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IN-UP_INHABITING THE UPCYCLING
Regenerative strategies for inhabiting the process

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ABSTRACT
The massive expansion of the suburbs in Italy between the 1950s and 1980s, characterised by the construction of subsidised public housing estates, has necessarily given way since the 1990s to physical and social redevelopment of large peripheral complexes. Starting from the project of technological, typological and energetic-environmental recovery of architectural artefacts and, more specifically, of public residential buildings, the contribution investigates the theme of regeneration by presenting the results of a project experience developed on the occasion of the RELIVE2020 design competition-workshop. The project proposal, through a systemic approach capable of providing a decisive contribution to regenerative processes, prefigures a replicable model of a resilient, inclusive and low environmental impact city.

KEYWORDS
regenerative processes, ERP neighbourhoods, systemic approach, circular economy, habitable building site

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In Italy, the process of urban growth took an important turn after the Second World War, from the construction of the smaller Unrra Casas neighbourhoods to the more substantial extensions of the INA-Casa settlements. This first expansion of a subsidised nature was characterised by certain elements of settlement recognisability deriving from the small urban dimension, capable of grafting itself onto a context that was originally agricultural, of which it maintained the textures and boundaries. In this context, the low population density and the physical proximity of the housing types, generally terraced and organised in blocks distributed around a central public space, favoured neighbourly relations and the seamless succession of private and collective spaces[1]. These were the years in which, alongside the emergence of requirements linked to the concept of individual well-being, the affirmation of collective well-being and the relative minimum thresholds, there was a need to protect the physical integrity of the environment, supported by research into environmental impacts and ecological issues (Gangemi, 1988). The growing demand for low-cost housing led to the design of a large amount of housing with interventions characterised by the presence of large, equipped axes that innervate 'large-scale' building nuclei. The construction of the large residential dimension of the 1970s refers to an urban architecture that, like the phalansteries of Fourier's utopian socialism, is conceived as a separate organism, self-sufficient and autonomous with respect to the consolidated city.

As construction practices, which had been used until then in residential interventions, progressed, a profound mutation of the building models of the working-class neighbourhood was generated, an evolution of the ideal of architecture of the modern movement. Italian Law 167/1962 marked the transition from the concept of council housing to that of public housing, with a significant increase in the quantity of buildings. With the abandonment of the morpho-technological prescriptions of the INA-Casa files and the introduction of the Piani di Zona, the large scale became the new paradigm of the Italian suburbs. Large-scale interventions, facilitated by the processes of prefabrication and the policies that promote their construction, give a monumental character to the suburbs of this period, completely revolutionising their language and social dynamics. The megastructure regulates collective life and the growth of the city in high-density urban contexts and is often composed of complex buildings with an urban value capable of radically revolutionising the relationship between open and built space and the conception of scale relationships themselves[2]. The massive expansion of the suburbs that took place in Italy until the early 1980s has necessarily given way since the 1990s to physical and social redevelopment of large suburban complexes.

The deep transformation of the culture of design that has taken place since the Second World War is reflected in the cities, which absorb the accumulation of different technical policies and approaches to the building process. At the same time, there is a programmatic environmental sensitivity, at the basis of the design concept, based on the concepts of environmental design which permeate many neighbourhoods. To date, a substantial percentage of Italy's building stock is made up of suburban building

Fig. 1 | View from via Archeologia of the R5 section of the residential complex (credit: I. Coletta, 2020).

Fig. 2 | View of the M4 section of the residential complex (credit: I. Coletta, 2020).

complexes, characterised by the need to redevelop and regenerate extensive urban areas on the fringes of consolidated cities, where forms of spatial and social decay manage to advance, in the delay, sometimes the absence, of operations to counteract the definition of prospective scenarios and treatment actions.

The up-cycling of industrialised systems | The urgency to produce an increasing number of low-cost housing has encouraged the use of heavy industrialisation building systems that have inevitably marked the suburbs since the 1970s, profoundly changing their essence through the creation of buildings with a complex urban value, becoming an opportunity for experimentation and a 'laboratory of modernity' (Di Biagi, 2006). Within the concept of 'building system', intended as a set of correlated and interacting choices on an architectural, technological and organisational level (Sinopoli and Tatano, 2002), a key role is played by the concept of assembly, which allows to define new production and design strategies in the field of building industrialisation, capable of radically modifying the traditional theory-practice relationship that has become a paradigm of reference for contemporary building design (Perriccioli, 1995). Technological solutions that take shape on a formal and structural level in the definition of modular systems that allow cities to be conceived as a three-dimensional space and that at the same time, due to their adaptability to multiple and changing situations, show a significant potential for reversibility in the construction or assembly processes (Vitale, 1995), still preserving innovative characteristics.

Assembly-based executive techniques are now enriched with new design values, based on the concept of flexibility, reversibility and adaptability: characteristics such as module, repetition, construction system, standardisation, in fact, assume a key role in regenerative processes, allowing the experimentation of new forms of living and a redevelopment oriented according to the principles of circular economy, able to design new urban scenarios, facing planetary emergencies (Bellini and Arcieri, 2020), and safeguarding the materiality of products in which to recognise the cultural value (Nardi, 2001). Serial reproducibility, the progressive passage from quantitative indices to a set of quality standards and the introduction of the concept of sustainable demand (Sinopoli and Tatano, 2002), confer new technical qualities, guarantee greater reliability and speed in the production and realisation of building products. In addition to the issue of well-being, whose conditions are now precarious in many urban peripheries, the effects of climate change affect overall environmental safety, for which a conscious approach is essential, capable of combining human intervention and natural resources (Tucci, 2020). The built heritage, as a non-renewable resource, and its management become central to the cultural debate, making the transition from the current linear economy to a circular economy necessary.

In the European building sector, the management of the built heritage starts with its individual parts. The reuse of materials and the use of waste of various kinds, even if it comes from environmental needs, give rise to a new experimental approach that identifies the use of second materials as the key resource of the project. The up-cycling process makes it possible to invert the usual sequence of transformation of materials and to enhance the identity of the existing building, giving rise to a second life that is compatible and consistent with the existing structure, through the rational and planned dismantling of components and the selective regeneration of usable materials. The possibility of proceeding according to the criterion of disassemblability favours the reuse of materials and goes as far as the recovery and reuse of elements and specific components of building artefacts ensuring efficient resource management, minimisation of emissions and maximisation of the durability of materials and components, with a consequent reduction in production and consumption, environmental impacts, and waste generation (Campioli et alii, 2018).

Public housing districts are therefore suitable for experimenting with design strategies capable of responding to changing needs through a conscious life-cycle approach. The possibility of local reuse of disused materials in the same context of reference generates balanced integration with the built environment, giving new meaning to the pertinent open spaces (Valente, 2004). From this point of view, within the regenerative process, the industrialised building can be seen as a resource from which to draw material which, through closed-cycle strategies and solutions, finds a second life and new uses, recovering the material culture of the place. It opens, therefore, a wide field of research and technological experimentation aimed at investigating and encouraging the adoption and dissemination of innovative tech-

nologies that allow the regeneration of existing neighbourhoods in neighbourhoods, capable of enhancing the environmental characteristics of the climatic, geographical and productive context in which they are inserted, with effective effects on the quality of life (Cangelli, 2015). Up-cycling applied to building and architecture makes it possible to rethink the usual practices for managing building processes and to define new, innovative ones capable of identifying new paradigms for sustainable construction and collective living, citing as examples the work of ARCò, Arturo Franco, Izaskun Chinchilla, Lot-ek and Superuse Studios.[3]

The contribution is part of this vision with the aim of investigating the theme of regeneration by proposing practices starting from the project of technological, typological and energy-environmental recovery of architectural artefacts and, more specifically, of public residential buildings, presenting the results of a design experience of urban regeneration developed on the occasion of the RELIVE2020[4] design competition-workshop, promoted by SITdA (Italian Society for Architectural Technology) and dedicated to Under 40s. The project takes its cue from European deep retrofit experiments and develops from the assumption that it is possible to trigger a process of urban regeneration by improving the quality of living. The project proposal aims at overcoming the paradigm of the suburbs as an area outside the city by means of a systemic approach capable of providing a decisive contribution to urban regeneration, prefiguring a replicable model of a resilient, inclusive city with a reduced environmental impact, which considers both the current conditions and those potentially achievable in the near future.

Through the adoption of environmental, spatial and constructive devices suited to the new needs of living, a model is proposed for the upgrade of residential neighbourhoods of subsidised housing according to the syntactic dimension which refers to the artefacts and the rules of their assembly, the pragmatic dimension to the performance and functional aspect of the environments and artefacts, the semantic dimension to their social, emotional and aesthetic meaning (Zucchi, 2006, p. 72).

Regenerative project for the urban compartments of Tor Bella Monaca in Rome | The aim of the project proposal is the redevelopment of the ERP buildings in the R5 and M4 compartments of the Tor Bella Monaca District in Rome (Figg. 1, 2) and the regeneration of the entire urban area. The subdivisions, designed by architect Pietro Barucci and engineer Elio Piroddi, have a clear urban layout, with in-line, tower and courtyard building types, constructed using heavy industrialisation techniques, with structures made of banches and predalles and prefabricated sandwich panel infill panels (Figg. 3, 4), now characterised by a significant decline in performance. The repetition of the typology and construction systems, together with the standardisation of the spaces inside and outside the building, have the potential to allow the development of appropriate regenerative strategies. The solutions at the basis of the project have been studied following the principle of replicability with the intention of adapting to both

Figg. 3, 4 | Prefabricated sandwich panels façade and corner solution of the residential complex (credits: I. Coletta, 2020).

compartments and proposing themselves more generally as possible guidelines for future regeneration projects in peripheral areas.

The residential part of compartment R5 is placed in the context as a curtain between the consolidated city and its natural part, developing in length for about 700 metres and perimeter on three sides of the courtyards that open on the eastern side with the intention of ensuring wide perspectives towards the Roman countryside. This clear division gives rise to two environments of a profoundly different nature from a functional point of view and relegates the building complex to a condition of marginality, as the last built element before the open countryside, a condition that is

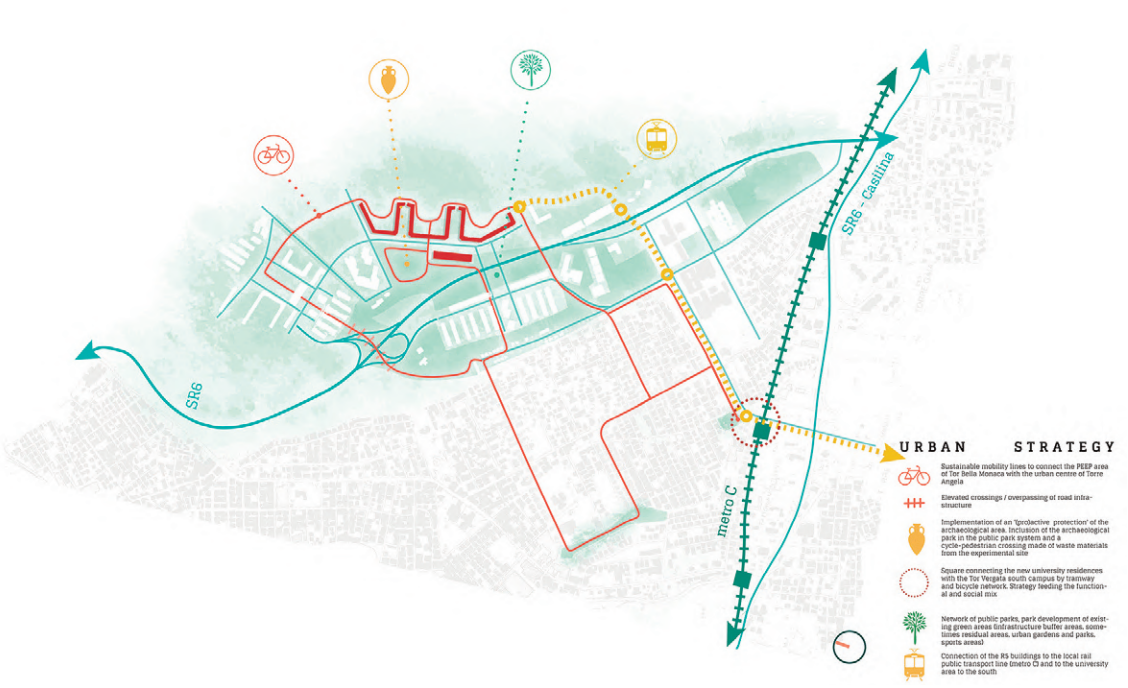


Fig. 5 | Plan concept (credit: M. Castigliano, 2020).

even more marked by the positioning of the entrances. Social interactions are therefore 'pushed' towards the interior of the courtyards and clearly separated from the public ones of the city, compromising interactions and social mixité. The regeneration hypothesis takes on this condition of margin and closure to imagine a scenario in which the buildings become the pivot of a public space that is a door to the countryside, visually permeable and physically traversable through spaces and paths returned to the community in innovative configurations.

Within the built environment, public spaces constitute a key system (Losasso, Leone and Tersigni, 2020) for effective regeneration strategies in terms of climate change adaptation. The open space represents one of the most significant resources of the expansion of Tor Bella Monaca; the large size of the buildings corresponds to a significant presence of green spaces, typical of the buildings of the 80s and which clearly distinguishes the public peripheries, where the articulation of open space becomes a unifying element of the residential neighbourhoods (Di Biagi, 2001). The intervention on these spaces allows the development of strategies and actions that consider perceptive, aesthetics, identity aspects, but also of programmatic, processual, multiscalar and temporal character (Gioffrè, 2018).

From the urban point of view, the regenerative strategy intends to reverse the current enclave condition of the area, especially of the north-eastern compartments (Fig. 5). This condition is generated by the physical distance, by a poor distribution of services, mainly concentrated in the south-east area, and by the infrastructural barriers placed between the expansion of the public city and the pre-existing settlement systems of Torre Angela, Tor Bella Monaca and Torre Gaia. Through slow and sustainable mobility and the creation of a network of parks, the project intends to introduce

the public housing estate into the urban dynamics of the city. A cycle network connects the green areas in the dense urban fabric with the large parks that act as climate buffers (Fig. 6). The intention is to introduce a set of redevelopment actions capable of intercepting instances of a multi-scalar and multi-disciplinary process and at the same time limiting the inconvenience to residents caused by the transformations. The idea is that of a building site which, modifying itself during the process, remains partly permanent by strategically changing its original function, transforming itself into solar shading devices or into new living spaces, through the aid of a basic element that allows the adaptation of new volumes to the different living and environmental needs.

Inhabiting the process: timetable for a new philosophy of living | The project introduces a model for managing alternative regenerative processes within the debate on the theme of redevelopment of the suburbs and in particular of subsidised housing projects carried out with technologies typical of heavy industrialisation. Starting from a model of circular economy based on the concept of up-cycling that allows the functional-spatial, performance-energy and environmental improvement

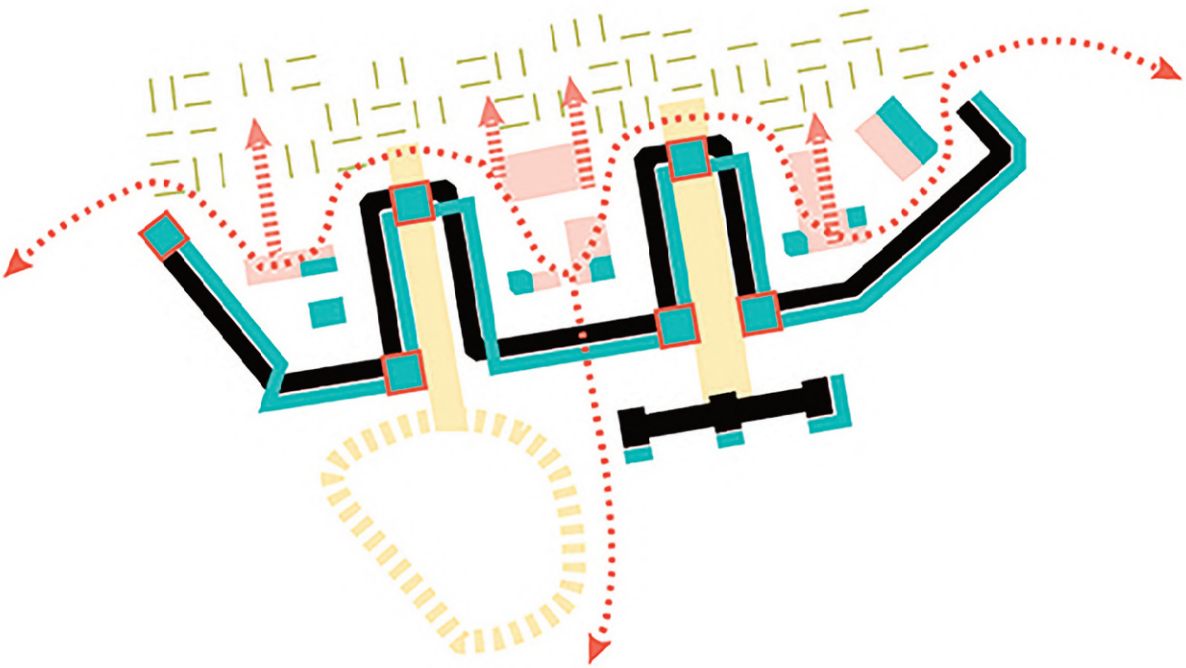
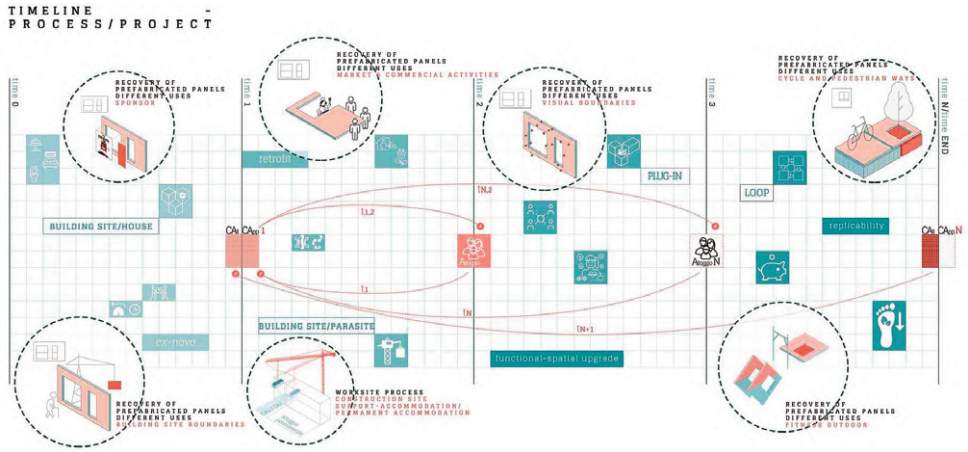
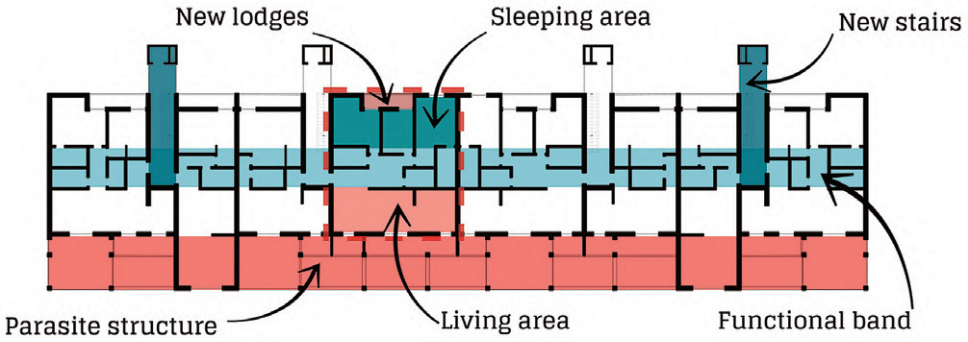


Fig. 6 | Open space concept (credit: M. Castigliano, 2020).





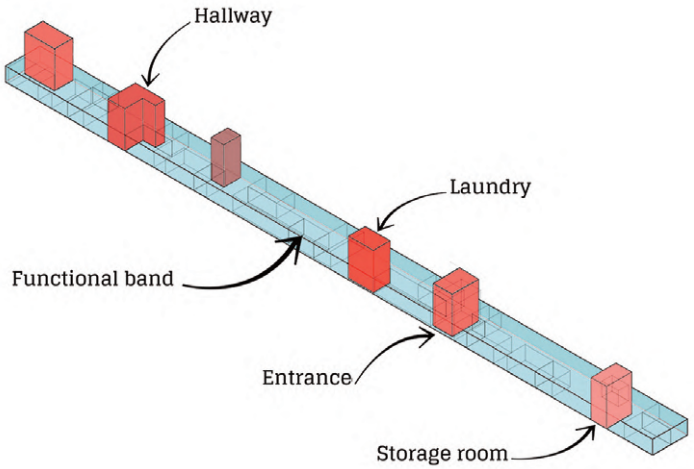


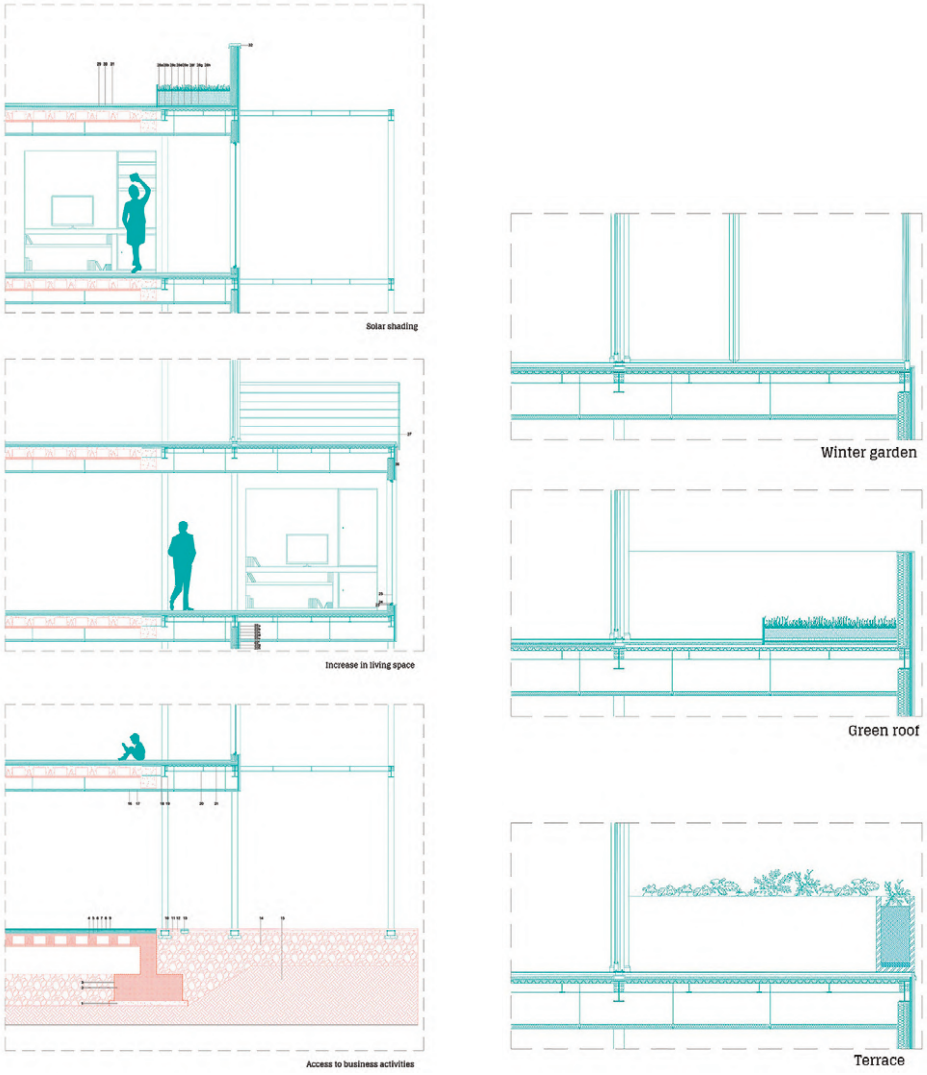
Fig. 7 | Project/Process Timeline (credit: E. Bassolino and I. Coletta, 2020).

Figg. 8, 9 | Cell-type of the Living Unit and possible distribution configurations and Functional band solution (credits: I. Coletta and M. Gallotto, 2020).

Next page

Fig. 10 | Selected part of the prospect with cycle and pedestrian passages and terraces on high levels (credit: A. Bernieri and S. Tedesco, 2020).

of building organisms, with the aim of being converted into architecture for sustainable collective living. The process envisaged aims, on the one hand, to achieve functional-spatial and technological improvements in terms of the performance of dwellings, and, on the other hand, to contain the shock that a long and complex operation of transforming inhabited places could generate for a neighbourhood community. As well as causing discomfort, the consequent substitutions of accommodation are also a logistically and economically complex operation due to the density of the neighbourhood. Therefore, through the direct involvement of the community in the design of new residential and collective environments, with a view to a significant reduction of the ecological footprint of the site, and the optimisation of the 'ecological productivity' of the housing system (Tucci, 2020), the aim is to give rise to a regenerative process from below, capable of activating dynamics of social cohesion and addressing the current critical issues.



Figg. 11, 12 | Technological detail of the additional element on the façade: Living space solutions; Open space solutions (credits: R. Bosco, M. Gallotto and S. Tedesco, 2020).

The building complex is severely marked by a high degree of obsolescence, which together with the changed housing needs in place make it necessary to find solutions capable of improving its performance conditions by ensuring indoor and outdoor improvement. The design solution that has made it possible to deal with the criticalities posed consists of an additional element on the façade, essential for establishing a relationship with the new context that did not exist before and for expanding the living space, leaving all the permanent functions linked to domesticity enclosed in the existing macro-object. The project foresees the juxtaposition of a light structure to the façade of the building, with the function of a mobile construction site, which is configured as a 'parasitic' element, allowing the insertion of prefabricated volumes in the

building and which at the same time lends itself as a passive device to control solar radiation, modifying itself morphologically and functionally according to exposure.

The process consists of a sequence of events (Fig. 7), originating from the idea of a continuous, liveable and non-invasive construction site, capable of conserving and recovering, in its own evolution, elements of the construction system, scraps from demolition and processing, defining a process of total up-cycling. The first sequence of operations, identified by 'time 0', involves the start of the building site phases and the construction of a housing site: a new building, consisting mainly of a structural steel skeleton and a core of services (vertical connection systems, kitchen modules and bathroom modules), capable of accommodating prefabricated modules. In these, the first groups of users involved in the redevelopment process will be able to arrange their own furniture, transforming the aseptic prefabricated modules into familiar elements, identifying their own lifestyle and way of being.

The technological and energy retrofit of the buildings takes place in 'time 1'. After the first families have moved into the site-housing, the dismantling of the prefabricated façade elements, the demolition of the internal partition elements and the laying bare of the structural elements begin. This is followed by the construction of the steel structure of the 'parasite yard' planned to be built adjacent to the existing building. The building site acts as a provisional structure as it is functional for the execution of the building site operations and contributes to the reconfiguration of the façade and the functional-spatial upgrade of the entire complex.

At 'time 2', once the retrofit operations have been completed, the groups of users, temporarily housed in the site-housing, return to the portion of the building that has been upgraded, by moving the prefabricated modules that have already been customised by crane. The replacement of the stairwells in the corners with two new vertical connections, positioned in continuity with the existing ones on the courtyard elevations, makes it possible to replace the existing 45, 60 and 70 square metre single-facing flats with double-facing flats, larger on all floors and with loggias on the courtyards. The result is better natural lighting and greater thermo-hygrometric comfort, thanks to the possibility of transverse ventilation, while at the same time adapting the spaces to the new living requirements defined by today's lifestyles. A functional strip runs through the centre of each apartment, containing services, hallways, entrances, etc., acting as a filter between the open and private areas (Figg. 8, 9).

The completion of the 'parasitic' structure becomes an opportunity to reformulate the public space: some of its parts are designed to be freely accessible, without interfering in any way with the privacy of the residents. These passages are deliberately detached from the façade behind and screened by brise soleil. The aim is to transpose the concept of the path vertically, while creating new and more stimulating visions of the urban and rural landscape. Two access points, located at the heads of the new element, connect the deck with the street and lead, through a system of stairs and balconies, to collective vegetable gardens 'in boxes', built in the roof, and to an urban terrace, ob-

tained by selective emptying of parts of the building (Fig. 10). This operation, together with the passages provided on the basement, favours natural ventilation and also creates new opportunities for socialising. The basement part of the parasite structure forms a portico which offers striking views in height and allows access to the commercial part, to the new accesses to the residential building and to the workshops for the construction and recycling of the elements recovered in the first phases of the construction site (Figg. 11, 12).

'Time 3' foresees the repetition of the whole process, starting with the placement of new prefabricated modules on the housing site, the relocation of other households, and so on, i.e. the initiation of a loop of replicable operations until the end of the redevelopment process of the whole complex.

Environmental quality and technological innovation in the up-cycling process | The redevelopment and regeneration of the area involved the definition of a synergic technological-environmental approach to make the building complex more efficient in terms of reducing heat loss, energy consumption and the rational use of natural resources. The proposed intervention, which is based on a holistic design process from the construction phases to the management and maintenance phases, envisages the reduction of waste and the reuse of construction waste, in order to minimise the ecological footprint throughout the entire life cycle thanks to the hypothesis of a technological and energy retrofit of the entire building, with the idea of creating an nZEB building complex, using natural and zero-km materials.

In the hypothesis of a conscious development and conception of the whole building process, the project for the redevelopment of the existing building includes the definition of an environmental strategy based on the exploitation of natural resources. Through the design and addition of the parasitic system of volumetric addition, an attempt was made to control and maximise the contribution of natural resources at the same time. In fact, the infrastructure placed in adherence allows, sometimes through overhangs, sometimes through shading systems, to control and optimise the solar factor also thanks to the dimensional variability of the depth of the element which is defined according to the orientation.

In addition, in order to exploit the contribution of natural ventilation, it was decided to provide each apartment with double facing (cross ventilation), as well as emptying some rooms on the ground floor and in the front of the building, in order to avoid the barrier effect due to the shape and size of the buildings in the area, and to allow greater permeability to summer air flows. In concert with the passive strategies for the building, a redevelopment of the open spaces has been proposed in order to guarantee the improvement of the well-being conditions of the users, also in view of the increase in temperatures due to climate change. Actions aimed at increasing vegetation in the green areas, as well as de-paving the paved areas inside the courtyards in order to increase the permeability of the soil and encourage evapotranspiration phenomena

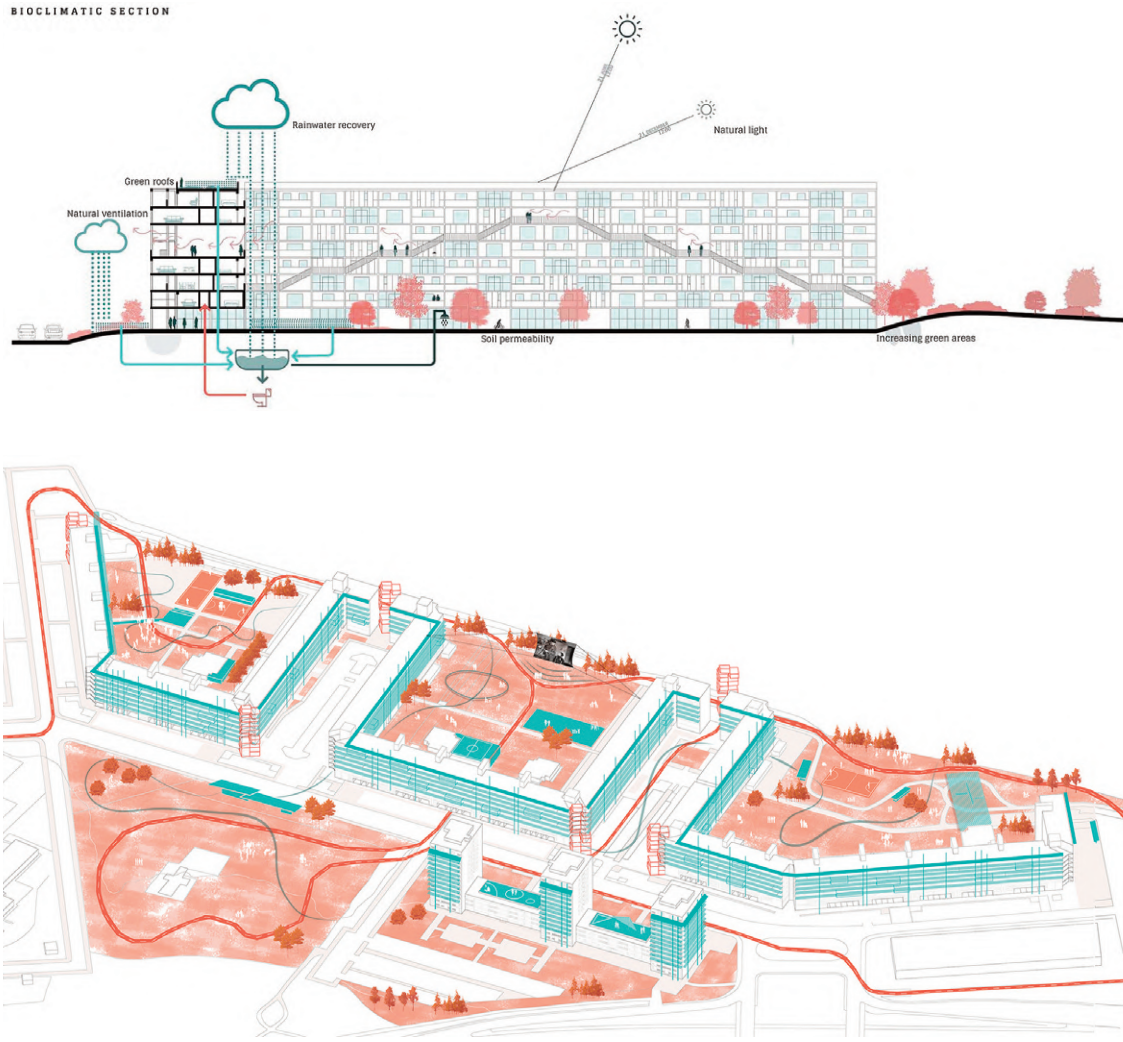


Fig. 13 | Bioclimatic scheme for the study of the project (credit: I. Coletta and S. Tedesco, 2020).

Fig. 14 | Project axonometry (credit: A. Bernieri and S. Tedesco, 2020).

that will reduce air temperatures during the summer season, could also guarantee a favourable impact on temperature control inside the accommodation, with a clear improvement in indoor and outdoor comfort conditions.

The waste from the processing, together with part of the prefabricated modules of the existing shell, find new life within the process with new functions and qualities. In particular, the variety of façade modules will give rise to paving slabs, in some cases already equipped with holes for new planting. These will also be used as street furniture or for outdoor recreational and sports activities, as well as signage in the vicinity of the archaeological area of the reinterred Roman villa in Via Archeologia, as support for information panels, reconstructions and Virtual Reality tours of the villa, in order to create dedicated educational paths. In addition, the up-cycling action and the addition of the parasite would provide for the implementation of rainwater recovery systems for both domestic and irrigation use, as well as the provision of green roofs to

improve the passive performance of the building and the integration of systems for the exploitation of natural resources (Fig. 13).

With the further aim of triggering a 'virtuous circle' with a positive impact on the socio-economic dynamics of the neighbourhood by activating employment processes, the project includes workshop spaces for processing recovered materials. In-Up_Inhabiting the Upcycling is a concept (Fig. 14) for the development of a management model for the conception and implementation phases of environmental requalification and regeneration processes, based on a continuous construction site capable of being self-sustaining and at the same time of being inhabited as it evolves, triggering new forms of natural resource management, circular and local economy and a new way of living in the community from the very first phases, also following the consequences of the Covid-19 health emergency. Triggering such reuse dynamics is both environmentally and economically advantageous, even more so than recycling: since the latter cannot be carried out on site, it generates additional costs for processing, especially transport. Although up-cycling actions are limited by the capacity to transform materials without prior recycling, they represent an important contribution to sustainable development and to a renewed vision of peripheral contexts today visibly marked by a highly compromised type of building.

Acknowledgements

The contribution is the result of a common reflection of the authors.

Notes

1) There are many neighbourhoods linked to the memory of post-war reconstruction, such as QT8 in Milan, Tuscolano and Tiburtino in Rome, the latter of which is the manifesto of architectural neorealism and the ideology of INA-Casa.

2) This important period included integrated and 'self-sufficient' neighbourhoods such as Gallaretese in Milan (1969/1970), ZEN in Palermo (1969-1973), villaggio Matteotti in Terni (1970/1975), Corviale in Rome (1972-1974), Sorgane in Florence (1962-1980), and Giudecca in Venice (1980-1982).

3) For further information see the webpages: ar-co.org; arturofranco.es; izaskunchinchilla.es; lotek.com; superuse-studios.com [Accessed 24 February 2021].

4) The SITdA Workshop referred to is 'Architettura e Tecnologia dell'Abitare | Upcycling degli edifici ERP di Tor Bella Monaca a Roma'; Project: In-Up_Inhabiting the Upcycling; Team: CaFé – Campania Felix_ with M. Leone, E. Bassolino, A. Bernieri, M. Castigliano, I. Coletta, M. Gallotto, S. Tedesco ('Federico II' University of Naples) and R. Bosco, P. Ferrara ('Luigi Vanvitelli' University of Campania).

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