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DESIGN EXPERIMENTATION FOR BUILT ENVIRONMENT'S CARE

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ABSTRACT
In view of the necessary change towards reduced land use, reuse of built environment and urban regeneration, this research-action looks at the redevelopment of peri-urban and complex urban areas, where the contributions of different subjects converge towards the circular reuse of spaces and buildings, opening new scenarios for the regeneration of cities. The cooperation with university research and public administrations planning is central to the methodology used for the proposed project experimentations. This provides opportunities for action on urban systems for the future of citizens. The documented design experiments focus on abandoned residential, industrial and management architectures, subject to the application of environmental control techniques, technological retrofit, formal re-design and development of new social opportunities.

KEYWORDS
design research, environmental control, urban regeneration, sustainability, public engagement

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In Italy, in the year in which the Ministry for Environment, Land and Sea Protection changes its name to Ministry for Ecological Transition[1], it is clear how relevant it is to discuss circular economy, reuse of built heritage and energy efficiency in cities and territories. In particular, the built environment's care and the consequent improvement of the quality of life and the relationship between man and nature are central in the current change of direction reported in this contribution. The awareness of being in a finite system of resources has taken place at various levels all over the world for several decades, but the application of the necessary measures is still ongoing because of conflicting interests in today's societies and by a naïve – or deliberately superficial – confidence in the development of new technologies as a solution to the problem. The examples meant to explain these issues are related to the Italian context, but turn their gaze to the rest of Europe too by making comparisons with successful projects in terms of results. The debate focuses on overcoming the technicality in addressing the topic of the recovery of existing buildings and the 'implosion of cities' described by Renzo Piano (Vv. Aa., 2014). This question can be answered with the direct involvement of research institutes and universities in the preliminary phases of recovery interventions within the delicate systems of existing districts, among which the suburban, public residential and disused industrial ones stand out for their complexity.

Universities, places of innovation by definition, can guide the res publica to achieve these common objectives in complex contexts, also encouraging the definition of partnerships with private investors or, as in the cases reported, with the contribution of public funding. The aim is the transformation of cities and landscape with an environmental and social approach (Rossi Prodi et alii, 2013) by using research methodologies in the architectural technology field. Strategic design experiments, developed in cooperation with public administrations, Universities and managers of existing building complexes, should therefore be preparatory to the definition of urban implementation tools and projects according to the Urban Acupuncture Theory (Lerner, 2014; Casagrande, 2014), but keeping a holistic vision of the urban system.

Recycling: approach development | The conversation about working in a finite resource system is recently back to the centre of the debate on the development of architectural technologies, as shown by the works and words of the Pritzker Architecture Prize 2021 winners, Anne Lacaton and Jean-Philippe Vassal (Mayoral Moratilla, 2018, p. 29). Renzo Piano shares the same view, and in 2013 he started the experimental project G124 with the idea that the growth of cities must be implosive instead of explosive, healing the Italian suburbs where to the social, environmental, and ethical components are added the economic burden, becoming unsustainable to expand infrastructure away from the built centres.

The projects and experiments of these architects are based on the idea that it is possible to take care of the built through an in-depth analysis of the buildings with an ethical approach that evaluates the immaterial dimension of architecture, among which

Fig. 1 | Rooftop Housing before the retrofit on the left and after on the right, by Studio Albori, Milan (credit: Studio Albori, 2007).

Fig. 2 | Cité du Grand Parc before the retrofit on the left and after on the right, by Lacaton & Vassal e Frédéric Druot, Bordeaux (credit: Anne Lacaton & Jean-Philippe Vassal, 2016).

the social sphere clearly reflects its degradation (Jacobs, 1961). Looking back to the values that should inspire the interventions in the cities, although these define the direction, the need for economic funds and project management skills remains. In the past decades, this led to a widespread trust in technicality[2] as a solution to this dichotomy, so central as to be the driving force of incentives and programs for urban redevelopment and construction industry on the national territory. On the other hand, the recent experiments generated by the cooperation between institutions, individuals and Universities show that research itself is an interdisciplinary method suitable for delicate interventions in the urban fabric.

At national level, as in the European scenario, the residential heritage is the object of renewed interest to identify strategies for better social and environmental conditions using funding as a driving force, provided for energy upgrading and structural security of existing buildings. Looking at the development of legislation, this is a chance we must be able to take in response to an urgent need that is anything but obvious. Even the most recent national funding, the Superbonus provided by Italian Decree n. 34/2020 (Decreto Rilancio), is limited to punctual interventions for energy efficiency. A national intervention that opens up new opportunities but lacks a holistic design vision of the building complex and its urban system. The socio-economic conditions and the technical-constructive characteristics of the large residential heritage, from the immediate post-war period until the early eighties, are recently subject to physical degradation. In the last years this determined an in-depth reflection on requalification, also because their recovery will constitute, in the medium term, a significant percentage of the activities in the construction field, much more than new building interventions. Unfortunately, the redevelopment of these areas is not so profitable, and the change of building use requires long and complex bureaucratic procedures.

In the 1990s, a new approach to urban growth inside the city was adopted. To cope with this change of direction and the financial resources needed for its implementation, special legislative devices, such as the Programmi Complessi[3] focused on the

need for regeneration of residential areas, are born. Applying an integrated logic to the redevelopment, these overcome the single functionality of the Piano Regolatore Generale (General Town Development Plan) and open the way to the functional mixité able to enrich the social and economic cities and, more urgently, the suburbs. The failure of many applications of such tools is affirmed by the same initiative of the Ministry of Infrastructure that introduces, with Italian Law n. 134/2012, the so-called Piano Città to take the lead on urban policies that had no funding for over ten years. The 2000s experienced a boom in construction, stimulated by a strong expansion in residential demand. The building regulations on housing, a tool that should ensure quality standards, has become a limit to architectural research and it is one of the major impediments to the interpretation of new needs. Regarding European residential construction, in 2018 Anne Lacaton stated that: «However, today the residential architecture and layout of the units are not very different from those of the 60s and 70s. In my opinion, the public debate should focus on materials issue and on how to deal with a change in life of building in 50 years» (Mayoral Moratilla, 2018, p. 24).

Among the winning design experiments, especially in Northern Europe, we find cohousing as an innovative shared way of living (Lietaert, 2007; Nicol, 2012). In Italy, cohousing projects of public initiative do not find a clear regulation that can support and guide their implementation. The analysis carried out by the Department of Architecture of Florence[4] in 2013 highlights that 57% of cohousing projects in Italy reuse existing buildings: an innovative model of public-private partnership and an effective instrument of urban regeneration through the reuse of public real estate (Bellini et alii, 2015).

An example of a mere technical regulation with predictable poor results is the Rooftop Housing by Studio Albori in Milan (Fig. 1). Encouraged by the regional law for the recovery of roofs for residential use, they built new apartments with a contemporary visual language such as the elevations of two municipal residential towers of the 80s. The implementation phase encounters several difficulties that the municipality itself had to remedy, negatively affecting the final architectural result and the objectives set by the intervention programme. Redevelopment projects of buildings in residential districts, worthy of the Mies van der Rohe Award in 2017 and 2019 respectively, are the Cité du Grand Parc by Anne Lacaton & Jean-Philippe Vassal and Frédéric Druot built in Bordeaux in 2016 (Fig. 2) and the Kleiburg Deflat by NL Architects and XVW Architectuur built in Amsterdam in 2016 (Fig. 3). In the case of Kleiburg, the prize was awarded for the first time to a redevelopment project, demonstrating the relevance and potential of the topic of the recovery of residential heritage.

Besides the change of Europe's political borders, in 2019 Collective Architecture recovered the Woodside Multi Storey Flats in Glasgow, 3 public residential towers of 22 storeys, each built in the 60s (Fig. 4). After an initial social analysis, the strong sense of community encouraged the Administration to abandon the initial demolition project. The intervention takes the lead in the United Kingdom for the energy performances achieved above the British regulatory standards, proving to be at the forefront

Fig. 3 | Kleiburg DeFlat after the retrofit, by NL Architects e XVW Architectuur, Amsterdam (credit: NL Architects, 2016).

Fig. 4 | Woodside Multi Storey Flats after the retrofit, by Collective Architecture, Glasgow (credit: Collective Architecture, 2019).

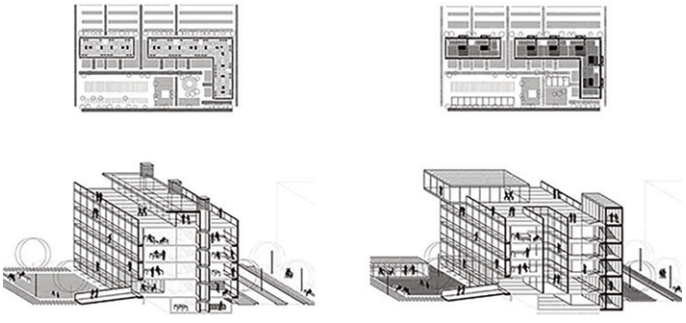


Fig. 5 | Soft retrofit on the left and medium retrofit on the right, Casale Caletto (source: S. Paris and R. Bianchi, 2018).

at international level. As in the case of Collective Architecture, sensitivity to the current environmental crisis (Flora and Dye 2015) and the experience of such projects can give an impulse to professionals to set a research team on sustainable design within the structure (Collective Energy).

Complex contexts such as these stimulate the project towards innovation, making clear the need for an interscalar and interdisciplinary experimentation support which can be found in Universities. For instance, Renzo Piano affirmed his confidence in university experimentation by choosing young students from various Italian University Institutes (Pellizzari, 2020, p. 10). Among the points of the G124 philosophy, there is also the commitment to obtain European funding through strategies that involve university research and public administration. Thanks to this, it was possible to develop the research funded by the Tuscany Region and commissioned by Publicasa to the Department of Architecture of the University of Florence, titled Tools and Methods for the Supply of New Social Housing Models in the Context of Processes of Valorisation of Public Real Estate Assets, to provide new social housing models and energy saving techniques through project outcomes of Cohousing in Rete[5] workshop. Leoncini, director of Publicasa S.p.A., highlights how this collaboration allowed the public structures to be at the forefront, becoming a support to innovations and to the raising of quality standards (Bellini, De Santis and Macchi, 2014, p. 5). The collaboration between university research and public administration planning is central to the methodology followed for project experimentations (Barberis and Cattaneo, 2019). The outcome of the research was presented in 2015 as part of international study days organised by the Department of Architecture of the University of Naples (Acampora et alii, 2015). The aim is to allow municipalities to meet the needs of social categories that are not fulfilled in the current public housing heritage, through tools and methods of design support that can interpret the present creating a new logic of living (Acampora et alii, 2015).

Paris and Bianchi (2018) carry out research activities on existing public residential housing, defined as ‘experiments’ to verify the possibility of operating following an innovative idea of the living culture, addressed to the managers of the public residential patrimony. Among their case of studies, the complex in the medium-density district of Casale Caletto in Rome and the complex of intensive economic and popular building in Le Vele district of Latina, both made in the 80s, are emblematic. The adopted experimental procedure demonstrates how energy-environmental sustainability of buildings can become effective only if combined with economic and social one. In this sense, local authorities, associations and citizens were involved in figuring out what were the social disadvantages related to the degradation of buildings as well. They have defined an abacus of interventions of ‘soft’ and ‘medium’ retrofit (Fig. 5) with different degrees of impact on buildings and citizens based on the economic availability of the managing institution. In terms of energy, technological solutions have been catalogued according to different level of resources used for their realisa-

Fig. 6 | Senator Renzo Piano's room G124, tutor and young architects of the G124 group, Rome (credit: C. Morelli, 2014).

tion to ensure the internal comfort of the building. Experimentations are currently being carried out in agreement with the public institution.

Project experimentation can take different forms, from field research to reflections in the University circle, to the 'artisan' work as that of Renzo Piano in his room in the Senate (Fig. 6). Although the actions of G124 have often been translated into real DIY laboratories, in many cases the young architects and students involved in the project team have not been attached to the present but have left ideas for the future. In Padua, the students divided the project in three phases that corresponds to the growing scale of work and the increasing number of participants involved. The last phase concerns an architectural project experimentation and an urban strategy, based on a feasibility study for the introduction of various functions oh the neighbourhood to be inserted around a new town square. The experience shows the lack of foresight of the Institutions towards a design experimentation that lays the foundations for a future optimal planning instead (Pellizzari, 2020, pp. 70, 71). Given the complexity of urban and design issues of built heritage, an interdisciplinary approach is necessary as well as the tangible cooperation between public administration and research, especially in a European vision. Therefore, these processes can give an impulse to the participation for the new Horizon Europe 2021-2027 competitions in order to provide wealth to the citizens in a sustainable vision for the future of cities and environment.

Recycling for the care of living | In recent years the increasing quantity and reliability of data on global damage, produced by modern science, has been pointed out to politicians by the new generation[6] and cultural[7] environmental movements. On the one hand, the urgency, where accelerations and stalls accompany this transition that invests reasoning on science and political forms (Campanella and Gagliasso 2020, p. 19), on the other hand, the strategic choices that descend from a cultural discontinuity still in progress that highlights the distortion between the magnetic attraction exerted at all levels by the topic of environmental sustainability and the poor results achieved until now. In order to make some progress, we need sustainability perspectives that require non-standard scientific and political reasoning, prediction of possible scenarios,

restoring quality, making them more sustainable, less energy-intensive and less polluted with processes and tools that allow us to deal with the global crisis by making 'more with less' (Berni and Boeri, 2012). Anne Lacaton suggested that the idea is not to do less, but rather to establish a hierarchy and do more; that is why working on existing conditions is another parameter we consider; less material means less risk of degradation; we aim to minimise the structure and partitions, allowing people to add refinements at the end of the process (Mayoral Moratilla, 2018).

For this reason, besides identifying criticality and possibilities to define new punctual and urban strategies for recycling, the participation of the University in the analysis phases of the areas generates a widening in the debate and new reflections for public administrations (Regione Toscana, 2019). In fact, The University can provide overall proposals for a true integration of areas that have shown potential for new models and new qualities of use. In the current practice of public housing managers, it is possible to record a progressive introduction of decisional support tools and virtuous practices in the intervention on the built. These suggest possible directions of research aimed at greater efficiency in the planning of redevelopment activities of the public housing stock. Thanks to the conscious use of technology in research, the proposals follow different perspectives on recycling issue; they materialise according to the design keys of the selective conservation of existing heritage, of its adaptation and volumetric and functional increase, of its environmental and physical sustainability, so that historical stratification and progressive innovation find the most appropriate ways to conciliation and expression.

Circular city roadmap: the city of Prato | The research finds its area of experimentation in the city of Prato and in the enlightened vision of its administration that pays attention to the issues of sustainability and the consequent future vision for its citizens. The identity of the City of Prato, since medieval times, has been shaped by its industrial vocation, but it is in the nineteenth century that the city is transformed due to an important industrial development, which still makes it one of the most important textile districts at European level. Giacomo Becattini (2015) highlights the value of the place of industrial districts such Prato. The consciousness of places also depends heavily on good administration of the urban territory and it can be threatened by capitalist penetrations that generates monotony and homologation in the industrial districts (Becattini, 2015). The demographic and economic growth of the Second World War has been characterised by a substantial immigration from southern Italy that doubled the resident population. This process has accelerated the birth of a social mixité that lasts (with a prevalent immigration from China) and a great urban growth in various directions.

Since 2013, the Prato Administration has been engaged in the organic reinterpretation of the urban fabric, complex and full of overlaps between productive and residential fabric. A programmatic work on some instruments and related interventions (partly in the phase of realisation[8]), which inserts Prato into the European network of circu-

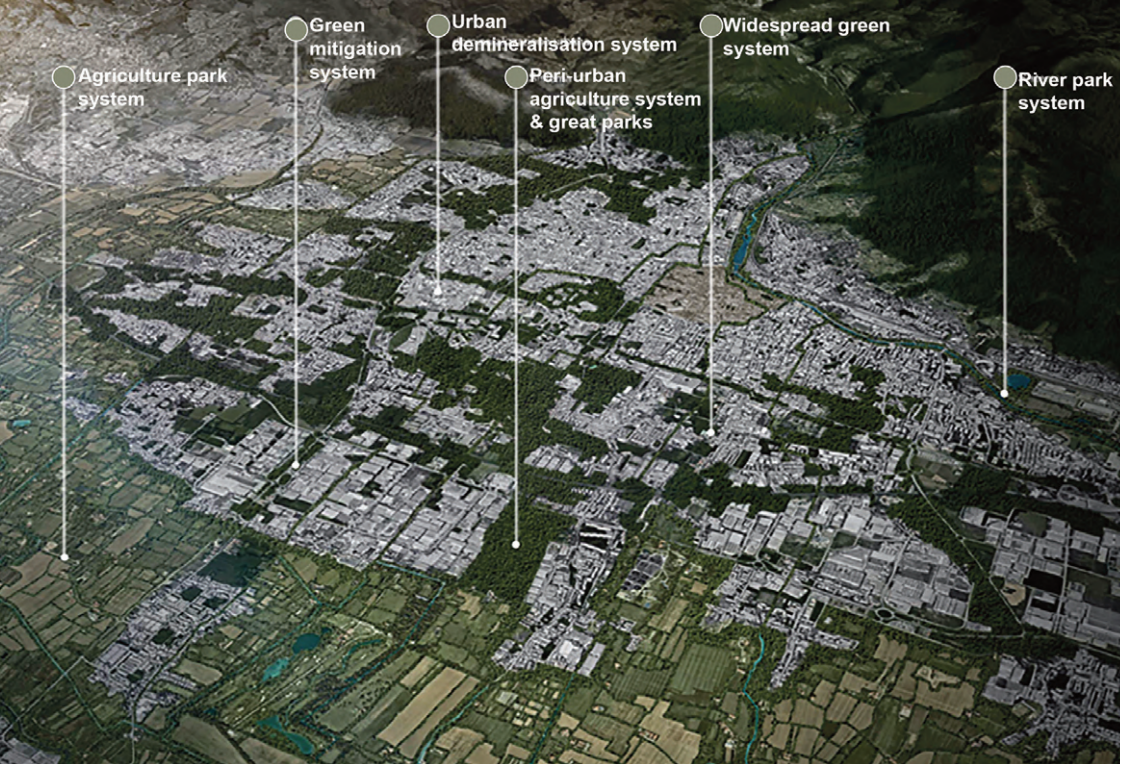
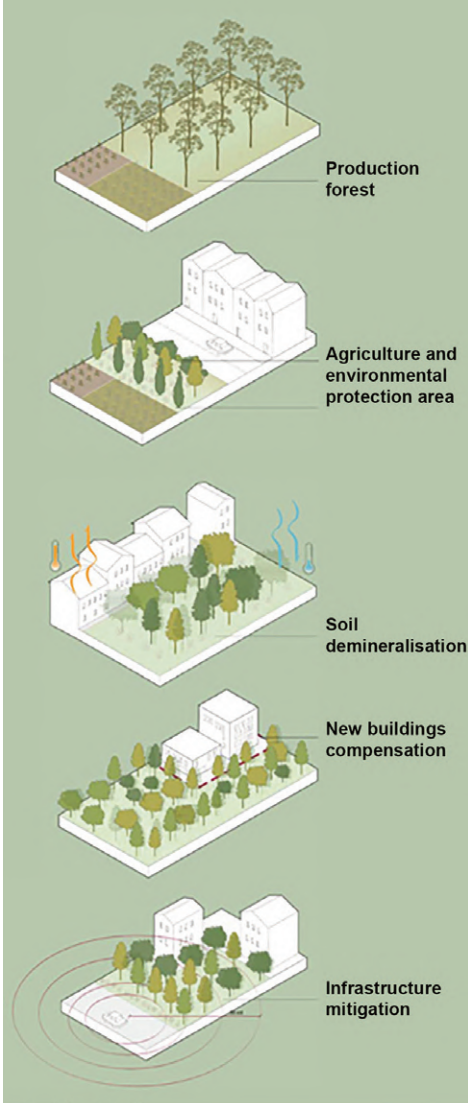


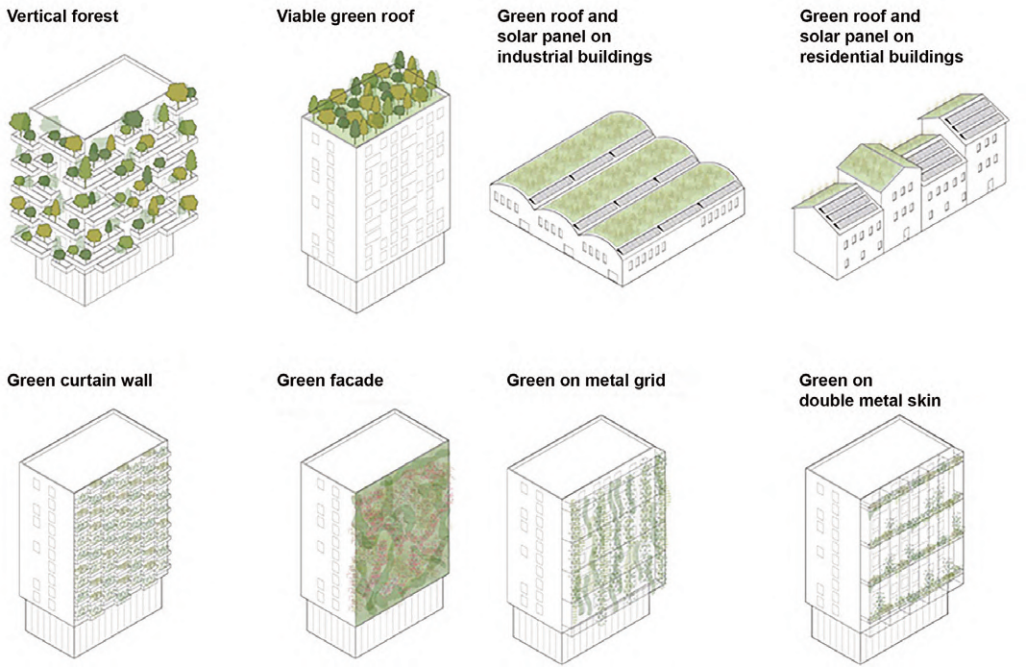
Fig. 7 | 'Green Prato – Urban experimentation between ecology and reuse', Luigi Pecci Center, Prato (credit: Prato Municipality, 2019).

lar cities[9] that are committed to driving the circular transition of cities, improving human wealth, and reducing emissions (Urban Agenda for the EU, 2020). The strategic framework of the Operational Plan produces an overall urban vision of the city starting from the identification of the strategic role that Prato plays in the regional and large metropolitan area. The general framework identifies the strategic issues on which the policies of governance of the territory and the choices of urban nature were directed: reuse, practices of re-cycling; Prato as City of Manufacture of the 21st century, alongside the textile-fashion district, where further supply chains have been developed, representing as many strategic sectors for the territory, in particular the ICT and agri-food and food sectors; major projects and strategic areas, urban innovation projects for the creation of Prato Brand; a new House Plan and the interaction between urban and welfare policies; environmental, agro-environmental and ecological issues, control and generative matrix for both morphological and functional recovery of the settlement system, adapted to face the pressing challenges posed by economic transition and climate change; the public space, in the logic of promoting an idea of Public City open and citizen-friendly (Barberis and Cattaneo, 2019).

In 2016, within the program Prato al Futuro, the Administration launched a virtuous path of communication and participation to guide the drafting of the new Operational Plan. A dense program of moments and places, physical and virtual, where to meet citizens, associations, professionals, entrepreneurs, and share the general vision of a social, cultural and economic development of the city of Prato. The aim is to carry out actions



Figg. 8, 9 | Prato Municipality, Operational Plan: Toolkit of buildings' interventions; Toolkit of actions (credits: Prato Municipality, 2013).



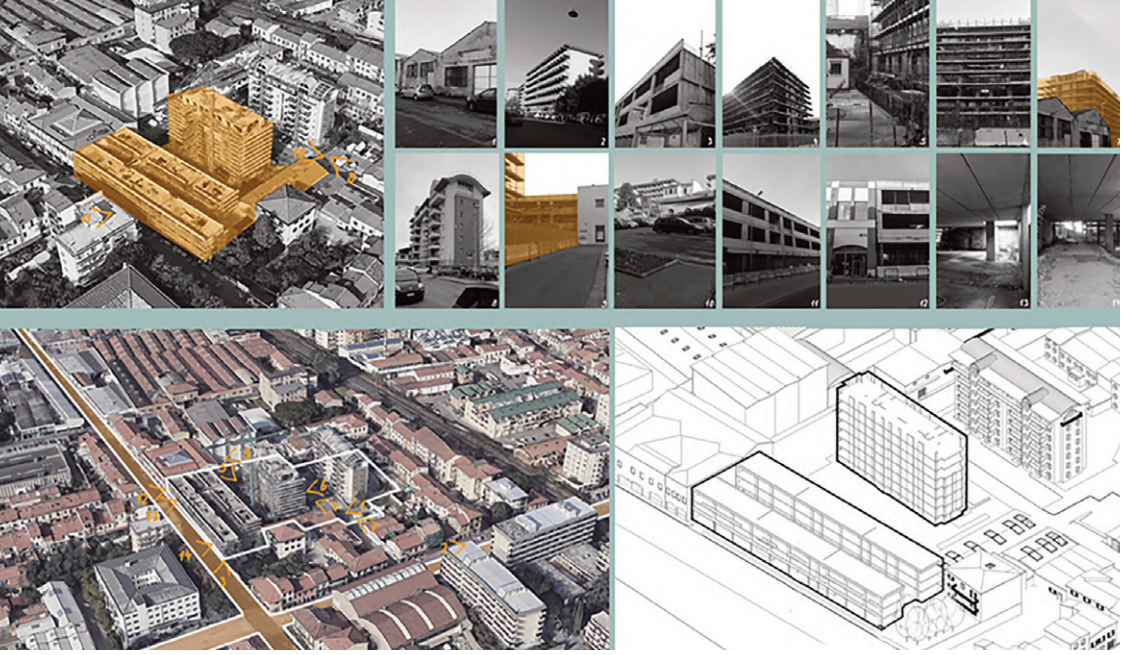


Fig. 10 | Ex-Valore Area in Prato: current state (credit: A. Kuzniatsova, 2019).

through shared governance models that facilitate the relationship between supply and demand. The Operational Plan for Prato aims at recovery and circular economy as an engine of change, using tools and processes that propose a cultural review of the old urban planning based on the concept of mono-disciplinary rationalist matrix. An urbanism that breaks the old patterns to forge new relationships with sociology, architecture, sustainability, art and economy, aiming at a two-dimensional management of the territory to become culture of the city (Donati, 2019). Consistent with this new cultural vision, the urban tool is displayed in an exhibition at the Luigi Pecci Contemporary Art Centre titled Verde Prato – Sperimentazioni Urbane tra Ecologia e Riuso, proposing three focuses of the Plan: Ecology, Re-use and Going Public (Fig. 7).

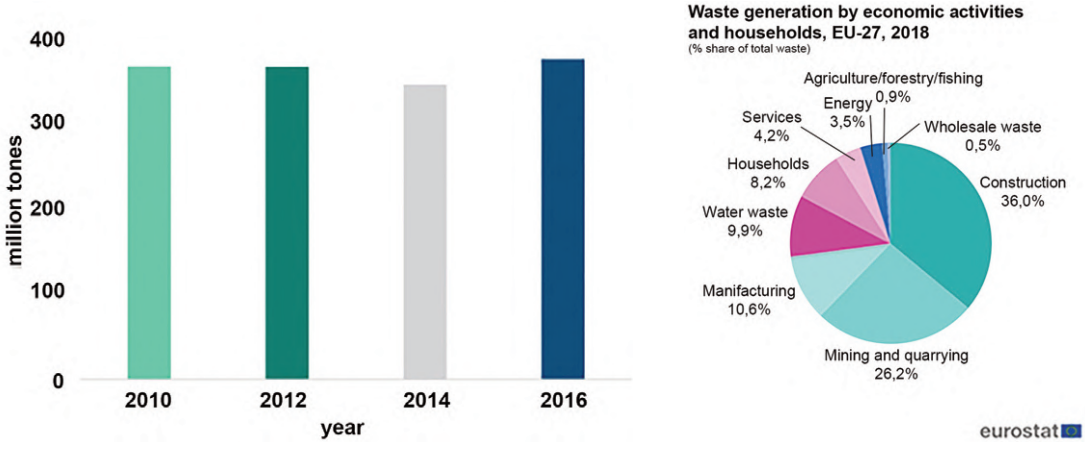
Since 2019, the Operational Plan has acquired its definitive effectiveness as a new municipal urban tool, proposing actions both in public and private sector. The premises of the Plan, to contribute to a healthy and resilient city thanks to the Nature-Based Solutions in architecture, have been realised in the launch of the project Prato Urban Jungle in July 2020. A co-design project on 3 pilot areas for sustainable and inclusive development, realised by the City of Prato with European funds of Urban Innovative Actions, involving Stefano Boeri Architetti Studio and the botanist Stefano Mancuso of the University of Florence. The Prato Operational Plan is characterised by its being an exportable model of new planning, rooted in the most advanced urban metabolism (Cattaneo, 2019, p. 119) which can be summarized as follows: ability to overturn the anachronistic logic of urban development regulations; strengthening of the implicit vocation of avant-garde manufacturing; experimentation of a new ecological, resilient and dynamic urban shape, based on the promotion of the natural component within the city.

In this context, bearer of a new cultural vision and an urban model for smart cities, lays the experimentation of the present research, aiming at defining recurrent criticali-

ties and models of participation compatible with new processes and instruments of urban regeneration. The methodology applied to case studies anticipates design solutions in accordance with the trends analysed in the international panorama, in order to verify and suggest applicative perspectives to the Municipality of Prato: intervention strategies for the reduction of soil consumption through densification and valorisation models of existing buildings; regeneration of the urban fabric through the encouragement of functional mixité able to start new social and economic activities associated with living; improvement of the energy performance through actions of requalification of the building envelope and systems engineering; increase of the permeability of the soil through interventions of volumetric equalisation and Nature-Based Solutions (Figg. 8, 9).[10]

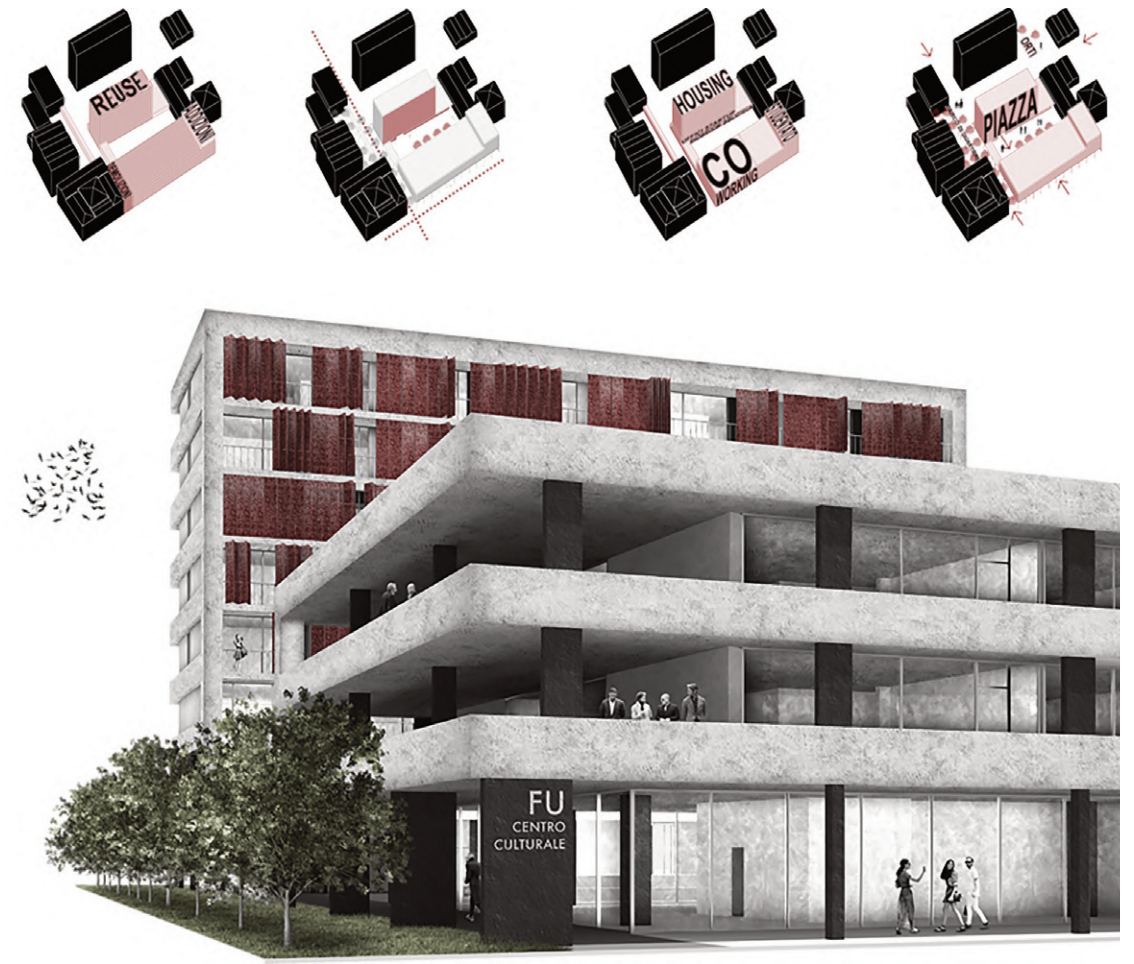
The methodology shows a systemic approach based on the awareness that environmental and energy sustainability can take place only if integrated with economic and social sustainability. The implementation of the experiments implied an in-depth analysis phase, in agreement with the technical offices of the Municipality, with the Public Estate Management Board and the citizens, to become aware of the social difficulties associated with the conditions of urban degradation and the state of maintenance of buildings. The consistency of the building and the levels of degradation were acquired starting from the digitisation of the original design materials and, through inspections, it was possible to proceed to a precise check on the state of deterioration together with the outdoor spaces, strictly linked to the effects of urban and social degradation.

The research is still in the process, so we can only talk about expected results in the context of ongoing intervention programmes[11]. The application of experimentation on several case studies, agreed through actions planned resulting from the Protocollo



Figg. 11, 12 | Generation of construction and demolition waste 2010-2016; Waste generation by economic activities and households 2018 (source: Eurostat, 2019).

Figg. 13, 14 | Design experimentation for the Ex-valore Area in Prato, Macrolotto 0 (credit: G. Brullo, S. Contino and L. Da Rold, 2014; A. Mengana, I. Pieri and A. Venturoli, 2018).



d'Intesa Laboratorio Prato, signed between the Department of Architecture of the University of Florence and the Municipality of Prato, is a useful operational tool for the Administration to access funding programmes and to promote public-private partnership processes. The Memorandum of Understanding also involves the European Policy Office for projects such as Horizon 2020 on sustainable mobility, smart cities and reuse policies: through the University, the Municipality of Prato can apply for substantial contributions at national and European level (Urban Agenda for the EU, 2020). The shared needs of research and training with an interdisciplinary approach gave birth to the Città di Prato University Centre, where research and training projects are carried out, showing how it is possible to open the academic world to a productive relationship with economic and cultural heritage of local society.

Recycling the unfinished: Macrolotto 0 | The case study is in a district of Prato called Macrolotto 0, renamed as the Prato Chinatown, just behind the ancient city walls. An area of about 44 hectares, without any public space, which the City Council has been paying attention to for a long time, proposing measures to improve social and economic cohesion, but without sacrificing the value of multi-ethnic contamination and the innovative charge of functional mixité. The City Council member Valerio Barberis believes that cities are attractive places for opportunities that open up to innovation, economy and research, but they are also fragile places where poverty, social segregation, the effects of climate change and pollution arise (Franzoia, 2019). Barberis himself had the foresight to address the Department of Architecture of the University of Florence, explaining the need for support from the academic world to the public administration. The required design experiments, necessary before intervening in such a complex context, have attracted European attention by obtaining the honourable mention in the category of developing projects for the retrofitting of cities with over 50,001 inhabitants in 2019 (CESBA, 2019).

In the 60s and 70s this area, structured as a city-factory, was one of the productive engines of the Textile Industrial District, where productive activities and housing coexisted but over time the productive buildings have been abandoned and it has been made a sporadic and random reuse with rare examples of a respectful regeneration of local values and with many speculative interventions. It was Bernardo Secchi in mid-90s who coined the term Macrolotto 0, during the drafting of the PRG (General Town Development Plan) for the Municipality of Prato, with the aim of defining a paradigmatic urban fabric for the genesis and development of the Prato textile industry in the post-war period. The mixité of Prato is one of the places where you can better understand the physical and economic characterisation and the urban fabric that it generated. Secchi understood that it was time to abandon the concept of zoning to apply the concept of network instead to create new and transversal links in the growth of the city, creating a set of productive, residential, commercial, infrastructural and leisure activities in a continuous and virtuous mix. A PRG at times 'visionary', disregarded

Fig. 15 | Macrolotto 1 before the intervention and after (credit: Prato Municipality, 2013).

by the successive political management, responsible for an exponential and careless growth of new productive areas with the consequent abandon of the old district.

Nowadays Macrolotto 0 is one of the main urban areas in Europe for concentration of migrant families with Chinese origin[12]. Despite its relatively central location, the district presents the typical features of suburban areas (Fishman, 1987): building and urban degradation, lack of public spaces, lack of services to the person, streets without background and other physical barriers (to the north the railway station, crossed by few narrow underpasses, to the west the ring road and the San Paolo district).

The case study is one of the results of the widespread speculative substitution: the ex-Valore area (Fig. 10), which bears in its name the irony of its fate. Two skeletons in reinforced concrete that stand out with their grandeur of unfinished work on Via Filzi, the main road in the neighbourhood. The area, with its strategic position at the entrance of the district and strictly connected to the city centre, is also one of the most strident faces of housing speculation and real estate stagnation in the city: one of the many interventions of building replacement that have taken over during the years, increasing the process of architectural disqualification and urban degradation. After the acquisition of the existing factory in 2008 by Società Valore S.p.A., a project is developed for the creation of 3 new buildings: two buildings in the line, six storeys high for residential use and a building with a gallery, three storeys high, for commercial use. In 2010, the old factory was demolished and works on the new construction site began. After various vicissitudes, one of the two residential buildings and a portion of the commercial building was completed, leaving more than 50% of the planned work in the form of a structural skeleton, including two underground parking levels. The intervention has a poor architectural value and a bad constructive and spatial organisation due to superficial design and planning. The total abandonment of the area has led over the years to an abusive occupation of the building site, with the consequent degradation of the near area.

At the time of birth, unfinished works are already considered as waste. Marc Augé (2004) argues that new modernity has no longer time to build history but only removable rubble to make way for reconstruction. Architectural skeletons in which the interruption of the construction process has determined a condition of unfinished with the

dominant presence of the structural frame. The Italian landscape and beyond is full of buildings wrecks[13], evidence of a market economy often wicked and careless that affects the degradation of cities and landscapes. In these cases, the skeletons are made of materials, such as reinforced concrete and steel, difficult to recycle (Cao and Romagni, 2016, p. 11). In 2016, approximately 374 million tonnes of construction and demolition waste were produced: the largest waste stream in the EU in terms of weight (Fig. 11). In the survey updated to 2018[14], the waste produced for construction and demolition is a real burden in the field of special waste produced in Europe (Fig. 12).

According to the Action Plan for Circular Economy[15], construction and demolition are defined as priority areas by the European Union, while the recent Waste Directive Framework set a target for recovery of 70% by 2020. «The major obstacles to circular economy concepts are economic ones, due to the lack of demand for recovered waste» (Wahlstrom et alii, 2020, p. 45). If we start from the consideration of rejection, intrinsic in the essence of unfinished works, then we need to think of an even more serious criticality, as associated with an unhealthy consumption of resources with an interrupted life cycle that can only burden further the size of the ecological footprint. A common factor to overcome many of these challenges is the role of the client, but «[…] while research has been carried out on the role of clients to improve the results of economic and sustainability projects, there were fewer in the circular economy field» (Adams et alii, 2017, p. 119).

The applied design experimentation addresses the most advanced suggestions and reflections on the circular economy, in the idea of transforming traditional production-consumption-disposal processes into strategies to reuse, repair, renew and recycle, not only on the scale of the product and material, but especially for the unfinished works, to replan the very essence of the urban fabric and turn what is normally considered as waste into a resource (Figg. 13, 14). Unfortunately, in most cases, we are used to deal with the problem of the skeletons of unfinished works only from the point of view of the emergency and not of the project. This study, therefore, emphasises the importance of recycling by focusing on the waste and, in this specific case, the unfinished work as a resource and starting point for a responsible project to reuse. The analysis phase was carried out with a sequence of activities that, from investigations and cognitive analysis of the morphological, typological, and technological characteristics of the artefact, has led to the development of design and construction strategies of intervention that offer themselves as models to take out the inherent potential of the unfinished work.

Starting from the critical issues that emerged, design solutions have been selected to create a new pedestrian permeability, add value to the plant-related component in open spaces, propose residential types according to new housing needs with low-cost smart solutions, volumetric additions with dry technologies to create and give value to new functions and new opportunities for economic development of the district, exploit natural resources using solar technologies properly. The project as a safeguard tool,

which doesn't only concern the constructive or aesthetic aspect of a work, but also how it will feed itself once brought back to life. Consistent with the objectives of the Plan, some possible scenarios have been verified in order to reinterpret the unfinished work proposing the reuse of the abandoned building skeleton with hybrid spaces solutions to promote the social mixité and create new welcoming and innovative living spaces (Figg. 13, 14). The design experimentation is connected to a system of public interventions[16] – that have been carried out or still in progress – within the district aimed at promoting the satellite activities already existed for the construction of a new HUB of creativity. Project destinations generally consist of a functional mix, which associates residences, social services, co-working, crafts, and retail trade. The strategies developed by the new plan aim to give value the area of Macrolotto 0 as a creative district, encouraging the inclusion of cultural activities in the existing productive fabric, increasing the provision of services of the territory and the permeability of the blocks, often so dense as not to have uncovered surfaces.

Urban forestation for an eco-industrial district: Macrolotto 1 | The size of the factory city is a peculiarity that, in recent years, has not only changed the faces of the city but also that of the economic dynamics associated with the productive districts. In the economic frenzy of the 80s following the historical settlement of Macrolotto 0, at the edge of the city it was born the largest Italian private industrial parcelling called Macrolotto 1. A system that shows its functional fragility in a few years when the change of scene of productive and social economies turns the industrial area into a wholesale one for ready-to-wear Chinese fashion: today more and more traders from all over Europe come to Prato, choose the products and leave again on the same day (Galullo and Mincuzzi, 2019). The process of Chinese reindustrialisation in this productive district has made the value of its land rent soar dramatically.

Giulio Giovannoni analyses and describes the complexity of the phenomenon, using the Anglo-Saxon literature of urban economy of the 'hundred percent location'[17]: the suburban sheds cost twice as much as the houses in the centre (Giovannoni, 2019, p. 92). A transformation that characterises these fragments of cities as places of lively social life, overlapping land and demographic density and intensity of use. The post-industrial productive structures are therefore an important opportunity for the care of the city, as places with an economic, social and productive potential: in terms of recycling and strategies for smart cities, they are offered as new spaces for design experimentation able to reprogram typological corrections for more innovative practices for the fruition of the city.

For the new Operational Plan, the University has collaborated through international research and workshops[18], facing with a multiscale approach the category of areas that Maurizio Bradaschia (2003) defined as 'middle town', where new forms of urbanity take place. The analysis and in-depth interdisciplinary reflection conducted on this case study have favoured the process undertaken by the municipal administration to

Fig. 16 | Operational Plan, urban forestation action plan, Prato (credit: Prato Municipality, 2013).

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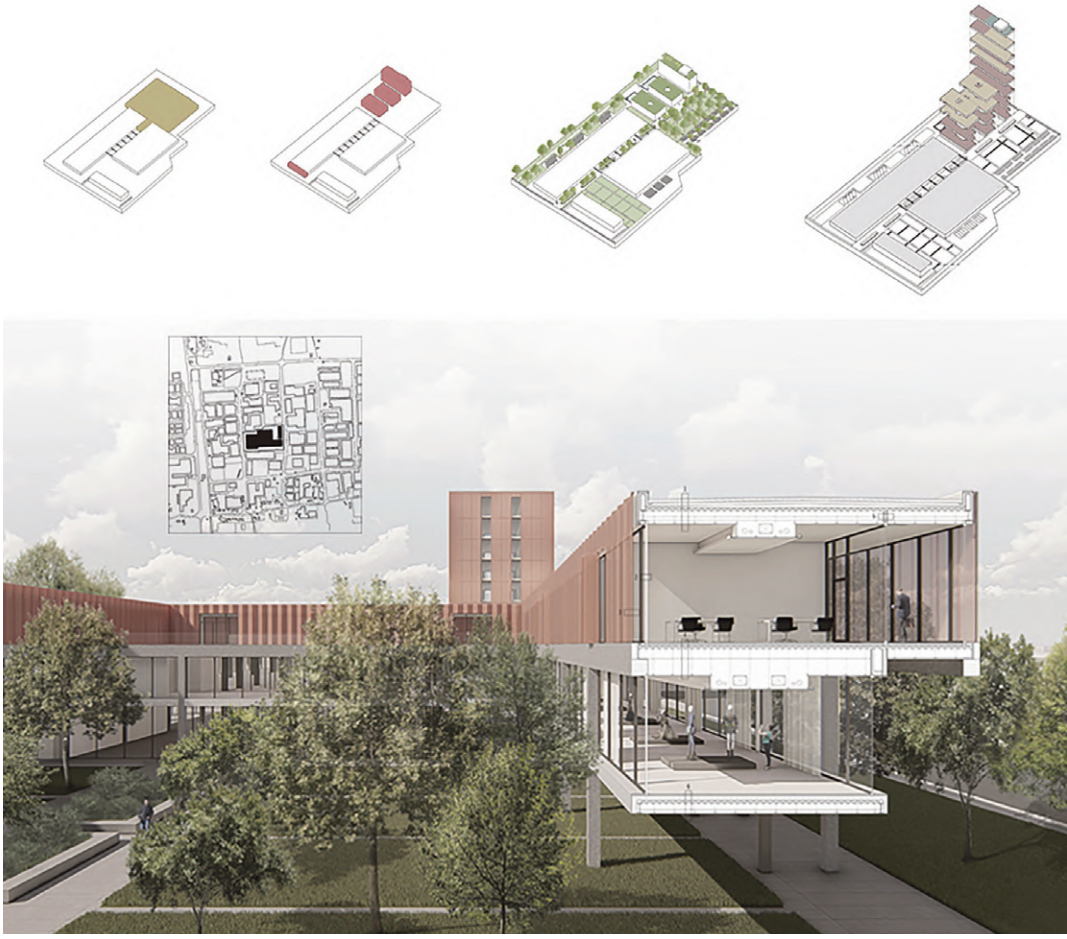
Figg. 17, 18 | Design experimentation for Macrolotto 1, Prato (credits: Laboratorio di Architettura e Ambiente, 2019; F. Giovannini, R. Ilmer and M. Petrolini, 2019).

transform the new urban tools in an opportunity to broaden visions for future transformations by interpreting, on the one hand, the needs arising from economic and social inputs and, on the other hand, adapting them to the environmental one for a sustainable development. For this reason, the city of Prato has developed the Action Plan for Urban Forestation to address the new Operational Plan strategic guidelines and provide the city with a renewed environmental and contemporary quality. The increase of wooded areas, especially in areas with higher urbanisation rates, gives the city spaces and corridors of life capable of growing biodiversity through processes of re-naturalisation (Fig. 15) among which Macrolotto 1 becomes the role of sample area (Fig. 16) for urban demineralisation. These interventions are facilitated by the possibility of re-naturalising portions of land through the partial demolition of the sheds that increases the gross useful area by 40% distributing it in height up to 30 metres.



Incentives for such changes are granted as long as the new set-up provides for the application of Nature-Based Solutions on clear land surfaces and buildings, while the burdens deriving from these transformations will be reinvested in the environmental requalification of roads and public spaces, according to a general masterplan managed by the municipal administration. The case study then becomes an experimental platform of a new urbanity and a resulting new landscape, in which the need for a volumetric increase comes to reprogram the settlement from single to hybrid functional, validating the effectiveness of condensation processes with vertical development to propose innovation on forms of use, spaces, type-morphologies, fabric for a balanced and resilient urban density (Figg. 17, 18). In this context, the resilient city model assumes a restoring meaning that is coordinated with the speed of socioeconomic change; on one side, it encourages adaptation to climate change,

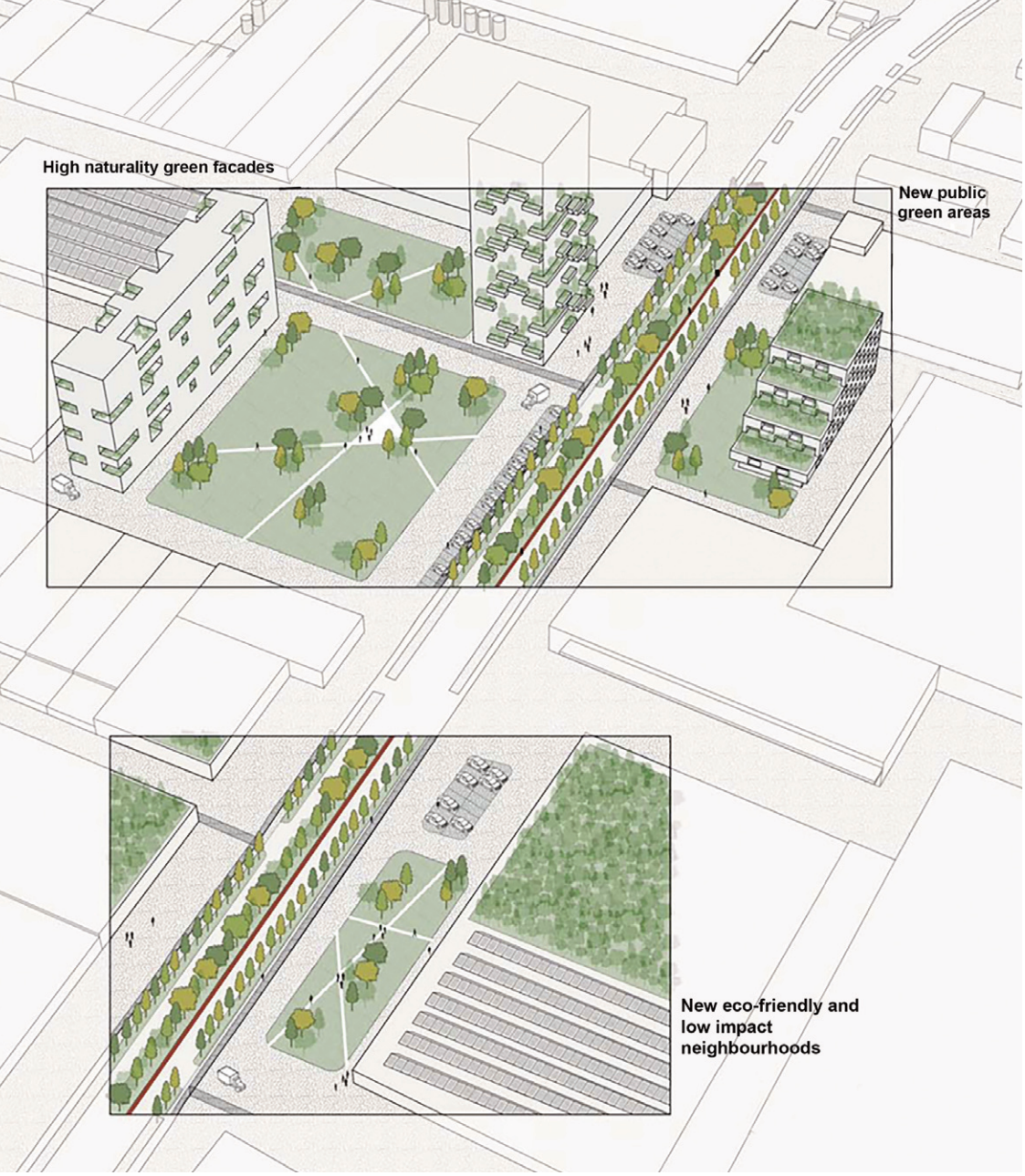


Fig. 19 | Operational Plan, actions for urban forestation, Prato (credit: Prato Municipality, 2013).

facing which cities are proving to be increasingly vulnerable, and on the other side, it promotes a better quality of life.

The applied design experimentation has addressed the problem from the urban scale of the neighbourhood to the detailed one identifying, with a 'per pixel' operation, a series of sample experiences to apply detailed design verifications that can facilitate the sharing of intent between public planning and private initiative. A punctual and widespread strategy of redevelopment proposals through functional mixité solu-

tions and innovative models to inhabit working and commercial spaces currently confined in places designed for production. All the proposals have a common aim: to subvert the state of the soil overturning the relationship between impermeable and permeable surfaces. The green system is the leitmotif of the new planning (Fig. 19): the new ecological net re-establishes the pedestrian connections between new interventions, bringing back quality and liveability to that disturbing and insecure scene of the present urban 'non-places' (Augé, 1993), dominated by a traffic circulation reserved only of trucks and cars.

In the design experimentation a general change of scene emerges, mainly determined by the process of humanisation on the urban fabric. Thus, factories become towns proposing a smart city model with solutions able to reduce the ecological footprint. The proposed compensatory measures aim to safeguard the connecting elements and to value public space in terms of accessibility, inclusion, architectural quality and perception. Working on the interfaces (exploiting the spaces between fences and industrial sheds) to define a new hierarchy of routes that encourages pedestrian and cycle mobility, enhancing the interstices and creating new exchanges and places of relationship. The demineralisation process applies not only to road sites and spaces between the lots, but especially in the buildings redevelopment projects that, through partial demolitions and additions, break the rigid planimetric scheme and the skyline of the area. This, with the use of Nature-Based Solutions and renewable energy resources, tends to reduce urban heat islands, drain the abundant rains with an organic and natural system, restore a healthy balance between urban landscape and natural environment and encourage energy efficiency.

The keywords of the design experiments are: 'interfaces', parts of the building (facades, coverings and roofs) which, although belonging to the private sphere, have direct consequences on public space; 'interstices', for an open space organisation aiming at creating a new collective green system in continuity with the city and the agro-food areas of the plain (with an intensification of greenery, urban furniture elements and materials essential to the perceptive urban quality increase); 'interconnections', for the creation of a network of sustainable mobility-oriented routes in continuity with existing cycle-pedestrian routes; 'interferences', for the realisation of activities to support the progressive specialisation of the area for marketing of textile products (showrooms, wholesale spaces), for catering, retail, temporary residences and accommodation. The material and construction details of new volumetry are designed, using dry technologies, for a program attentive to the life cycle of the building and the use of environmentally friendly materials. The technological solutions go from double skin solutions for vertical closures to the use of renewable sources for the energy needs of buildings, up to strategies for the collection and recycling of rainwater[19]. The comfort and quality of interior spaces are ensured by studies on natural light based on the orientation of the buildings. Besides, the presence of lodges and patios with selected plant species allows for a controlled lighting

throughout the year and contributes to cool down the temperature in the summer.

Final considerations and future developments | From analysis to planning, design experiments create visions to present ideas in a stimulating but simple way: the potential of buildings and areas is revealed by transmitting, at an emotional level understandable to all, the feelings that you would experience in a place if it were reinterpreted. These qualitative results are useful for administrations to innovate and integrate urban planning instruments and participate in European funding calls. From a financial point of view, measuring the feasibility of the intervention proposals will be the next step developed with the disciplinary contribution of the economic evaluation of the project. This type of analysis, since the project experimentation phase, can facilitate public administrations to propose attractive opportunities for public-private partnerships, aiming at promoting sustainable environmental and social action.

The intrinsic complexity on creating methods and standards for cooperation between scientific research and public administrations requires constant updating and innovation. The examples of collaboration here described have been actualised in fragile contexts at urban, technological and social levels. The success of such interventions, the approach to design, the theoretical and empirical research can be the basis for articulating and structuring a methodology for similar actions in Italy and Europe.

Notes

1) The Italian Ministry for Ecological Transition is the government authority responsible for the implementation of environmental policy (D.L. 22/2021). It used to be called Ministry for the Environment, Land and Sea Protection which was born in 1986 (Ministero della Transizione Ecologica). [Online] Available at: minambiente.it/pagina/competenze [Accessed 20 January 2021].

2) «A solution can be defined as purely technical when the modifications it requires do not leave the field of natural sciences and therefore do not commit to a negligible extent the moral resources or the system of values that inspires the action of man» (Hardin, 1968, p. 1243).

3) Programmi Complessi become operational at national level thanks to Italian Law 179/92 on Programmi Integrati and Programmi di Riqualificazione Urbana, law 493/93 on Programmi di Recupero Urbano and invitation for tender in 1998 for Contratti di Quartiere, reconfirmed with a second programme in 2002, promoted by the Ministry in the field of urban recovery following the acknowledged inadequacy of many urban areas for lack of infrastructure and reduced urban quality.

4) Tools and Methods for the New Social Housing Models Offer in the Process of Valorisation of Public Real Estate, Research of the Department of Architecture of the University of Florence for Publicasa S.p.A., Financing Tuscany Region, Integrated Development Project 5.2 – Abitare Sociale in Toscana, April 2013.

5) An experience that saw the involvement of a group of teachers, assisted by researchers and external experts, as part of the activities of the Laboratory of Technological and Environmental Design of the School of Architecture in Florence. The workshop deals with the relationship between innovation, creativity and project, supporting the concrete possibility supporting the concrete possibility of increasing and promoting the integration of experiences between academic research and public entities.

6) The Swedish activist Greta Thunberg was counted among the ten most influential people in science in 2019 by the magazine Nature (Schiemeier, 2019).

7) Climate Clock by Gan Golan and Andrew Boyd, an itinerant environmental installation that marks years, months and days before Earth reaches the point of no return. Exhibited in 2019 in Berlin, 2020 in New York, 2021 in Paris.

8) Since 2014 there have been several instruments and funding in synergy, activated on urban transformations of the city of Prato: DUP (Single Programming Document), PAES (Sustainable Energy Action Plan), PUMS (Urban Plan for Sustainable Mobility), PIU (Urban Innovation Project), PRIUS (Extraordinary Programme for Urban Regeneration and Suburban Security, DPCM 25 May 2016), URBES ISTAT Report, Immigration Guidelines, Digital Agenda, Smart City Plan, Project 100 Squares.

9) The Declaration on European Circular Cities was officially launched at the 9th European Conference on Cities and Sustainable Cities, Mannheim 01/10/2020 (Circular Cities Declaration, 2020). [Online] Available at: circularcitiesdeclaration.eu/cities/prato [Accessed 20 January 2021].

10) The European Commission defines Nature-Based Solutions: «Solutions inspired and supported by nature, which are cost-effective, provide environmental, social and economic benefits at the same time, and contribute to building resilience. These solutions bring, in a more diversified way, nature and natural characteristics in cities, territories and marine landscapes, through locally adapted interventions, efficient in terms of resources and systems» (European Commission, 2021). [Online] Available at: ec.europa.eu/info/research-and-innovation/ [Accessed 20 January 2021].

11) The first results of the research (still in progress) have been used to participate in the invitation to tender called National Innovative Program for the Quality of Living, in cooperation with the Municipality of Prato (art. 1, paragraphs 437 and following, Italian Law n. 160 of 27/12/2019 – Currently under evaluation – May 2021).

12) The foreign resident population represents the 21.72% of the total residents. The Chinese community is the main foreign community of the city and one of the fourth largest in Europe (Municipality of Prato, 31/12/2019).

13) In Italy in 2019, 546 unfinished building works were registered only for public works sector of national interest (Ministry of Infrastructure, 2019).

14) Waste Generation 2018 data are provided by Eurostat. [Online] Available at: ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics [Accessed 20 January 2021].

15) The ETC/WMGE report provides a detailed analysis underlying the AEA briefing on Construction and Demolition Waste - Challenges and Opportunities in a Circular Economy, 13 January 2020 (Agenzia Europea per l'Ambiente, 2020). [Online] Available at: eionet.europa.eu/etcs/etc-wmge/products/etc-reports/ [Accessed 20 January 2021].

16) Public projects financed still in progress: Covered Market Macrolotto 0, third pilot area of the Prato Urban Jungle Project with European funding from Urban Innovative Actions; PIU Prato Media-Library Bar, Coworking and Piazza and PLAYGROUND PIU with funding POR FERS 2014-2020 – Urban Innovation Project (PIU).

17) Location with the highest exposition to market customers, higher sales, and/or the highest values of land and rents (American Marketing Association Dictionary). [Online] Available at: marketing-dictionary.org/o/one-hundred-percent-location/ [Accessed 20 January 2021].

18) The Intermediate City – Towards a New Urbanity is the title of the international design workshop held in Florence, promoted by the DIDA of the University of Florence together with DPA ETSAM, Universidad Politécnica de Madrid and in collaboration with the Municipality of Prato and the support of Conser S.c.c.p.a., 2-7 October 2017.

19) As part of the strategies for energy and environmental improvement (APEA Protocol – Ecologically Equipped Production Areas) the district of Macrolotto 1 is provided with a water recycling

centralized system: the production of recycled water from civic and industrial wastewater is distributed through a 12-km-long industrial aqueduct and it is used as fire defence, in textile production cycle, in cooling towers and toilets services of the district.

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