BDC

Università degli Studi di Napoli Federico II

24

numero 2 | anno 2024

BDC

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Direttore Responsabile: Luigi Fusco Girard
BDC - Bollettino del Centro Calza Bini Università degli Studi di Napoli Federico II
Registrazione: Cancelleria del Tribunale di Napoli, n. 5144, 06.09.2000
BDC è pubblicato da FedOAPress (Federico II Open Access Press) e realizzato con Open Journal System

Print ISSN 1121-2918, electronic ISSN 2284-4732

Journal home page www.bdc.unina.it

BDC volume 24, issue 2, year 2024

print ISSN 1121-2918, electronic ISSN 2284-4732

Housing quality and ecological transition: practices of rehabilitation and maintenance of public housing in Italian inner areas

Qualità dell'abitare e transizione ecologica: pratiche di riqualificazione e manutenzione dell'Edilizia Residenziale Pubblica nelle aree interne italiane

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ABSTRACT AND KEYWORDS

Housing quality and ecological transition
The theme of small towns, which represent the lifeblood of Italy, is the subject of attention of the European Union, which is laying the foundations for the revitalisation and enhancement of this widespread heritage through policies and programmes. The global crisis, descibed by Edgar Morin as a multilevel crisis, poses new challenges to these territories and demands that housing projects undergo a methodological and conceptual revision to better address changing conditions. The challenge lies in defining design solutions, both technical and technological, to respond to the poly-crisis system through a logic that connects material culture with innovation. This paper presents part of the findings from research conducted by an interdisciplinary team at the Department of Architecture of the University of Naples within the framework of the PINQuA programme. Specifically, the paper focuses on exploring potential ecological transition strategies capable of fostering environmental awareness by leveraging the environmental, social and economic potential of specific places. The process considers both exogenous and endogenous factors, and emphasises the renewed care of built heritage, both existing structures and newly developed ones, through rehabilitation and planned maintenance strategies.

Keywords: ecological transition, public housing, energetic retrofitting, planned maintenance, inner areas

Qualità dell'abitare e transizione ecologica
Il tema dei piccoli paesi che innervano il Paese Italia è oggetto di attenzione da parte dell'UE che, con misure e programmi, pone le basi per rivitalizzare e valorizzare questo patrimonio diffuso. La crisi planetaria, quella a più livelli descritta da Edgar Morin, pone nuove sfide a questi territori e richiede che il progetto dell'abitare adotti una revisione metodologica e concettuale che sappia interpretare al meglio le condizioni del cambiamento. Si tratta di definire quali risposte progettuali, tecniche e tecnologiche, sono poste in campo per rispondere al sistema di poli-crisi in una logica di connessione tra cultura materiale e innovazione. Il contributo restituisce parte degli esiti di una ricerca condotta da un gruppo interdisciplinare del Dipartimento di Architettura dell'Università di Napoli nell'ambito del programma PINQuA. In particolare, il contributo si concentra sulla ricerca di possibili strategie per la transizione ecologica capaci di generare una sensibilizzazione ambientale partendo dalle potenzialità ambientali, sociali ed economiche dei luoghi. Il processo considera fattori esogeni ed endogeni, e implica una rinnovata cura del patrimonio costruito, esistente ed ex-novo, attraverso processi di riqualificazione e di manutenzione programmata.

Parole chiave: transizione ecologica, edilizia residenziale pubblica, riqualificazione energetica, manutenzione programmata, aree interne

1. Introduction. Living in the time of polycrisis

In 1993, Edgar Morin and Anne-Brigitte Kern, in their text Terre-Patrie, used the name polycrisis to emphasise the state of interconnectedness among the various challenges that have characterised and continue to characterise contemporary life since the last decades in the last century (Morin & Kern, 1993). Investigating the concept of polycrisis leads the authors to highlight a very specific character of the above-mentioned interconnectedness: there is a complex inter-solidarity among several vital problems, which pushes to merge the several crises into one "only" problem. Environmental crisis, energy crisis, health crisis, social crisis, economic crisis, political crisis, etc. are therefore challenges with porous boundaries that contribute to the definition of a complex and multi/ inter-scalar system of questions, whose answers need to be formulated as well with a systemic approach capable of combining equity, economy and ecology.

These last three terms refer to the well-known concept of sustainable development, a very much-abused concept but still the three dimensions - environmental, social and economic - are inseparable if future strategies and actions are proposed to drive the natural progress of life, inherent in human nature, in a direction of safety and well-being.

It is also interesting to highlight that, based on the definition of sustainable development given in the report Our Common Future[1], a widely accepted definition, the multiple aspects and the different ranks of the social, environmental and economic dimensions of development were then explored in depth, with increasing emphasis on the extent to which the economy and the environment determine the living conditions of humanity. The original definition introduced the concept of the responsibility of individual and collective actions in relation to an intergenerational pact, and gave centrality to man with his own desires in a context of growth (development) in which it is necessary to change the usual behaviour (sustainability). It therefore supported the , now scientifically established, thesis that the development model based exclusively on the logic of profit (capitalist model of wealth production) generates social inequality: «We will not be facing the crisis of capitalism tout court, but what we are witnessing is undoubtedly the crisis of a certain type of capitalism, based on unsustainable macroeconomic imbalances, on leverage, on deep and increasingly emphasized social inequalities» (Punzi, 2012). On the other hand, the idea that we must increasingly promote an economy capable of improving the quality of life of individuals is present in the founding documents of the European Community, such as the Treaty signed in 1957, which states in Article 2: «The Community shall have the task of promoting [...] a harmonious development of economic activities throughout the Community, a continuous and balanced expansion, increased stability, and an ever-increasing raising of the standard of living [...]».

Likewise with regard to the environment, since the 1970s the need to promote the protection of biodiversity, the preservation of the integrity of ecosystems, respect for the planet's carrying capacity, the wise use of resources in harmony with the natural rhythms of production, but also the reduction of waste, rubbish and the production of polluting gases, etc., to ensure a beneficial stay in nature essential for life (Sloterdijk, 2017). In other words, there is the idea that progress can be defined as such when it pursues to protect the ecosystem (environmental sustainability), if it promotes productive growth capable of guaranteeing the quality of life (economic sustainability), if it aims at the defence of human rights, poverty reduction, the fair distribution of resources and the protection of health (social sustainability).

Acting in disregard of these needs is to lay the foundations for compromising the

health of individuals, encouraging uncontrollable migratory phenomena, increasing poverty and social inequalities, and prohibit a growing number of people from living in places with high quality standards, resulting in an increase in housing discomfort. The need to reverse the way of life introduced by the eruptive oil source has led the international community to enact programmes, strategies and actions aimed at countering its causes and effects. It is enough to think of the long history of Conferences of the Parties (COPs), the first of which was held in 1991, anticipated in 1971 by the encyclical Pope Paul VI Octogesima Adveniens, in which there is a clear and explicit call, with a planetary breath, to pay attention to the ongoing attitude of destruction of nature and therefore of man. Over the years, the involvement of international communities in sustainable development issues has marked two milestones of engagement on a global scale: the 2030 Agenda (United Nations, 2015) and the Paris Climate Agreement (UNFCCC, 2016).On its part, the European Union, through its own measures, has invited the Member States to activate virtuous and sustainable processes. These include the Next Generation EU to support member states' energy and economic transition initiatives, and the European Community's Recovery and Resilience Facility and Technical Guidelines to guide the drafting of national plans. In 2021, based on the above mentioned mechanism, the Italian government approved the National Recovery and Resilience Plan (NRRP), which consists of three strategic axes (digitalisation and innovation, ecological transition, social inclusion) and six missions (1. Digitalisation, innovation, competitiveness, culture and tourism; 2. Green revolution and ecological transition; 3. Infrastructure for sustainable mobility; 4. Education and research; 5. Cohesion and inclusion; 6. Health)[2]. In 2019/2020, the Ministries of Infrastructure and Sustainable Mobility (MIMS), Economy and Finance (MEF) and Cultural Heritage and Activities and Tourism (MiBACT) are promoting the PINQuA programme, whose main objective is to reduce housing and settlement discomfort, with particular reference to the suburbs. A programme to redevelop and expand the public and social residential heritage, regenerate the socio-economic fabric of urban peripheral areas, increase accessibility and safety of places and repurposing abandoned and degraded spaces and properties. The programme addresses the problem of current housing emergency, with approximately 1.7 million homeless families, of which 650,000 are on the Public Housing (ERP) ranking list, and the housing problem in which approximately 1.5 million families live, of which 800,000 are in acute discomfort and 700,000 in severe discomfort (Federcasa & Nomisma, 2020). The NRRP has added 3.2 billion euros to the resources already allocated for implementing the PINQuA, which finances proposals from local governments, , of which 40% will be for interventions in the “Mezzogiorno regions”, the regions of southern Italy (Tartaglia, Castaldo, & Baratta, 2022).

This paper presents a research experience carried out in the framework of the PINQuA programme by an interdisciplinary group from the Department of Architecture of the University of Naples, focusing on small municipalities in the Campania Apennines[3]. After introducing the theme of living in small towns (§2), the article describes possible strategies of ecological transition and environmental awareness that can be developed from the potential of the places (§3). In the following paragraphs, the article describes the experimentation on the case study of the municipality of Calitri (AV), highlighting strategies and operational methods (§4), and discussing the outcomes in relation to the themes and the research questions.

2. Technological innovation for the Ecological transition in small towns

The small towns that characterise Italy's settlement structure, both along the coasts and on the Apennine and Alpine ridges, are places that suffer more than others from the effects of global and local dynamics. Their peculiarity lies in the fact that, through their stratification, their urban structures, their widespread and valuable architecture, they are actual evidences of the material and immaterial cultures of the peoples who have inhabited them, lived through them, conquered and made them unique over time. They tell of the relationship between the raw materials available and the techniques used, between geography, orography and architecture, between the light and domestic space (intimate) and urban (social), between man and environment, between artifice and the idea that shaped it in order to respond to individual and collective needs. These are settlements, immersed above all in nature, which keep their own different and varied character and characteristics, through which it is made easy to detect those original and primordial elements, true typological and constructive archetypes, which can be identified (Nardi, Campioli, & Mangiarotti, 1991); they represent the identity matrixes of the different territories, based on the value of the importance given to inhabited space, on the deep sense of belonging to places, as taught by anthropological studies: «We are the place where we were born and grew up, and the places we heve inhabited, known and lived. [...] The anthropological place is is the one inhabited, humanised, recognised, periodically refounded (think of festivals and rituals) by the people who belong to it or feel they belong to it. [...] There is something charming and evocative in the language, in the physiognomies, in the gestures, in the traditions that make the inhabitants of the same town physically look similar. We are alike because we resemble places, and we resemble places because places are our own construction» (Teti, 2018).

Since the second half of the twentieth century, these places have undergone a slow and steady process of abandonment: political, social, demographic and productive changes have led the big cities to expand beyond their borders, towards the periphery, in a continuous process of growth that has seen the birth of metropolitan cities; small towns, on the other hand, have experienced a shrinking process; in a short time, their local economies were no longer able to compete on the global market; began to 'suffer' from the loss of basic services - health, higher education, etc. -; they experienced the emigration of young people, who moved to other places where they could meet work and training needs. In this process of abandonment, the architecture is degraded, emptied, and the series of tiny elements that make certain territories recognisable, sometimes unique, are erased.

As a result of the closure of the railways, a system that connected the whole of Italy, linking societies and communities and facilitating economic, social and cultural exchanges, small towns are definitely isolated and loose the role of junction in the network system of which they were part. They become peripheries, in the sense attributed by European documents and scientific literature (DPS, 2014; ESPON, 2017; Oppido, Ragozino, & De Vita, 2023).

Nevertheless, there is a survival force inherent in these places, which is probably to be found in their common characteristics: they insist in contexts of high environmental and landscape quality; they recover typical constructive and formal characteristics; they renew local traditions; have a limited and compact extension of the built (D'Andria, 2022; De Matteis, 2018).

Starting from this vital force, it can be extremely promising to experiment through processes of regenerating the living spaces in response to the challenges posed by the contemporary polycrisis system. In small towns, “green” actions are able of

influencing not only the social structure but also the productive one, they have greater chances of "success"; they can become avant-garde places, laboratories of innovative design, where a "global process of ethical-cultural change" can be tested (Silvestri, 2015; Carrosio, 2019; Rete di Giovani Ricercatori per le Aree Interne, 2022).

The process of the ecological transition of this heritage also passes through interventions that push to find in technological innovation the field in which to establish an appropriate relationship between interventions of transformation and preservation of the existing (Bellomo & D'Agostino, 2021).

An innovation that starts from the potential of the existing built environment in order to transform it into actions capable of making the evolutionary process "metabolic", as the result of a close interrelation and interaction between different systems in the search for a renewed system/environment balance (Falotico, 2020).

Furthermore, in its philosophical meaning, the act of innovation is closely linked to that of knowledge, so that every cognitive process is in itself an innovation. Then it becomes a prerequisite for innovation, and especially technological innovation, the connection between different knowledge, between scientific research, building site and production (Civieri, 2012), between scientists, designers and the local community, between building and maintaining.

2.1 Energetic retrofitting for ecological transition

Studies and research on technological and energetic retrofitting interventions aimed at restoring and improving the original performance of the existing built heritage, or at introducing performances not required at the time of design and realisation, become a knowledge system of great importance from which to start updating intervention strategies and methodologies. The design of a retrofit intervention expresses the precise will to consider the existing heritage as a "renewable" resource, by virtue of the technical and typological-architectural choices underlying its realisation, which, appropriately revalued, can give a new quality to the built environment.

Technological and energetic retrofitting invests in buildings and/or buildings agglomerations and often consists in façade renovations - recladding, overcladding, refitting; in actions of "parasitism", "grafting", "emptying" or "remodelage"; in solutions that mainly concern the envelope and the technical system, giving new qualities to the existing building and adapting it to new individual or collective needs, new ways of living, new regulatory, economic and technical political imperatives. However, especially in small towns, it is very useful to look at local, spontaneous architectures, certainly not for a nostalgic re-proposition of forms, typologis, materials and techniques that are vernacular or traditional, but to question ourselves by «[...] "sensitive questions" which, in various ways, stress, challenge, tear our topicality [...]. The contact with the past profoundly modifies our experience of time and serves to reconnect theoretical activity with operational practice, basic research with operational research, and to make us aware that there is no competence without knowledge» (Perriccioli, 2016). And it is precisely knowledge that is the most important action in a retrofit project, because it makes it possible to reveal the material culture of the place and to identify the potential and criticality of the existing building. It is from this knowledge that, in the design phase, the assessment of the compatibility of the technical/design solutions with the environmental, architectural, functional-distributive and constructive characteristics is made. In fact, it is necessary to avoid achieving a certain result, correct from a regulatory or technical point of view, through the uncritical application of technical options that risk, at the

typological and compositional level, to definitively erase a heritage of studies, research and experimentation, and at the constructive and functional level, to disappoint the expected results.
It is essential to develop strategies and methodologies for sustainable action that can be shared by the societies that inhabit these places, in order to rebuild communities and link knowledge, skills and stories to promote new and renewed environmental awareness.

2.2 Maintenance and care of the built environment for the ecological transition

Studies on building and urban maintenance, which have flourished especially since the 1970s in relation to the growing interest in environmental protection, have contributed to the recognition of maintenance as a sustainable action, as it promotes the reduction of land, energy and material consumption, as well as transport and pollution, by prolonging the "useful life" of the built heritage (Olanrewaju & Abdul-Aziz, 2015).
In other words, the fundamental principles of a maintenance culture are consistent with those of a sustainable culture in that they promote interventions aimed at preserving natural and man-made environmental capital and its social, environmental and economic values over time.
Furthermore, the close link between planned maintenance (UNI EN 13306: 2018) and the European Union's energy policy[4] for climate protection at international level is evident. Maintenance, defined as «the combination of all technical, administrative and managerial actions during the life cycle of an asset, aimed at preserving it or restoring it to a state in which it can perform the required function» (UNI EN 13306: 2018), aims to maintain the efficient operation of buildings and their systems over time, thus increasing their durability. It follows that maintenance cannot be confined to a purely technical-operational sphere, exclusively in the management phase of buildings and the environment, but must participate in the architectural project through the definition and planning of actions. In this sense, it acquires a relevant strategic and programmatic role, fundamental for the effectiveness of the project outcome over time.
Moreover, maintenance, integrated into the design and building process, contributes to the creation of a highly sustainable "circular production process" (Fusco Girard, 2005). It has a positive impact on both the economy and the environment: in a construction sector that is increasingly oriented towards the valorisation of the existing, an increase in employment in the field of maintenance is expected, accompanied by a growing demand for specialised skills and skilled labour; maintenance activities help to reduce breakdowns, maintenance-related accidents, unproductive time (due to non-use or malfunction) and future maintenance costs; the maintenance of the built environment improves the quality of living spaces, making them more "attractive" for the influx of external capital and resources (Directorate General for Internal Policies, 2016; Achig-Balarezo et al., 2017; Farhani, Wallbaum, & Dalenback, 2018).
From a regulatory point of view, national legislation and sectoral regulations clearly express an awareness of the strategic role assigned to maintenance in the preservation and enhancement of the built heritage through planned maintenance activities. Since the 1990s, public works legislation (L. 109/94 as amended, Lgs. D. 36/2023) has confirmed this role, imposing the obligation to plan maintenance activities as early as the design phase[5] . With the shift from the management phase, when the work is completed, to the design phase - the moment when choices are made that will influence the life cycle of the building - building maintenance, no

longer confined to the purely technical-operational sphere, has increasingly become a strategic and programmatic factor, a harbinger of subsequent innovations (Pinto, 2012; Viola, 2022).

3. Strategic Actions for a possible Renewed Environmental Awareness

The constant demands brought about by the profound transformations of time and space, the modification of existing cognitive maps, the constant need to deal with unexpected events (Daher, 2013) require visions, understood as «the ability to build the framework of reference within which to structure and inform problems, searching for appropriate solutions; vision not as the thaumaturgic ability to foresee the future, but rather as the inventive ability to construct a possible future» (Campioli, 2016).
Well then, what should be asked to the capacity of inventiveness? Probably to draw attention to the broad context of the contemporary project, based on a way of thinking and doing that can no longer be confined to linear, absolute, univocal and unidirectional categories of interpretation and decision, but is variable, adaptable, prefigurable, open, collective and connective, multidirectional and indeterminate; probably to read, behind apparent contrasts, the real possibility of combining consolidated know-how and innovative experimentation, codified needs and unspoken demands, in a logic that unravels confusion in order to work on fusion; probably to identify the potential vectors of transformation specific to each place; probably to focus on each place's capacity for change.
All this seems to suggest a continuous and constant dialectical confrontation, not to be taken for granted, in order to look at a built fabric, in this case that of small settlements, made up of invariants that can become paradigms of a new way of life; made up of dimensions that transcend administrative, geographical and orographical boundaries; made up of architectures that become part of a local and global network, in which ancient wisdom is combined with contemporary expertise. In this perspective, the project of environmental and architectural rehabilitation is combined with the project of maintenance to become a “situated project”, a single strategic action that starts “from the inside”, from the places and the community. A project that is also able to underst the potential of urban spaces and voids to promote small and large-scale interventions that, by their very nature, have the multiplying power of a modus operandi that refers to cultivating, maintaining, preserving in order to improve; a project able to translate new gestures into renewed habitats, where the relationships between the environment, the individual and artefacts must be able to respond to contemporary challenges, without betraying the results of that slow process of mutation shared and promoted by the community in the name of a progress that may be at odds with the values and ambitions of the social, architectural and economic heritage.
For the scientist, therefore, the task is to allow everyone to inhabit their own place in their own time, to design, in a collective and connective way, both the space in which to carry out daily actions and the actions and programmes to maintain over time the qualities designed and desired, overturning «[...] the image of evolutionary processes: the traditional one, which identifies the direction of evolutionary processes in a hypothetical progressive optimisation of the adaptation of systems with respect to the environment, is replaced by another, which interprets this direction instead as the result of a close interrelation and interaction between different systems, in function of maintaining both the continuity of the organisation of the systems and the equilibrium between system and environment» (Tagliagambe, 1997).

Thus, urban and building rehabilitation actions become strategic when they are based on the relationship/connection between material culture and possible innovation, between settlement demand and territorial potential; on preserving and enhancing the existing heritage by promoting techniques compatible with the necessary transformations that will be generated over time: the construction of artefacts using light, reversible, transformable, recyclable and reusable technologies; the use of local raw materials wherever possible; the activation of processes of transformation of what is waste for a sector and a resource for architecture; the association of local skills with local production systems, whether abandoned or emerging.

Maintenance actions become strategic when they are able to trigger process, service and product innovation, with effective and efficient repercussions not only on the environment but also on the social and economic dimensions: process innovation by involving users and local knowledge in the implementation and management phases, by shortening supply chains, by defining maintenance strategies and programmes that are not standardised on the stock of real estate, but on the basis of environmental (climatic, hydrogeological, seismic, availability of water and raw materials, etc.), settlement and cultural specificities; service innovation, through direct and indirect training in on-site management and the activation of operational physical and virtual poles and networks; product innovation, through collaboration in the definition of sustainable and context-appropriate systems and components, to activate a life-cycle extension based on adaptive, durable and maintainable solutions, realised starting from the recovery, reuse and recycling of building production waste, with a vision of a circular economy.

4. Case-study: the PINQuA National Innovative Programme for Housing Quality “Re-Inhabiting Inner Areas”

Financed by the PINQuA National Innovative Programme for Housing Quality (D.I. n. 395/2020) of the Ministry of Infrastructure and Transport, the “Re-Inhabiting Inner Areas” project is an experiment in a strategy of collaborative renovation, rehabilitation and maintenance of public housing, based on the provision of customised housing with high quality and service standards. The project, developed by a team made up of the Campania Region, the Campania Agency for Public Housing, the Department of Architecture of the University of Naples and local professionals, involved the small municipalities (less than 5,000 inhabitants) of Alta Irpinia, in the southern Italian Apennines.

The pilot case has been selected by the regional authority and the coordination structure among those areas where the National Strategy for Inner Areas (SNAI) is at an advanced stage of implementation and where the potential connection with metropolitan areas is best. Alta Irpinia is in fact one of the four pilot areas in Campania involved in the SNAI and is affected by the construction of the "Hirpinia" station on the high speed/high capacity Naples-Bari line.

The unified strategy that guides the project proposals in Alta Irpinia interprets the quality of life as the driving force behind a process that integrates the educational and productive dimensions in a virtuous circle that is self-sustaining and self-feeding. To this end, if the project strategy responds on the one hand to the need to reconfigure contemporary forms of living, focusing on the issue of marginalised areas and constructing new forms of metro-rural policy, on the other hand it proposes the experimentation of innovative social infrastructure processes in the hinterland to guarantee renewed and equal citizenship rights based on community services capable of generating new skills and new economies (Fabbricatti et al., 2022).

The project process included, for each municipality involved, the drafting of a Technical-Economic Feasibility Plan (PFTE) in accordance with the Public Contracts Code Lgs. D. 36/2023 Art. 41.

In the municipality of Calitri, the design team[6] intervenes in a residential expansion area built after the Irpinia earthquake of 1980. This area is characterised by the physical and functional separation from the town centre of public housing stock and isolated dwellings built more or less on the edge of a main road (Figure 1).

Again, the project interprets the collective dimension of housing, integrating educational and productive activities to build a cohesive and environmentally aware community, a proactive rather than peripheral urban core. To this end, the project envisages three interrelated lines of action, starting from the Public Housing district.

– Housing quality: functional-spatial and thermo-hygrometric improvement of public housing;
– Proximity welfare: communal spaces, social concierge services and care and maintenance of places based on collaborative and intergenerational management;
– New economies: creation of a maintenance network (hub and spoke), with training of residents and/or craftsmen for small maintenance jobs; creation of a renewable energy community, demonstrator for the Apennine hinterland, based on the principle of sharing the converted thermal and electrical energy and on a plurality of different users - making the participants complementary in the use and conversion of energy.

Figure 1. The Public Housing in the suburbs of the municipality of Calitri (AV)

Source: Elaborated by the authors, 2024.

4.1 Energetic retrofitting measures

The three lines of action just described will be implemented in the project for the rehabilitation and maintenance of the public housing stock in the municipality of

Calitri, through solutions relating to both buildings and open spaces.
With regard to the residential buildings (Figure 2), based on an analysis of the type of building (multi-storey buildings with an uninhabited attic), the construction system (reinforced concrete) and the type of envelope (box wall) on a documentary basis (graphic drawings), the study proposed to increase the thermal buffer value of the loft, proposing an adequate insulation, and to proceed with an overlay insulation of the building envelope, paying particular attention to the new hole fillings, shaped to take advantage of the thermal wave according to the orientation of the artefacts and the apparent path of the sun.

Figure 2. The Public Housing in the municipality of Calitri, multi-storey buildings

Source: @Fabbricatti, 2024

With regard to open spaces, a particularly interesting aspect has been the study of criteria for the design of buildings intended for collective activities and social services, a study that has become an opportunity to explore new connection systems between existing spaces (public housing stock) and new user flows.
These buildings are fully compliant with environmental sustainability regulations, as they are designed to be energy self-sufficient, using renewable energy sources together with passive solutions for the building envelope. The building technologies explored included the dry-mounted solutions with an XLam load-bearing structure and the use of systems and components largely made from secondary raw materials, thus contributing to the activation of circular economy processes. The aim was to introduce innovative, flexible, demountable and therefore recyclable and circular designed solutions (Talamo, 2024) that could be realised through clean and fast construction sites.
The building is configured as both a place of training and a place of sharing. Its spaces can be used to learn new ways of caring for shared spaces, of using resources more wisely, of managing waste, and at the same time for recreational/educational activities, the design and management of which are entirely in the hands of the

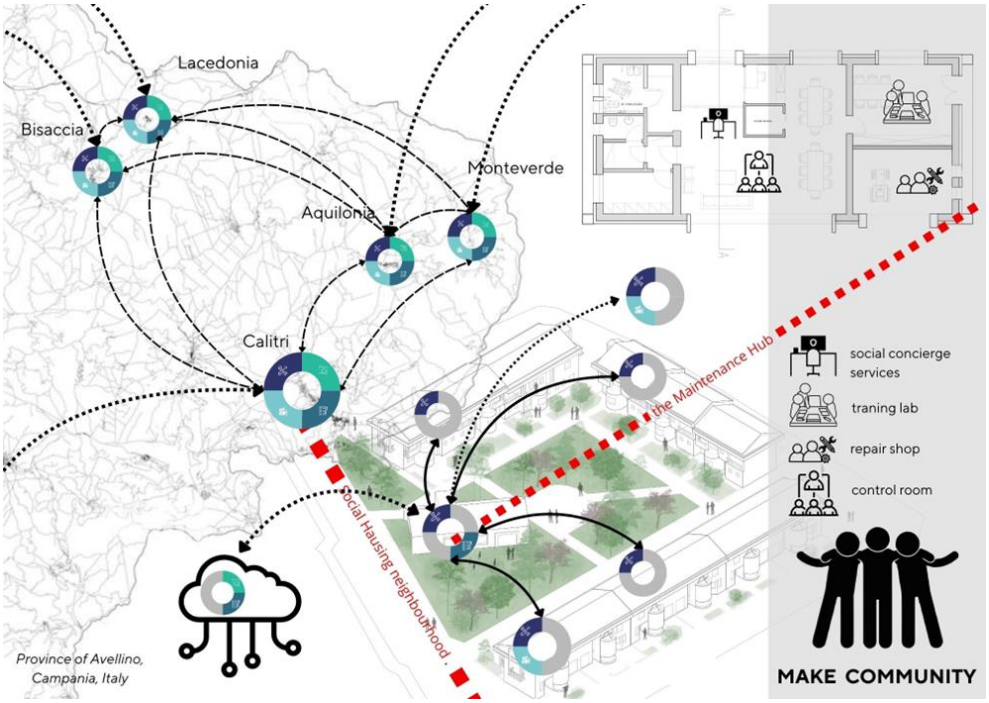
residents.
Thus conceived, they can be configured as attractors of new landscapes in the making: the ambition is to lay the foundations for renewed habitats, i.e. renewed relationships between artifice, man and the environment.
It was therefore a question of focusing on the need to mature a collective awareness, we could say of an environmental nature, in a spontaneous and connective way, but also in a reasoned and shared way, for subsequent incremental advances in socio-technical development, strengthening the relationship/connection between material culture and possible innovation, between settlement demand and territorial potential.

4.2 Maintenance as a sustainable practice and as a driver of a community empowerment and engagement

The project drawn up within the framework of the PINQuA "Re-Inhabiting Inner Areas" considers maintenance as an intrinsically sustainable practice (Pinto, 2012), aimed at extending the life cycle of newly built and rehabilitated assets, and at the same time, if properly managed, as an opportunity to strengthen the links between the community and its living environment. Indeed, the project promotes maintenance as a potential activator of community engagement and empowerment processes aimed at building technical skills and employment opportunities for young and old (Viola, 2022; Wood, 2005).
In line with the concept of the overall proposal, the maintenance model proposed by the project for the municipality of Calitri aims to:
- optimise the maintenance of public property (in terms of results, time and costs);
- increase the sense of belonging and care for the environment of the inhabitants;
- develop and/or consolidate the skills of the local population in relation to the maintenance service;
- in the long term, to encourage experimentation with innovative equipment and tools to improve the effectiveness, safety and cost of maintenance operations, to share technical know-how and to develop new businesses and start-ups;
- in the long term, to set up a network of maintenance operators in order to optimise the service at local and territorial level, involving the creation of a system of hubs (control rooms) and networks between the various parties involved in the management of the service.

To this end, the maintenance approach contributed to the definition of the project choices for the rehabilitation of public housing, defining the use of sustainable and context-appropriate construction technologies that meet the requirements of reliability, durability and maintainability (cleanability, replaceability, reparability, disassembly). Furthermore, to support the concept, the project envisaged the construction of small artefacts and/or functional integration in existing buildings to be used as a maintenance service centre. This is a peripheral management body for building maintenance at the neighbourhood or subdivision level, responsible for collecting and managing reports of deterioration/malfunctioning from residents/users and feedback information from activities in the maintenance plan, which is then sent to a control room (Figure 3). The project envisages that the residents themselves, once trained, will take on the management role, with the aim of also coordinating small teams of residents and/or craftsmen for minor maintenance work. Each hub, to be set up as a network between neighbouring communities, will function as a front and back office, a training workshop, a repair workshop and a storage facility for tools and vehicles for minor maintenance work.

Figure 3. PINQuA project. The network of Public Housing Maintenance Hub



Source: ©DiARC team, 2023

For the implementation of the hubs, the Scheduled Maintenance Plan for Public Housing has been drawn up (Lgs. D. 36/2023; UNI 10874: 2000; UNI 11257: 2007). The drafting of the instrument of the Preventive Maintenance Plan, required by Lgs. D. 36/2023, was conceived as «a document that, taking into account the design drawings, foresees, plans and schedules the maintenance activity of the work and its parts in order to maintain its functionality, quality characteristics, efficiency and economic value over time» (art. 19).

As a preliminary design tool, aimed at orienting the design solutions and the maintenance policy of the managing body, the maintenance plan has been drawn up starting from the definition of the most appropriate maintenance strategies (UNI 11257: 2007), also encouraging an active role of the users. In particular, it extends the maintenance and management activities entrusted to the user and introduces the figure of the trained user. The actor is not only the person who experiences the space, but also all those who, as a result of training or technical-practical preparation, are able to carry out a specific task that requires specific skills. This user carries out maintenance and inspection tasks of medium complexity (Figure 4). To this end, the maintenance plan foresees an awareness and training campaign for users on the correct use of building systems and their components, including green areas and common outdoor spaces. In addition, the project provides for the training of maintenance users (technicians, workers, craftsmen, researchers, etc.) during the execution phase of the works, through participation in school camps.

In order to support the collaborative network, the project, which is currently being implemented, envisages an alternative and appropriate local mobility system, characterised by electric road shuttles connecting local communities and interchangeable mobility nodes, following the old rural roads (Fabbricatti & Colucci, 2023).

Figure 4. PINQuA project. The main actors in a collaborative maintenance process

Source: @Fabbricatti & Michela Di Palo, 2023

5. Discussion and conclusions

Fragile contexts, characterised by territorial imbalances and social inequalities, still subject to phenomena such as depopulation, marginalisation, exploitation of resources, emigration, abandonment of agricultural land, etc., have recently been recognised as reservoirs of resilience, due to the presence of those priceless goods and services (so-called ecosystemic) that are indispensable for human well-being, "which are often not taken into account, simply because they are not monetised and are not considered in the same way as the consumer goods produced in the poles of central areas" (Marchetti, 2016). The resilience that inner areas have shown over the years is the result of a strong identity rooted in place, combined with a recently documented propensity for innovation: the margins have become places of freedom, laboratories of experimentation, where solutions are sought that can be generalised to wider territorial contexts. The idea that a new geography of innovation and social change is possible, in which emancipatory processes of change are gradually thickening in areas located at the margins, is gaining ground (Carrosio, 2019). All this must be able to dialogue with the ecological transition imposed by the activities of international bodies, the European Union and therefore Italy, which are translated into programmes, policies and regulations.

The PINQuA programme has made it possible to 'apply' in a peripheral area in a small Campanian town the studies and research that the author has been carrying out for years on the process of architectural and environmental rehabilitation and the role of maintenance as a strategy for the care and preservation of places, leading the research group to reflect on the periphery of peripheral inner areas, i.e. the edge of the edge, both in physical/environmental and social terms.

The presence of an interdisciplinary research team allowed for an integrated view of the multiple aspects required to define a technically feasible project within the binding and non-binding regulations dictated by the EU. Therefore, although the

paper presents the results of the input provided by the Architectural Technology researchers, it is clear that this input influenced and benefited from the other competences present in the team.

A relevant methodological aspect, experimented on the occasion to study approaches for the rehabilitation and maintenance of the public housing stock of Calitri, consisted in sharing, upstream of the process, a set of requirements capable of considering, almost simultaneously, both the effectiveness and efficiency of the proposed solutions and the real possibility of being able to maintain them over time, while guaranteeing high quality standards.

In addition, the set of requirements has been constructed in such a way as to satisfy not only the major requirements related to sustainability (Km0 supply, appropriate use of resources, reduction of energy requirements, etc.), but also those related to the use of space, both closed and open, compatible with the habitual behaviour of users and with those that will be introduced in relation to the innovations proposed, such as the creation of a renewable energy community, maintenance networks, social concierge, collaborative services, heritage communities (Council of Europe, 2005).

Finally, the proposal of dry, light, demountable construction technologies, using recycled materials and products (as recyclable as possible), innovative for the specific contexts of the PINQuA programme, but at the same time compatible with them, should contribute to spreading the idea that it is possible to experiment with the transformation of parts of small settlements in a logic of care and respect for the environment, both in a global sense and, above all, in a local sense. The logic of maintenance also contributes to the dissemination and learning of new technologies, so that change becomes an evolutionary process embedded in the natural development of a place with its community.

Notes

1. «Sustainable development is development that enables the present generation to meet its own needs without compromising the ability of future generations to meet their needs». Definition of sustainable development as elaborated in the report Our Common Future, 1987.
2. Following the revision of the Plan, which was finally approved on 8 December 2023 by the Economic and Financial Affairs Council. , the new chapter REPowerEU - the EU plan adopted to reduce energy dependence on Russia and accelerate the green transition - was introduced in the Italian National Recovery and Resilience Plan PNRR as the new Mission 7 (https://temi.camera.it/leg19/pnrr/missioni.html accessed on 30 September 2024).
3. The municipalities involved in the study were Aquilonia and Calitri in the province of Avellino; Laviano in the province of Salerno.
4. We refer in particular to the Kyoto Protocol (2005), the EU Green Deal and the Habitat Agenda (United Nations, 2016), which aim to reduce emissions by 55% by 2030 and achieve climate neutrality by 2050.
5. In Italy, the current public procurement legislation, Lgs. D. 36/2023, introduces at the planning levels the instrument of the Preliminary Maintenance Plan (Annex I.7 art. 19) as part of the Technical and Economic Feasibility Plan and confirms the Maintenance Plan as part of the Executive Plan (art. 41).
6. The working group for the PFTE of the Municipality of Calitri is formed by: Donata Vizzino, as Single Project Manager of the proposing party Regione Campania; Angelo Maria Pirone, as Single Project Manager of the implementing party Agenzia Campana Edilizia Residenziale ACER, with Carmine Andreotti and Carmine Crisci as project coordinators. For the Department of Architecture of the University of Naples, the scientific advisor of the project, the team is formed by Michelangelo Russo (scientific head), Enrico Formato and Alessandro Sgobbo (scientific coordinators), Adelina Picone (project coordinator), Mariangela Bellomo, Gilda Berruti, Claudia Colosimo, Angela

D'Agostino, Michela Di Palo, Katia Fabbricatti, Giovanni Laino, Salvatore Manzo, Cristina Mattiucci, Caterina Mennella, Eleonora Petroni, Giovanni Rizzo, Luisa Russo, Giovangiuseppe Vannelli (project team).

Author Contributions

Although the authors jointly contributed to the conception and design of the work, the final drafting of the paragraphs "1. Introduction. Living in the time of polycrisis", "2. Technological innovation for the Ecological transition in small towns", 2.1 "Energetic retrofitting for ecological transition" and "4.1 Energetic retrofitting measures" is attributed to Mariangela Bellomo; of the paragraphs "2.2. Maintenance and care of the built environment for the ecological transition", "4. Case-study: the PINQuA National Innovative Programme for Housing Quality Re-Inhabiting Inner Areas" and "4.2 The maintenance service as a sustainable practice for a community empowerment and engagement" to Katia Fabbricatti; of the paragraphs "3. Strategic Actions for a Possible Renewed Environmental Awareness" and "5. Discussion and conclusions" to both of the authors.

Funding

The research was funded by the PINQuA National Innovative Programme for Housing Quality (D.I. n. 395/2020) of the Italian Ministry of Infrastructure and Transport, and by the National Recovery and Resilience Plan (Italy's PNRR).

Conflicts of Interest

The authors declare no conflict of interest.

Originality

The authors declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere, in the present of any other language. The manuscript has been read and approved by all named authors and there are no other persons who satisfied the criteria for authorship but are not listed. The authors also declare to have obtained the permission to reproduce in this manuscript any text, illustrations, charts, tables, photographs, or other material from previously published sources (journals, books, websites, etc).

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