere traffic channels that have accompanied it, until the sustainability discourse led to a general rethinking of how mobility should be planned in cities. The second part of the paper reviews alternative urban visions to the still prevailing car-oriented model, which re-actualize the idea of the street as a multifunctional space, providing social and environmental 'returns' in addition to its role as a transport infrastructure. The notion of the street as a 'space of potential' is then developed through an inductive classification of regenerative actions at different scales, both material and immaterial, as well as permanent and temporary, thus providing a unifying conceptual framework for further research and practical applications in the fields of urban design and sustainable mobility.

Keywords: streets; regenerative design; sustainable city

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1. Introduction

The street is a fundamental component of urban systems and, both quantitatively and qualitatively, "the most fitting symbol of the public realm" [1] (p. 9).

The street is typically associated with three essential physical roles [2]—circulation; public space; and access to estates, housing, and services—corresponding to different functions. That is, respectively:

- The connection between parts, neighborhoods, and zones of the urban system and between these and the outer world;
- Human interactions of various kinds, between people walking along the street (or travelling along it by other slow modes that enable interpersonal relationships), crossing paths, meeting each other or engaging in activities, whether work-related or recreational;
- The spatial organization of buildings, lots, and open spaces, which distinguishes the different patterns of the urban fabric and overall determines the settlement form.

With the rise of transport mechanization, the role of the street as a traffic device has progressively imposed itself on the other two functions, becoming a matter of engineering with variable levels of technical specialization depending on the type of connection to be ensured and the volume of flows to be managed. To date, most of the scientific literature on streets and roads refers to traffic-related issues and transportation planning that, since the 1960s, has developed as a sectoral field, with distinct purposes and language from urban planning and design (among recent contributions, see, for example, [3–9]).

Although automobile motorization and traffic engineering have severely weakened the significance of the street as a "quintessential social public space" [1], the possibility of accommodating diverse social practices in addition to movement—including informal or illegal ones [10–12]—is nonetheless immanent to every type of urban connection.

The complexity of the street, either explicit or implicit—"The intermediate position of streets in the environment, intersecting public and private, individual and society, movement and place, built and unbuilt, architecture and planning" [13] (p. 1)—makes this unit of space the most representative 'topos' of the urban scene, a synecdoche of the whole city. As Jane Jacobs observed, "If a city's streets look interesting, the city looks interesting; if they look dull, the city looks dull" [14] (p. 107).

It follows that the design of streets is an essential task of urban design [1,2,15–18].

Starting from this assumption, this paper questions how the potentially multifaceted role of streets in the organization of urban systems has been or can be reinterpreted from the perspective of making cities more sustainable and resilient [19], a challenge that implies overcoming the still prevailing car-based model of urban transportation and moving towards a multimodal, post-automobile city [20–23]. The aim is to provide both a key to projects and initiatives prefiguring new street types and landscapes that already consider this perspective and a conceptual framework for urban design, seen as a tool and driver of the sustainable regeneration of settlements, to get the most from the most widely available and generally misused urban space—the street.

1.1. Urban Design as a Regenerative Sustainability Tool

Among the disciplines and practices of spatial design, urban design, beyond being an ambiguous and open-ended term [24–26], is generally concerned with the shaping and management of the urban environment, joining up different needs and areas of action [27–29]. The scope of urban design ranges across "all scales of the urban socio-spatial continuum" [24] (p. 117)—from the region to blocks, streets, and buildings [30].

In the last few decades, the sustainability debate has called for a general rethinking of the principles, aims, methods, and techniques of spatial design at all scales, resulting in the identification of requirements and performances for the human habitat [31–34] to inform both new developments and the redevelopment of existing settlements, along with the formulation of new theoretical, methodological, and operational approaches [29,35–39].

Drawing on an extensive body of literature, Gibbons highlights how this debate has reflected three different ways of understanding sustainable development [40]:

- A 'conventional' approach, which came into being after the publication of the Brundtland Report in 1987 [41]. Acknowledging that the unfettered exploitation of natural resources is a threat to the very survival of the human race, its basic objective is to reconcile economic development with the conservation of essential resources within the limits of their ability to perpetuate themselves over time, so as not to penalize future generations;
- A scientific approach, which is typical of the 'contemporary sustainability' paradigm [40] (p. 2), developed from the emergence of sustainability science as a specific field of academic research and teaching [42,43]; along the lines of 'conventional sustainability' [40] (p. 2), it aims to guide the transition towards eco-efficient and socially fairer development models, relying on problem-solving rationality and technological improvements. This is the approach that inspired the 17 SDGs of the UN 2030 Agenda [44], geared towards the achievement of satisfying livelihoods driven by economic growth in a context of limited resources;
- A regenerative approach, presented as 'the next wave of sustainability' [40] (p. 1); unlike its predecessors, this approach does not focus on fixing the degenerative processes caused by human activities by seeking an acceptable balance between consumption and resources, but on directing human action towards a "conscious alignment with living systems principles of wholeness, change, and relationship, as nature does" [40] (p. 3). Its aspirational aim is to achieve increasing levels of health, well-being, and thrivability, which implies the adoption of a holistic worldview and enhanced capacities of "adaptation, self-organization, and evolution, as well as making decisions about

infrastructure, land use, governance, food systems, cultural practices, and lifestyles that support whole-system health" [40] (p. 4).

According to its advocates, the shift to regenerative sustainability is essential to overcome the inability of the sustainable development paradigms implemented so far to make a decisive break from destructive business-as-usual practices that threaten the planet and produce inhospitable places in which to live [37,40,45,46]. Regenerative sustainability underpins the constructs of ecological urbanism and design [29,36], regenerative design [35,37,45,46], and so on, which, from different angles, convey a worldview based on responsibility, care, appreciation of differences, positive integration between natural and anthropic components, and attention to the qualitative and not only quantitative aspects of living environments, among others. This is reflected in a design process that eschews any standardization and questions sectoral specializations while taking advantage of the specificity and complexity of local conditions—environmental, social, cultural, and economic.

Focusing on the public realm, the regenerative approach to urban design has been discussed by the author in previous contributions [19,47] by updating in the light of sustainability objectives the notions of 'capital web' and 'civic design', originally defined by D. Crane [48] and D. Scott Brown [49] in relation to the issue of public interest in large-scale physical planning and urban design. The former refers to the structural pattern of the territorial organization, made up of the essential elements of the environmental system, public infrastructure, and equipment, while the latter is understood as the design of the capital web, through which the visions and values that inspire it become tangible and acquire cultural significance. Assuming that today's "public interest in the management and transformation of physical space is to be sought primarily in the (re)constitution of a healthy and safe urban habitat, in harmony with natural processes" [19] (p. 323), the capital web and civic design are seen as the raw material and primary tool, respectively, for triggering developmental change processes in urban contexts.

1.2. Structure of the Paper

The paper is divided into five sections. Following this introduction, Section 2 develops the bi-univocal correlation between urban design and street models through a brief historical overview. It focuses on the transition from the walking city to the transit city (the city that, in the first phases of industrialization, was modeled on temporal distances by new mechanized public transport means, instead of metric distances proportional to walking, as occurred in pre-industrial settlements) and from the latter to the automobile city [50]. The section highlights critical positions that have emerged since the 1950s against this model, which reflects the predominant role of car mobility in advanced societies, as well as early street experiments inspired by them that can already be ascribed to the sphere of urban regeneration. Section 3 is about the further paradigm shift towards multimodality in urban transport, prompted by the sustainability discourse. Implying a different use of road space that, once again, includes public and non-motorized travel as a significant part of the mobility offer, sustainable mobility prepares the way for potentially widespread regenerative design interventions. This new perspective is the subject of Section 4, where alternative city models for the post-automobile city are reviewed and a qualitative classification, on an inductive basis, is proposed of actions that, from different angles, evidence the transformative potential of streets. Finally, Section 5 sets out the conclusions and possible lines of research to be developed for the future.

2. The Effects of Transport Mechanization, between Integration and Specialization

2.1. Streets as "Dwellings of the Collective"

"With some exceptions, such as underground metro systems, each advance in transportation technology—from horse-drawn streetcar, to electric streetcar, on-grade and elevated railways, automobile and superhighway, airplane and airport—has degraded the pedestrian environment" [51] (p. 1). Despite the profound changes to the Western urban model resulting from industrialization, such as to undermine the notion of a city consolidated over millennia as a spatially delimited and introverted domain, dialectically opposed to the natural and rural land [52], the street, while transformed by increased demand and new means of transport, still maintains its multifaceted character, in continuity with the past [1,53].

In Ildenfons Cerdà's Barcelona expansion plan, a milestone of the nascent urban planning discipline, the traditional idea of the street as an extension of the dwelling providing "an endless number of services, all of which are of great importance to the neighborhood . . . " [54] (p. 149, cite in [55]) is reflected in the metrics of its unprecedented grid pattern, made up of 20 m wide streets with 50 m wide 'diagonals', equally divided between traffic lanes and sidewalks.

The new typologies of boulevards and ring avenues, introduced around the middle of the 19th century in Paris and Vienna by demolishing medieval quarters and ancient city walls, respectively, also constituted a model of both modern traffic infrastructure and innovative public space, whose ability to interpret the spirit of the times is the reason for their rapid spread throughout Europe. Enlarged street sections and the increased distancing between intersections, separated carriageways and pavements, rows of trees on the sides, public lighting and other technical equipment, and tram tracks and underground station entrances, together with shop windows, cafes, and public buildings facing onto the street, are all features that, giving the streets the symbolic value of modern life, help to re-actualize their social role—to use Walter Benjamin's words—as "dwellings of the collective" [56] (p. 1051, cit. in [49]).

Early criticism of the risk that design standardization sought by street engineering would impoverish the urban landscape came from the German town planner Camillo Sitte. According to Sitte, the necessary modernization of the city should take into account "what might still be salvageable, and retainable as a heritage, of the beauties of old town planning" [57] (p. 12) and, consequently, subtract from the laws of circulation at least "a few main streets and plazas" [57] (p. 92) to preserve their original civic role.

Instead, the exaltation of new transport systems, either in the form of a central axis that serves as the backbone of the entire settlement or a network of inter-municipal connections between self-contained small towns, underlies the two main alternative models to the industrial city advanced by the urban reformists of the time; namely, Arturo Soria y Mata's Linear City [58] and Ebenezer Howard's Garden City [59]. In both models, the main infrastructure plays only a transport role, while local streets are merely intended to provide access to the built-up areas, according to a principle of specialization that diminishes the social role of connections, thus revealing its intrinsically anti-urban significance.

2.2. The Rise of the Automobile City

From the second half of the 1910s in the United States and the 1930s in Europe, the transition from prevalent collective modes of mechanized transportation to individual motorization was accomplished, thanks to the evolution of the internal combustion engine, the innovations introduced in the United States by Henry Ford to the production chain (1913), and the availability on the market of cheap fossil fuels. In the decades following World War II, this process was greatly accelerated by the decisive support provided by national governments to the involved industrial sectors.

This paradigm shift in urban transportation was backed up by the mainstream architecture and urban planning of the time, which, through the *Congrès Internationaux d'Architecture Moderne* (CIAM) [60] and the projects of its most prominent figures, provided the theoretical arguments and technical tools that, under the banner of the 'machinist civilization' [61], guided the development of Western cities throughout the century—and still today inform urban planning in many parts of the world, despite a now established critical judgment.

The proponents of Modernism set out to solve the dysfunctionalities of the industrial city (e.g., congestion, unhealthiness, lack of green space, decay of the old residential fabric, and so on), identifying its most representative spatial device, the 'rue corridor', as the critical element to be overcome—the 'rue corridor' being the street between built fronts inherited from pre-industrial models, so derogatorily defined by the movement's leading exponent Le Corbusier [62].

The solutions advocated by Modernism are, on the one hand, the separation of urban functions, as enshrined by the movement's manifesto, the Athens Charter (1931) [63], and, on the other, the hierarchy of traffic flows, and consequently of the road system, to manage the displacements of a motorized population. At the top of that hierarchy are urban highways. This resulted, de facto, in a "schism in urban design" [2] (p. 7) between traffic infrastructure and built-up areas, reflected in a strict division of labor between road and traffic engineers on the one hand and urban designers and architects on the other.

Over the decades, the impact of car primacy on the form and functioning of settlements has been disruptive, or even "disastrous", considering both the clearance of the existing urban fabric carried out especially in the United States to make room for urban highways, as well as the "negative effects of highway engineering as a formative influence on urban layout, in effect, disurban creation" [2] (pp. 8–9). While individual mobility and planning by zoning undermine the multifunctional and compact character of the pre-Fordist city by encouraging the disintegration of the urban organism, the huge surface area required to accommodate mass motorization destroys any balance between the amount of space to be allocated for circulation and parking and that usable for all other activities. With different degrees of intensity depending on national contexts and specific situations, the resulting effects on car-oriented cities include the following:

- The spread of low-density suburbs, characterized by car-only accessibility and the almost total absence of collective spaces, surrogated by specialized shopping, business, and leisure centers [64];
- Otherwise, the development of monofunctional peripheral neighborhoods in which the application of oversized road design parameters and parking standards prevents the creation of a continuous system of public space;
- The loss of identity of streets and roads designed as mere traffic channels;
- The occupation by cars of much of the existing public space; since the 1960s, attempts have been made to contain this encroachment by means of pedestrian or traffic-restricted zones, to protect at least historic centers [65,66]—a measure that, in turn, can have deleterious effects either in terms of isolation or social and tourism gentrification [67–69].

2.3. The Street as a Manifesto

Criticism of the involution of the street in modern settlements has arisen from different perspectives since the 1950s.

Appreciation of the vitality of old neighborhoods threatened by highway development programs is the premise of the battle launched from New York City by Jane Jacobs against their demolition and the background of her advocacy of the street as a unique place of identity and sociality for urban communities [14]. Taking a different stance, Lewis Mumford condemns the simple-minded commitment to the automobile, rather than to people, of American urban policies, resulting in car dependence and mutilated and deformed communities [70].

The car is also stigmatized by anthropologist Edward T. Hall as "the greatest consumer of public and personal space yet created by man" [70] (p. 175), and by Gordon Cullen and his colleagues of the Architectural Review [71,72] as the major agent, together with its related semiology, of visual degradation of the urban landscape.

The need to reconsider the complexity of the street as an urban phenomenon, rejecting "a reductionism so sadly evident in much of the literature and in the actual designs and transformation of streets" [73] (p. vii), underlies a research project conducted in the 1970s at the Massachusetts Institute of Technology under the direction of Stanford Anderson, which culminated in the volume *On streets* [74]. In the opening chapter, city historian Joseph

Rykwert makes it clear what is at stake: "The expectation of daily human contact that the street uniquely offers, and offers in a pattern of exchanges without which the community would break down, is inhibited at the risk of the increasing alienation of the inhabitant from his city. The cost of this alienation is not easily calculable" [75] (p. 16).

With a more experimental approach, Danish architect Jan Gehl's studies on human behavior in the 'space between buildings' [76] and community-based initiatives in the Netherlands, aimed at reducing the domain of the car and encouraging people's interaction in urban neighborhoods, challenge the functionalist approach to the design and regulation of roads and streets. As a result of the latter, the Dutch woonerf, first pioneered in Delf in 1969, paved the way for traffic calming and street rearrangement measures throughout the country, becoming the model for 'living' or 'shared street' movements worldwide [77]. In a climate of renewed interest in the 'rue corridor', hand in hand with the re-evaluation of the urban block [78] and, conversely, the repudiation of the urban planning and design principles of Modernism, conceptualizations like 'livable street' and 'democratic street' started to become familiar in urban studies [79,80].

At a larger scale, the integration of infrastructure, architecture, and landscape [81] became topical between the 1980s and the early 1990s in Barcelona, when the city underwent a major renovation to host the 1992 Olympic Games [82,83]. In the debate preceding the works, the principle was asserted that, as in the Cerdà Plan, new transport infrastructure should ensure, in addition to efficient mobility, a corresponding 'social return' by creating a fair balance between driveway lanes and the space designated for other uses [84]. The challenge was met successfully both in the new outer ring roads ('Cinturones'), where continuous cross-sectional changes saw the infrastructure adapt to the surrounding context, and in the restructuring of the main internal axes, inspired by traditional road types (e.g., the wide avenue with a central *rambla*). Similarly, in France, in the wake of the reclamation of the Champs Elisées (1990–1994) [85], which in the 1960s had been transformed into anonymous traffic corridors, the classic boulevard typology is once again a reference for the design of new roads, following an urban re-composition logic opposite to the self-referentiality of standard infrastructure [86,87].

More recently, the theme of the street as a public space and mobility device has been re-framed within the discourse on the sustainable city.

3. Urban Mobility as a Lever of Sustainability

Since the 1970s, the notion of sustainable development has established itself globally as a political issue, becoming, especially after the 1987 publication of the Brundtland Report [41] and the 1992 Rio Conference, the main leitmotif of the debate on the future of cities. In the face of the growing world population and its increasing polarization in urban areas, the focus on how to make cities sustainable has led to a new paradigm shift in urban mobility, being identified as one of the main levers to trigger the needed change.

Indeed, mobility impacts all three 'pillars' of sustainable development—environment, economy, and social cohesion [88,89]—and it is probably the issue that most visibly displays their mutual conflict potential in urban contexts.

A 'mobility turn' [90] is also essential to achieve decarbonization and meet the targets of the Paris Agreement on Global Warming (2015), given that the transport sector is still 90% dependent on fossil fuels and is responsible for about 22% of global carbon dioxide emissions, 74% of which can be attributed to individual (40%) and freight (34%) road transport [91]. Therefore, reducing car dependence also means, in the medium term, making cities more resilient to peak oil [32].

Although not directly included among the 17 goals set by the United Nations 2030 Agenda for Sustainable Development [44], sustainable mobility is addressed as a target of Sustainable Development Goal no. 11—Sustainable Cities and Communities. Moreover, the role of transport is directly or indirectly mainstreamed into many targets of the other SDGs [92].

Since its establishment in 1994, the European Union has played an important role in this debate. According to the Aalborg Charter for Sustainable European Cities [93], signed in the same year in Denmark by representatives of 80 local governments (which rose in the following years to about 3000 from 45 countries, including non-European ones), the model to aspire to is a high-density city, such that it allows for economies of scale in public transport and energy provision, organized into mixed-use neighborhoods to reduce the need for mobility. The Charter defines sustainable mobility as patterns that reduce enforced travel and favor intermodality between walking, biking, and public transport, while "Motorized individual means of urban transport ought to have the subsidiary function of facilitating access to local services and maintaining the economic activity of the city" [93] (p. 3).

In EU policies, such radicalism will later be softened in a framework where green cars still have a significant future in cities among the options of a multimodal offer. Information and communication technologies (ICTs) are also expected to play a major role, in terms of intelligent transport systems (ITSs) [94,95], aimed at optimizing the control and management of traffic flows, as well as providing user-friendly access and integrated pricing to the available mobility options and services (including shared modes, all types of public transport, parking facilities, and so on), according to the concept of mobility as a service (MaaS) [96]. In fact, urban transportation is the field in which the otherwise vague notion of a smart city [97,98] has a clear meaning.

An international framework to address sustainable mobility, originally developed in Germany in the 1990s, is the avoid–shift–improve (A–S–I) approach [99–101], according to which coordinated policies should, in this order, (i) prevent people from driving to meet everyday needs, or at least shorten the length of unavoidable motorized travel (avoid/reduce); (ii) provide environmentally friendly alternatives to the use of individual vehicles, such as active and public transport (shift/maintain); and (iii) increase the efficiency of motorized modes, including the fuel efficiency of all vehicles and the operational efficiency of public transport to make it more attractive (improve).

All three strategies have important spatial implications, such as the creation or redevelopment of urban neighborhoods and districts so that they are compact, mixed-use, and pedestrian-friendly, as well as the resetting of road and street space in order to prioritize active and public mobility modes.

Sustainable districts in Europe, compact neighborhoods planned according to the principles of New Urbanism in North America, and the international EcoDistrict protocol [102] have been so far, with "mixed success, especially outside Europe" [45] (p. 10), the test benches of the contemporary sustainability approach to respond to the first issue. As for the latter, best practices show how the process of the 'smart reuse' of road systems can be triggered by different measures: the inclusion of public transport tracks and reserved lanes (e.g., modern tramways in French cities [103] and bus rapid transit systems (BRT) in Latin America [104]); the implementation of low-speed zones, where traffic calming allows for narrowing motor vehicle driveways for the benefit of active mobility (as in Graz, Freiburg, and many other towns in Austria and Germany); or the creation of widespread bike networks (very common in Northern European countries).

Although, in current practice, the 'schism' between road engineering and urban design is still the rule, the renewed consensus on the multifunctional role of the road, at least in terms of multimodality, and the return to the scene of the pedestrian as an active subject of urban mobility, pave the way for reconsidering the social, and possibly ecological, 'return' of connecting spaces, from the perspective of a more holistic urban regeneration.

4. The Street as a Catalyst of Urban Regeneration

After decades of discussions about 'our common future', the promises of a global paradigm shift from an extractive development model geared towards unlimited growth, destructive of ecological balances and a generator of increasing social and territorial inequalities, to an alternative model that truly does not compromise "the ability of future generations to meet their own needs" [41] (p. 41) have remained largely unfulfilled, high-lighting the limits of an approach to sustainability conditioned by political negotiation and still influenced by an economistic and mechanistic worldview [40,45]. Hence the criticism from many quarters of conventional sustainability and its contemporary-science-driven declination, considered to be little more than palliatives for the environmental and social pathologies produced by the Anthropocene [104], and the call for a paradigm shift in the way sustainability is understood as well; that is, from a principle of containment–neutralization–compensation of the environmental impact of human activities to a holistic vision aimed "to restore and regenerate the global social–ecological system through a set of localized ecological design and engineering practices rooted in the context and its social–ecological narratives" [45] (p. 19).

The dynamic, processual, and relational character of regenerative sustainability, consistent with an interpretation of the world "as a fundamentally interconnected, complex, living and adaptive social-ecological system that is constantly in flux" [45] (p. 15), finds an immediate spatial analogy in the capital web, which encompasses both the environmental structure and the material communication systems of settlements. The latter embodies patterns of physical relationships and, through the movement of people and things, enables interaction between different parts of urban and territorial systems, orienting or supporting their development trajectories over time. This makes them, for better or worse, "clues to understanding how these systems are sustained, how they self-organize and how emergent outcomes are produced. And living systems theory would add, patterns are also clues to their evolutionary potential" [46] (p. 29).

In fact, the trans-scalar, ramified, and extensive nature of spaces for movement represents in itself a great potential for pervasive regeneration, if it is supported by resuming the multifunctionality that has always and everywhere characterized the street in the pre-Fordist city, in an updated way and congruent with today's challenges. Rather, the redesigning of these spaces should avoid uncritically reproducing, as happened with the rise of the automobile city, models and rationalities that are alien to the local context—as is the case today with buildings designed according to the standards of international sustainability certifications [40,105]. Instead, modes of transformation are to be sought in a deep and shared understanding of settlement principles and potentialities that shape the 'story of the place' [46].

Moreover, the new appreciation for the 'rue corridor' typical of the pre-industrial compact city does not exhaust the possibilities of using physical connections as a tool for reconstructing urban values—social, aesthetic, and environmental—even in the less dense and less defined parts of the settlement. Indeed, as Oriol Bohigas explains, speaking of transport infrastructures as contemporary forms of public space: "Communication facilities [...] may offer different typologies—the subway, underground or elevated circulation, traffic classification, new combination patterns, etc.—but all of them allow the priority permanence of the social functions that have been defined in traditional typologies" [106] (p. 21).

Looking back, the experience of Olympic Barcelona, of which Bohigas was a protagonist, is evidence of how a city, by pursuing a social return from the typological reinterpretation of different transport infrastructures, "has both forged for itself what is a model capital web and has demonstrated its extraordinary generative power in initiating and shaping change. What is impressive now is not just the individual interventions, but that the total transformation seems much more than the sum of its parts" [107] (p. 33).

The governance of mobility and the reconfiguration of related spaces can thus become a powerful catalyst of urban regeneration, in a symmetrical and contrary way to how the unfettered growth of individual motorization has so far been a source of functional imbalances, loosened social relations, environmental degradation, and semantic impoverishment in cities worldwide.

4.1. Urban Visions beyond the Automobile City

A radical change in the way street spaces are used underlies new visions of cities that interpret the transition to less energy-intensive and more resilient urban models as an opportunity to enhance the intrinsic or latent qualities of a place, improve its ecological performance, foster sociability, and create a healthier and safer living environment for citizens.

Transit Oriented Development (TOD) and Equitable TOD (eTOD), the Car-free City and the Walkable City, the 15-Minute City and Complete Neighborhoods, the Climate-proof City, and the Net-zero Carbon City are some conceptualizations to identify the best-known models that, although not replicable everywhere in the forms in which they have been experimentally applied in some specific contexts, have high degrees of adaptability and scalability. While presenting overlapping aspects, these visions use different lenses to address urban sustainability.

TOD, theorized by the U.S. urban planner Peter Calthorpe as an antidote to urban sprawl [108], inspired by virtuous Northern European examples of compact cities networked with efficient public transport services, envisages an urban organization structured by public transport routes and polarized around transit stops, concentrating the most attractive activities and facilities within pedestrian priority zones. The model is thus based on the integration of urban and transport planning to break the vicious circle between urban growth, land consumption, car dependence, and related environmental impacts. Its most literal application is in Portland, following the Metro 2040 Growth Concept [109], where it proved to be an effective method of reducing traffic congestion. Promoted by the World Bank as a model capable of overcoming the structural dysfunctions of mega-cities in emerging countries [110], while pursuing sustainable mobility, it usually results in an increase in real estate values in the best-serviced urban areas, leading to gentrification, which exacerbates, rather than heals, mobility injustice relating to social conditions [111,112]. Revisiting the model in terms of eTOD [113,114] entails the adoption of accompanying institutional measures aimed at involving the communities concerned in land use and planning processes, protecting low-income residents and local business, and supporting affordable housing programs along the transit lines to prevent predictable degenerative effects and restore TOD to its transformational significance.

In the Car-free and Walkable City, the focus is on ensuring the accessibility, on foot and by other environmentally sustainable means, of the main urban places and facilities as a prerequisite for traffic restriction or prohibition in large parts of the city [23,115,116]. The design of a pedestrian-friendly and attractive environment enhances the role of the street as a public space, where, besides walking, people can stop, stroll, meet, enjoy the urban landscape, play, and exercise—thus also promoting a healthier lifestyle [117,118]. Extensive pedestrian networks (quite different, therefore, from confined pedestrian precincts in places of commercial or tourist interest) have been created in Cordoba (Argentina) and Munich since the 1970s [119–121]; strategies towards the Car-free City are now being implemented in some major European cities such as Hamburg and Oslo [118], while ambitious walkability plans have been proposed for Stockholm, London, and Berlin [122–124].

The 15-Minute City and Complete Neighborhoods models primarily pursue a social purpose, that is, the creation of a network of living communities, to be leveraged by fostering urban proximity, so that all citizens can meet their daily needs (including healthcare, education, shopping, and recreation, as well as have access to green areas) within a short walking distance from home [125]. Complete Neighborhoods are a key goal of urban planning in Portland, Melbourne, and Vancouver [126] to complement sustainable transport strategies (such as TOD in Portland). Paris' version of the 15-Minute City, namely 'La Ville du Quart'Heure', is informed by smart city advisor Carlos Moreno's view of a city [127,128], where daily commuting is no longer necessary thanks to a polycentric organization based on four pillars: proximity, density, functional mixity, and digital ubiquity (i.e., the spread of smart working). During the COVID-19 pandemic, the 15-Minute City model was included as one of the keys for a 'Green and Just Recovery' in the Mayors' Agenda of global cities belonging to the C40 network [129].

Climate mitigation and adaptation are the objectives behind the Net-zero Carbon City and the Climate-proof City, respectively [130–132]. More specifically, in the former, the objective is the decarbonization of most human activities and the offsetting of residual emissions by increasing the ecosystem performance of the territory. According to the EU Sustainable and Smart Mobility Strategy (2020), to achieve carbon neutrality by 2050 in the member countries, transport-related CO_2 emissions should be cut by 90% compared with current levels [133]. Such a substantial reduction requires a leap in scale compared with the mobility policies implemented so far in European cities, which can only be achieved by drastically reducing the number of daily trips made by individual vehicles, thanks to a more evenly distributed location of urban facilities and improved walkability, bikeability, micro-mobility, and shared and public transport, prior to the replacement of endothermic engines with electric motors powered by renewable sources—that is, more by 'avoid/shift' than 'improve' measures. This implies a radical change in the urban streetscape to adapt mobility networks both to the new multimodal offer and the fulfillment of compensatory ecosystem functions.

Integration of urban forestry and nature-based solutions (NBSs) into street design to enhance the ecosystem functions of the urban environment [134–136] play a decisive role in making cities more resilient to non-reversible local impacts owing to the global climate crisis, such as the urban heat island effect, runoff, and pluvial floods caused by extreme precipitation. An advanced example of this is the Copenhagen Strategic Flood Masterplan by Rambøll Studio Dreiseitl (2013), which provides a toolbox for extensive interventions on the public space, including new designs for streets, boulevards, parks, and plazas, so that, when floods occur, they could significantly contribute to water retention and drainage, while creating a new urban landscape that is dynamic and sensitive to changing weather conditions [137].

4.2. Streets and Roads as Spaces of Potential

The above visions and models are conceptualizations of what can be achieved at the urban scale by making better use of connection spaces, both by retrofitting the existing city and in newly designed developments. The image of the possible city they deliver is reflected and often anticipated by new street environments, such as the outcome of material and immaterial actions on the setting or use of streets.

The ability to unveil potentials beyond the spatial and temporal limits of the intervention is fully in line with the logic of regenerative design. A recurring reference is made in the scientific literature on this topic to the conceptual framework proposed by the organizational architect Charles Krone to interpret the different 'levels of work' at which every living system (including urban systems and their subsets) operates [37,46,138]. An ideal line separates the two hierarchically lower levels, working on existence—in order, 'operate' and 'maintain'—from the top levels, working on potential—'improve' and 'regenerate'. 'Below the line' work is necessary to increase efficiency and maintain the effectiveness of the system in the face of external perturbations or threats, such as the global climate crisis. 'Above the line' work realizes the potential embedded in the system, letting it evolve and contribute to the advancement of the broader whole of which it is part. According to Mang and Reed, "Understanding regeneration as a hierarchy of differentiated levels of work offers an ecosystem perspective that can reveal both the interrelatedness and necessary interdependence of the different sustainability approaches, as well as the distinctive niche each occupies" [46] (p. 27).

If we apply this framework to urban mobility infrastructure, we can argue that operating and maintaining levels of work address the technological upgrading and spatial adaptations of the transport system that are necessary to accommodate the shift towards clean vehicles and multimodality, thereby ensuring the required transport performances while counteracting GHG emissions. According to this sectoral view on sustainable transport, derived from the contemporary-science-driven approach to sustainable development, no question arises about the role of urban connections as channels for traffic.

However, as the goal of any sustainable transport strategy is to achieve a modal split from the car to other modes of travel, management of the 'spatial split' consequent to this technical action provides an opportunity for interventions, either local or systemic, whose social and environmental return can go far beyond the sectoral dimension of transport. This is what the urban planner Bruno Reichen, talking about the 'revolutionary' outcomes of modern tramways in French cities, defined as "induced urbanism". "The observation of the shift from a technical project to an urban project adapted to the distinctive situation of a city is a remark that can be made for all recent projects. What is called urban integration underlies the effort to multiply the effects induced by the project. To such an extent that the criterion of integration often becomes the premise for the choice of the mode of transportation" [139] (p. 88).

By reference to Krone's framework, working 'above the line' means bringing out this potential, leveraging the special prerogatives of mobility spaces, such as

- The vocation to act as multifunctional public spaces;
- 'Federative' ability—i.e., the ability to link together different places, policies, and expertise;
- Adaptability over time to changing needs—an inherent quality of open spaces that urban connections deploy at all settlement scales.

By-default outputs of sustainable mobility provided by the bottom levels of work, such as better air quality, less traffic noise, and increased safety for vulnerable road users, make an essential contribution to creating the conditions for this leap forward, meeting the basic quality criteria that livable public space must ensure—such as "protection against risk, physical injury [...] and unpleasant sensory influences" [17] (p. 238). Further improvements—in terms of urban livability and social inclusion, access to urban facilities, imageability and cultural significance of the place, landscape quality and ecosystem services, climate resilience, environmental health and well-being, and so on—may then trigger regeneration processes at the highest levels.

4.3. Realizing the Potential: Reinvented Streets and Roads as Germs of Sustainable Regeneration

Since the polemic against functionalist planning and post-World War II programs to make Western cities car-friendly, the revaluation of the street as a vital component of the city is a topic of discussion that over time has been enriched with projects and proposals that go beyond the nostalgic revival of models from the past. Although this attitude is still present, for example, in New Urbanism's call for traditional neighborhoods [140–142], the appreciation of the street as a space of potential has shifted from praise of the pre-Fordist 'rue corridor' to the rethinking of all types of connections in response to different needs and purposes. The range of practices and experiments at different settlement scales and with different degrees of transformation is now very wide: from local streets to urban highways, from the reuse of roads and streets without any modification in their layout to the heavy renovation of transport infrastructure aimed at optimizing its integration in the environment, from the prefiguration of alternative patterns to their practical testing on existing street spaces, and so on.

By way of acknowledgment, different types of actions related to the reuse and redesign of urban connections, which can be read under the lens of regenerative sustainability, are classified below and summarized in Table 1. Three keys related to the abovementioned prerogatives of mobility spaces—inherent multifunctionality, federative ability, and adaptability over time—are used:

- The original motivations of the project, i.e., the primary function or need the planned intervention is intended to meet;
- The mode of intervention, with respect to the possibility of producing chain or extensive changes from single or coordinated actions;

- Finally, and closely related, the mode—temporary or permanent—of the transformations, in which the dynamic-processual character and the long-term vision of regenerative sustainability are respectively reflected.

Table 1. Inductive classification of regenerative actions on urban connections.

Classification Keys	Type of Actions	Recurring Applications
Principal Motivation	Reallocation of road space	remodeling existing roads
		indirect (regulatory) actions
	Re-mending of physical relationships	underground tunnels
		trench covers
		pedestrian/bicycle bridges
	Increase in pedestrian space	shared streets
		roadway pedestrianization
	Climate mitigation and adaptation	biophilic design of streets
		indirect (regulatory) actions
Mode of Intervention	Demonstrative actions	reclaiming streets for active mobility
		reclaiming streets as public space
	Regulatory actions	regulations and standards
		guidelines
		incentives
	Hotspot/incremental actions	urban acupuncture
		tactical actions
	Extensive/systematic actions	based on transport plans/programs
		based on integrated plans/programs
	Flagship actions	
Implementation mode	Permanent actions	
	Temporary actions	

Many gradations and overlaps can be found between and within the groups, as exemplified in Table 2, with reference to some significant case studies cited in the paper.

4.3.1. Classification by Principal Motivation

We can distinguish four groups of actions, with some possible corollaries.

1. Actions to reallocate road space, aimed at favoring alternative modes of transport to the car. These interventions apply sustainable transport policies and plans, whose physical spatialization, hand in hand with increased access to mobility for vulnerable road users and sections of the population that were hitherto totally or partially excluded from it, is addressed to multiply the related positive effects on livability, social and economic vitality, and the environmental and landscape quality of the concerned areas. Such interventions usually imply the horizontal division of the street section into lanes dedicated to different modes of transport (individual motor vehicles, public transport by road or rail, and bicycles), sized according to their technical parameters, and pedestrian strips intended for different social uses and landscape arrangements, which are more flexible and can be integrated with the open spaces adjacent to the infrastructure. The "shift from a technical project to an urban project" [139] (p. 88) is manifested, along with its effective capacity to produce additional social and environmental returns, in the balance achieved between conflicting spatial needs, depending

as much on the service level of transport infrastructure as on the variables of the place. This group covers the following:

- Projects to remodel existing roads—e.g., urban arrangements along the tramway lines built since the 1990s in French cities such as Strasbourg, Bordeaux, Lyon, and Nice [103]—as well as the construction of new roads according to the same principles—e.g., the recent 1.5 km north extension of the central axis of Tirana (Zog I Boulevard) [143];
- Indirect actions, such as the definition of new design criteria and dimensional parameters, to reshape the urban street and road network—e.g., the *New Metrics for 21st Century Streets* set by the New York City Department of Transportation in 2012, to meet safety, environmental, and livability issues [144].

2. Actions aimed at establishing or mending physical relationships, mainly pedestrian, between parts of the city divided by infrastructures such as freeways, railways, and canals. The doubling of layers, which allows the infrastructure service level to be maintained while overcoming the related barrier effect, is achieved by the vertical division of paths, which can be obtained in three different ways:
   - By channeling traffic into a tunnel and accommodating the reclaimed public space above (see, for example, the undergrounding of the Central Artery in Boston [145] and of the M30 motorway in Madrid [146]);
   - By means of a walkable slab built above the infrastructure (as in the pioneering Freeway Park project in Seattle [147,148] and the green covering of Avenue Presidént Wilson in Saint Denis, north of Paris) [149];
   - By means of pedestrian walkways that cross the infrastructure at height (e.g., the crowdfunded Luchtsingel pedestrian bridge in Rotterdam, which reconnects public spaces in a suburban neighborhood of the city by overcoming a railroad and a major traffic artery [150]). In such cases, the regenerative effect derives not so much from the multifunctionality of the link as from the possibility of creating new patterns of relationships on a different layer, resulting in a new whole that is more than the sum of its parts.
3. Reuse, adaptation, and transformation of road sections, where the increase in pedestrian space is the main purpose and not the side effect of more 'ecumenical' transportation planning. At the neighborhood scale, this goal often conveys an explicit intention to foster social interaction and inclusion, universal accessibility, and a sense of community, and is thus frequently pursued in the context of participatory processes. The opportunity to return to people spaces formerly occupied by motor vehicles can be pursued in two different ways:
   - On the basis of a principle of space sharing, which does not exclude the automobile, but subordinates its use to rules of coexistence with vulnerable road users (i.e., by traffic calming measures, like in the aforementioned 'living streets' or 'home zones' [77]);
   - Through the pedestrianization of roadways and parking lots, following the definition of new traffic patterns (an example is the renovation of the 400 m long central section of Slovenia Street (Slovenska cesta) in Ljubljana as a boulevard for only pedestrians and public transport [151]).
4. Regreening actions, aimed at climate mitigation and adaptation. In this case, the public space regained from the modification of road sections is characterized by the increase in planted areas, the use of NBSs, as well as the integration of the concerned stretches into green corridors [152]. The group includes:
   - The biophilic (re-)design of streets and roads (a pioneering example is Seattle's Street Edges Alternatives (SEA) pilot project for roadside rain gardens, whose success in managing runoff led to the establishment of new city standards [153]);
   - Indirect actions, addressing and supporting the redesign of roads as blue-green infrastructure (e.g., the Green and Healthy Streets Fund delivered by the Mayor

of London in partnership with Transport for London to financially support projects that integrate green infrastructure and climate resilience measures, while promoting active travel [154]).

4.3.2. Classification by Mode of Intervention

Five types of actions fall into this group.

1. Demonstrative actions. These are short-term actions, in the form of happenings or occasional events, aimed at reclaiming the use of street spaces, monopolized by cars:
    - For active mobility (see, for example, the demonstrations of the global Critical Mass movement, aimed at promoting the use of the bicycle in the city [155]);
    - As public space, by applying the regenerative logic inherent in the practices of Tactical Urbanism [156]. With special regard to the American context, Bertolini reviews many street experiments pursuing the vision of 'streets for people instead of 'streets for traffic'—namely 'intersection repairs', 'parklets', 'pavements to plazas', 'play streets', 'open streets', or 'ciclovias'—wondering about their effectiveness in triggering systemic change in urban mobility [157]. This is in fact difficult to assess, as the author concludes, because of the lack of data and the confined and short-term nature of such initiatives, which sometimes only last a few hours. However, under the lens of regenerative sustainability and design, it is important to highlight their communicative significance, not only in relation to their ability to self-promote and reach out to the population where the event is organized, but also, and especially, in conveying alternative worldviews, through a different narrative of the street that illuminates its hidden potential, which the experiment proves to be 'possible utopias'.
2. Regulatory actions. These are intangible actions that inform, guide, or support the transformation of roads and streets, both spatially and in terms of their use, from channels of traffic to multifunctional components of the urban system. They include regulations, standards, design guidelines, dedicated funds, and so on. In addition to the examples already mentioned, there is the Code de la Rue, which, in Switzerland, Belgium, France [158], and Luxembourg, complements traffic laws, allowing for the creation, through civic participation processes, of Zones de Recontre, where streets are subject to limitations on vehicular speed to benefit vulnerable users and foster urban vitality. The guidelines recently released by the Ministry of Housing and Urban Affairs of India to make arterial roads safe and friendly to pedestrians and cyclists using low-cost techniques of Tactical Urbanism [159] can also be taken as a reference for this kind of action.
3. Hotspot actions following an incremental approach. These consist of localized, sometimes small-scale, interventions on focal points of the system, potentially reproducible in similar ways at other locations and at different times. They are aimed at bringing or restoring civic uses or ecosystem functions in urban spaces that are mostly used as traffic channels or parking lots. Actions of this nature are typically referable to the methods of Urban Acupuncture and Placemaking [160–162]. In addition, as in Milan's Piazze Aperte program, they can represent a first 'tactical' step to test, by means of reversible low-cost works, new urban arrangements, which, once they are successful, can be turned into permanent ones [125]. A special case of incremental intervention is the "One-Minute City" program launched in 2020 by the Swedish Governmental Agency for Innovation Systems Vinnova, whose purpose is to promote proximity relationships through newly designed modular street furniture, matching the size of parking spaces, which can be easily assembled by residents outside their front door, to create basic facilities such as playgrounds, mini-gardens, places for sitting, bicycle racks, and so on [163,164].
4. Extensive actions following a systematic approach. These planned actions correspond to the creation of new networks for public transport, cycling, and walking, as well as greenways, understood as a strategic lever of the transition to more sustainable urban

models, including the previously mentioned ones: TOD, the Car-free city, the Walkable city, the 15-Minute city, and so on. Thirty years after its groundbreaking urban renewal interventions for the 1992 Olympics, Barcelona is again an outstanding case study for the Superilla Plan, adopted in 2019 after being anticipated by incremental pilot projects at neighborhood scale [125,165]. The plan would rearrange the Cerdà grid by creating a network of 'green streets' with traffic-calmed 'superblocks' inside and new plazas at major intersections. In this way, 40 hectares of pedestrian and green areas will be reclaimed for public use. A further example of a systematic intervention aimed at climate adaptation is being implemented in Copenhagen in pursuance of the Strategic Flood Masterplan. The aim is to make the Østerbro-St. Kjelds neighborhood the city's first climate-resilient neighborhood, having its streets transformed into blue-green infrastructure for cloudburst management [166].

5. Flagship actions. Here, this means interventions with great iconic or symbolic value, which do not necessarily affect large systems but prompt a change in perspective and introduce new urban narratives. Although they are not replicable in the strict sense, as they are closely related to specific occasions and spatial conditions, their communication ability makes them an inspirational model to interventions à la manière de at various scales and in different contexts. The creation of pedestrian routes from the reuse of decommissioned transport infrastructure (such as Paris' Promenade Plantée and New York's High Line [167–169]) as well as from their demolition (such as Seoul's promenade along the previously tombed Cheonggyecheon Stream [170]), falls into this category.

4.3.3. Classification by Implementation Mode

Depending on their temporalities, actions can be distinguished as follows.

1. Temporary actions. This is the mode specific to demonstrative actions and incremental interventions that use Tactical Urbanism techniques [150] to test new arrangements, possibly as a prelude to permanent transformations. This group also includes transformations induced by new regulations for roads and streets, which, while altering, even radically, their ordinary conditions of use, maintain the pre-existing physical arrangement and are reversible. This is the case with streets that have just been pedestrianized before undergoing renovation or that are closed to traffic in a temporary, though recurring, manner. A striking example of the latter is the Minhocão highway in São Paulo, a 2.8 km overpass that runs through the middle of a dense urban fabric, which, since 2013, in the evening and on weekends is transformed into an urban promenade [171].
2. Permanent actions. These interventions alter the constructive characteristics of the street or road, resulting in assets to meet new uses that are no longer reversible, but by carrying out further structural works. The category includes the following:
    - The reallocation of road space, previously occupied only by automobile traffic, to different modes of transportation, especially when new dedicated infrastructure is built (e.g., tramway tracks, protected lanes and equipped stops for BRT services, and so on);
    - The final designs of reclaimed spaces following successful temporary experiments;
    - Projects aimed at creating a new urban landscape, using urban connections to improve ecological and climate performance in the built environment;
    - Projects to reuse decommissioned transportation infrastructure, entailing its integral redesign as active mobility routes and green corridors;
    - Interventions that seek to reconcile the maintenance of significant traffic flows with the creation of a friendly environment for pedestrians and bikers by 'splitting' the infrastructure (through a tunnel, overpass, or footbridges) to vertically separate the two levels.

Table 2. Interpretation of significant case studies of street and road reclamation and design using the proposed classification keys.

Mode of Intervention / Implementation Mode	Reallocation of Road Space	Re-Mending of Physical Relationships	Increase in Pedestrian Space	Climate Mitigation and Adaptation
Demonstrative actions	Critical Mass movement's initiatives *	Intersection repairs *	Open streets *	Parklets *
Regulatory actions	India Tactical Urbanism guidelines *	São Paulo (BR) scheduled closures of Minhocão highway *	Switzerland, Belgium, France Code de la Rue *	London (UK) Green & Haelthy Street Fund
Hotspot/incremental actions	Tirana (AL) Zog I Boulevard's extension	Rotterdam (NL) Luchtsingel pedestrian bridge	Milan (I) Piazze Aperte program *	Seattle (US) Street Edges Alternatives project
Extensive/systematic actions	Curitiba (BR) BRT system	Boston (US) Tunneling of former Central Artery	Barcelona (E) Superilla Plan	Copenhagen (DK) St. Kjelds resilient neighborhood
Flagship actions	Paris (F) Champs Elisées' reclamation	Seattle (US) Freeway Park	NYC (US) High Line	Seoul (KR) Cheonggyecheon Stream promenade

* Temporary/reversible actions.

The range of actions that have produced visible transformations of the capital web intersecting the above three categories is extremely broad and affects large, medium, and small urban areas in different regions of the world. It is evidence of a growing awareness of the potential multidimensionality of the urban street, whose inherent "functional and semantic depth" [16] (p. 41) has been flattened by the predominant hydraulic use assigned to it by traffic engineering, but which can still be revived through regenerative design in every type of connection, including the most specialized ones.

5. Conclusions

The international debate on sustainability, even in its most reductive forms, reflected in a still sectoral approach to urban transport, has nonetheless given a significant impetus to the reconsideration of the street as a multifunctional space, questioning the primacy of the car and bringing active mobility back on the scene. With these premises, the emergence of a new wave of sustainability allows us, on the one hand, to reread the most advanced design experiences of the recent past from an evolutionary perspective, while, on the other, it calls for an approach to urban design that integrates objectives, spaces, design expertise, and spatial and temporal scales. This makes the street, in terms of both its federative capacities and symbolic significance, an increasingly strategic field of application for urban regeneration to convey new visions of a sustainable future—here, summarized in the terms of the post-automobile city [20]. This is true even though the scientific literature on regenerative design has so far focused on the topic to a limited extent. While much research has been devoted to sustainable mobility, both as policy and in its many engineering implications, the opportunities that a mobility turn can engender "on the urban socio-spatial continuum" [24] (p. 117) have remained in the background, and even more so the possibility of reorienting mobility strategies within a holistic approach that "embrace the notion of adding value to place and aspire to deliver enduring, net-positive benefits to social, economic and ecological systems, while considering these systems and benefits in an integrated way" [172] (p. 139).

The contribution of this study is to partially fill this gap, by

- Explicating the prerogatives and potentials of connecting urban spaces to act as catalysts and drivers of extensive sustainable regeneration;
- Claiming the multifaceted nature of mobility spaces, often still considered a 'monopoly' of road and traffic engineering and, therefore, approached in a mechanistic and reductionist way, insufficient to meet the challenges of the ecological transition of cities; in fact, the proposed shift of mobility infrastructure from a technical project to a civic design project is a way, consistent with Carmona's definition of urban design, to make "better places for people than would otherwise be produced" [28] (p. 74);
- Providing a unifying conceptual framework for projects that, while very different in nature, size, and duration, share the ability to capture and harness the immanent potential of urban connections to leverage regenerative sustainability. It is believed that this effort can have practical utility, both in guiding planners and designers from 'improving' to 'regenerating' levels of work and as methodological support to community-led and research-action initiatives.

The exclusively inductive and qualitative approach that informs the classification of the actions proposed in Section 4 can be seen as a limitation of this research. Anyway, in line with the concept of regenerative sustainability, the goal was not to arrive at an exhaustive taxonomy, but a conceptualization that would help build a narrative for regenerative streets and roads.

One limitation is certainly the small number of case studies cited, which does not account for the extremely rich, albeit fragmentary, panorama of regenerative streets pioneered in all corners of the world. It is the author's intention to give more space in a forthcoming, broader publication to the many case histories collected and in constant evolution.

Further research should be addressed to the crucial testing ground for regenerative and civic design, that is, the low-density suburbs and superblock urbanization following the North American model [173], which is still dominant in many other regions of the world as well [174]. Moving from the postulate of promoting alternative transport modes to the car, available studies on this type of settlement mostly focus on traffic regulation and geometrically based analyses of the road network [9,175–178]. However, the key issue seems to be a different one; that is, why, in a city designed for the automobile, should people move by other means? If it is true that "No problem can be solved from the same consciousness that created it" (Albert Einstein, quoted in [179]), it is more likely that the question can be answered within a process in which all components of the place synergistically come into play, leveraging latent qualities to give new meaning to the whole, rather than from studies that still address mobility as an autonomous function with its own rules and standards.

One more challenging aspect to be further investigated is how to prevent regeneration interventions from turning into drivers of gentrification, albeit in its 'green' and 'ecological' variations [180–182].

Some flagship projects of urban connections presented as regenerative practices, such as the High Line in New York City or the BRT system in Curitiba, are now suffering from their own success and are being critically reconsidered with regard to the unequal distribution of the benefits that they produce for the population [183,184]. The problem, as we have seen, is common to TOD projects (hence the need to rethink the model in terms of equitable TOD), but also to market-driven neighborhoods planned according to the principles of New Urbanism [185–187] and to many pedestrianizations carried out with the aim of creating more livable environments (not to mention pedestrian areas created only to accommodate mass tourism in art cities). Special attention should thus be paid to practices in which the goals of social equity and the protection and participation of low-income populations are internalized in the transformative process.

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