

- B3 - block 3**
- APARTMENTS type B = 1B + L + service rooms
  - APARTMENTS type C = 3B + L + service rooms

## "Modern" suburbs in lockdown: the INA CASA neighbourhood by Filippo Rovigo in Messina

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### ABSTRACT

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The recent CoViD-19 emergency, a dramatic issue for our health, and the vexata quaestio of the existing buildings recovery, especially of the neighborhood, are the ends of an Ariadne's thread that must help us find an exit from the two huge problems. These issues, coupled by the isolation constrain, can be converted in a great opportunity by using targeted choices, supported by sustainability criteria that are now unavoidable.

In the present paper, a specific suburban area- former Fondo Basile by architect Filippo Rovigo, on the northern edge of Messina was selected. For this area - following the original indications formulated by the emerging "neorealist" culture for garden cities - we intend: to redefine barrier-free paths; to add green and blue infrastructures; to evaluate incidences on energy performance; to redesign interior spaces to accept the need for sterilization and "flexible" furnishings; to experiment with functionalized surfaces (self-cleaning, antibacterial, heat-insulating); to introduce ad hoc home automation.

Therefore, it is necessary to start from a very serious accident on which we stumbled exploiting this experience in order to look at the virus as an opportunity for a general rebirth of the neighbourhood. This latter can be based on new or experimental concepts in order to allow a sustainable restoration of the Modern Architecture, addressed to the second post-war period heritage, not guaranteed by the constrained regime provided for by the Cultural Heritage Code. This possibility is back in the fore thanks to a more recent strategic direction for the protection of "new landscapes" promoted by the Regional Department for Sicilian culture and identity.

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### KEYWORDS

Messina, Modern Architecture, social housing, CoViD-19, lockdown

## 1. A PROTOCOL FOR THE SAFEGUARDING OF "MODERN" NEIGHBOURHOODS IN LOCKDOWN

The disrepair of the "modern" suburbs built after World War II seems to have suddenly become evident. Long before the term took on its current meaning, they were deep in lockdown, abandoned to self-construction for performance adjustments, becoming explosive containers of high social distress and unequivocal manifestations of numerous building dysfunctions.

The suburbs we would like to deal with are currently affected by a "confinement" problem with a dual value: a previously existing "implicit lockdown", rooted in a difficult context that is spontaneously "closed" and marginalised, and a new "explicit lockdown" imposed by the risk of contagion and sanitary inadequacy. The former type requires protection tools not yet considered by the Code of Cultural Heritage and Landscape (Legislative Decree 2004/42), which seem to barely touch on modern architecture and social housing neighbourhoods even less so.

However, an action of redemption and rethinking could perhaps come from the "explicit lockdown", which could protect against the spreading of the virus, it having brought the issue of the suburbs to the fore, including the self-contained nature of neighbourhoods and the centrality of services and infrastructures.

As such, attention turned to a social housing neighbourhood built in Messina after World War II. Its, identikit responds to the reflections currently being developed, as it is marginal and degraded but with exemplary potential for the multidisciplinary themes to be adopted: from the restoration of the Modern to urban regeneration; from the adaptations of the housing and performance model to the opportunities of home automation, from congruent technical solutions to experimentation with materials. While remaining aware of the fact of having intercepted suggestions and possible solutions that will require further investigative tools, a conceptually "experimental" outcome is proposed.

## 2. IDENTIKIT OF THE SAMPLE DISTRICT

The urban layout of the former Basile Fund is linked to a social concept that is inclusive of the essential services, in harmony with a typological scheme that respects the objectives of that historical moment, with the "houses for all" proposed by the Fanfani Law (1949). This notion of housing drew its heralded dignity from a very small-scale reproposal of a model that was widely tested during the transition, moving first from the nobility to the bourgeoisie and then from the high to medium-low bourgeoisie. The result is typical of many Italian working-class condominiums built from 1950 onwards, namely a solution with entrance, corridor, bedrooms, kitchen, toilet, balcony, living room, all small but separate and often subject to demolitions and change in favour of open space that is considered more "modern", although today this is being at least partially reconsidered.

The underlying inspiration was linked to the necessity, but also to the enthusiasm of the post-war reconstruction in Italy. It did not exactly constitute a search for a hard and pure existenzminimum, but rather that of giving everyone an "ideal" allocation that would soon find a sounding board in the vast "Piano INA Casa", albeit while limiting the dimensions of individual spaces and defining common construction techniques. This continued to mark the mass housing interventions of the second half of the twentieth century. In particular, many neighbourhoods that were not expressly centred around social housing nevertheless repropose the same distribution model, perhaps expanding the individual spaces but without rejecting the internal articulation.

The neighbourhood identified is therefore emblematic of an extremely widespread building and constructive typology, with most of the apartments still inhabited and in need of rethinking. This is especially true at this moment, which, together with some areas of potential, has revealed the inability to respond not only to current standards of comfort but above all to an emergency that is destined to keep us all in our perfectly sanitised homes, while avoiding the typical conflicts caused by the confinement and allowing everyone to carry out their activities, including work.

It is a potentially resilient residential area as it offers shared spaces that can be changed, smart as it is flexible and adaptable to contingent needs, safe as it self-sanitises and contactless, thrifty as it balances protected management and reduced consumption.

### 3. HYPOTHESIS OF A COHERENT PROTECTION PLAN

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Each architecture is a unique and irreplaceable creation and, as stated by Cesare Brandi in his "Theory of conservation" there is a fundamental distinction between the products of human activities, which are "industrial creations" and the "unique objects". To the latter he gives credit as a path for the future generations to inherit the values and meanings of their ancestors. Therefore, a conservative intervention must bear on itself the legacy of those meditations about the global preservation of the context. Opposite considerations could be made about those architectures, whose construction contemplate the use of industrialized materials or serial productive processes, for which the intervention will be focused on the functional and the MEP/HVAC systems restoration, possibly complying with the necessities arising during the course of those architecture's life cycle. This draws a separation line that implies which interventions are to prefer in which context. The reasoning which parted "alive" monuments from the "dead" ones (Gustavo Giovannoni, 1931) allows, in this case, to identify both those artefacts susceptible of transformations (that give them back a functionality in response to the ever-changing requirement) and those whose interventions should be focused solely on the absolute conservation for the primary need is to document techniques and construction methods. Conservation of modern architecture underlined the necessity to deepen the knowledge about its fundamental characteristics in order to meditate about the most suitable way to operatively salvage and preserve. This approach has been therefore conducted assuming the former Fondo Basile as a experimentation ground about the resolution of the problematics both already

manifested - structural consolidation of reinforced concrete, performance update, formal qualities - both other, more recent, requiring of health preservation imposed by CoViD-19 emergency. The validation of structural functioning, if it will be necessary to modify the arrangement of both the partition walls and the resistant walls, would assume to make the calculation of the whole structure, by posing a serious problem on the testing methods because, at the end of 1950s resistances were estimated with Kani's method, which took in account a resistant contribution deriving from the use of a stiffening ledge. This led to the conclusion that would be advisable to use solution for the internal division of the space that will not alter the original static scheme.

During the years some performance updates related to the thermal comfort have been adopted, using an autonomous heating system which interfered with the formal quality, although minimalist, that the original planner intended. An "health-centered" review could be the needed occasion to introduce thermal, acoustic, lighting and sanification updates with the desirable contactless systems. These new systems allow to manage a huge variety of traditionally switchboard-controlled functions through the use of sensors and voice-controlled commands, while involving a modest amount of demolitions in order to install new ductworks. A technical renewal is due and can be considered as a natural evolution for architecture in general; if it will be knowledge-driven can be integrated with the principle of conservation of traces and values, which are evaluated to be of importance for the future generations to inherit.

### 4. TO BRING THE CENTER BACK IN THE PERIPHERY

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The pandemic has rekindled the urban planning debate on principles that seemed already well stated as "dispersion" and "density". Discussing about the first of them, the position of Carlo Gasparri seems one of the most interesting considerations on the CoViD-19 emergency: he

attributes a multiplier effect of the infection to the features of the territorial organization of the "diffused" city. In the same way, the dense city is into a crisis so deep to overturn the model settled to contrast land consumption and achieving objectives of sustainability, economic-social development and efficiency of infrastructures and services. The truth is that we have been caught off guard. Now the lessons learned are different and lead to reflect about the "right urban dimension" but also on the need of greater flexibility and adaptability to the changes that any kind of a future, unexpected or simply not understood in time, can reserve.

The research for a third way imposed by CoViD-19 seems to simply indicate a "normal" and "muting" city. At the same time, a new "normal model" in which it is possible to intensify and trigger new urban relationships with the existing one could be generated. Concentration and diffusion will continue to coexist if the goal of containing soil consumption, through a careful use of environmental networks, leads to "densifying the dispersion and permeating the concentration by increasing its porosity and voids" (Pavia, 2015).

The theme of urban porosity - and there is no more porous space than the suburbs - is one of those principles able to reestablish a centrality to the marginal areas, making them, for example:

- strategic places in the arrangement of green and blue infrastructures (Fig. 1);
- essential areas to ensure capillarity of green spaces (understood in a broad sense) with the aim of strengthening the network and ecologies of urban landscapes; reorganizing the water cycle (altered by climate change and related extreme events); restoring security to the territories; creating networks for the production of energy with renewable sources (Gasparrini, 2015; Gabellini, 2018).

CoViD-19 led us to reconsider the social and therapeutic potential of open space and proximity facilities, and the importance of la ville du quart d'heure (Fig. 2), a post-auto city where it is possible to find everything you need within 15 minutes' walk from home. It is an urban model that brings neighbourhood life and social relationships back to the center where a mix of uses and the redundancy of some equipment and services would help residents to satisfy basic needs and live a healthier and safer life. To achieve it we need to practice a new kind of capillary and resilient urban regeneration, a homeopathic urban planning, a design of green areas aimed to restore urban landscape and create new ecosystem services. The failure of the large-scale neighbourhood - from Sant'Elia in Cagliari, to Zen in Palermo, to Librino in Catania, not to mention the best-known cases such

Figure 1.  
Green and blue infrastructures (IRIDRA, 2018).



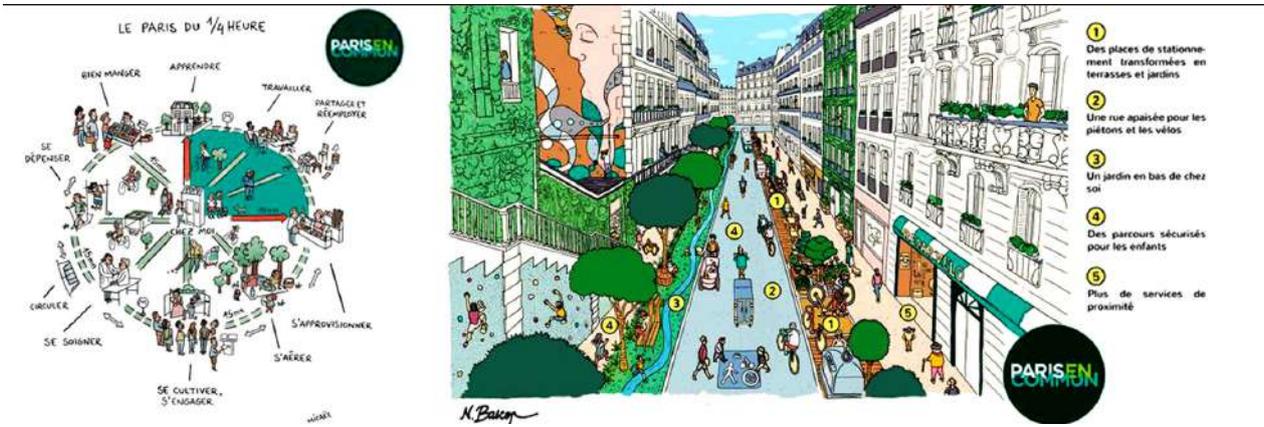


Figure 2.  
La ville du quart d'heure (FASTCOMPANY, 2020).

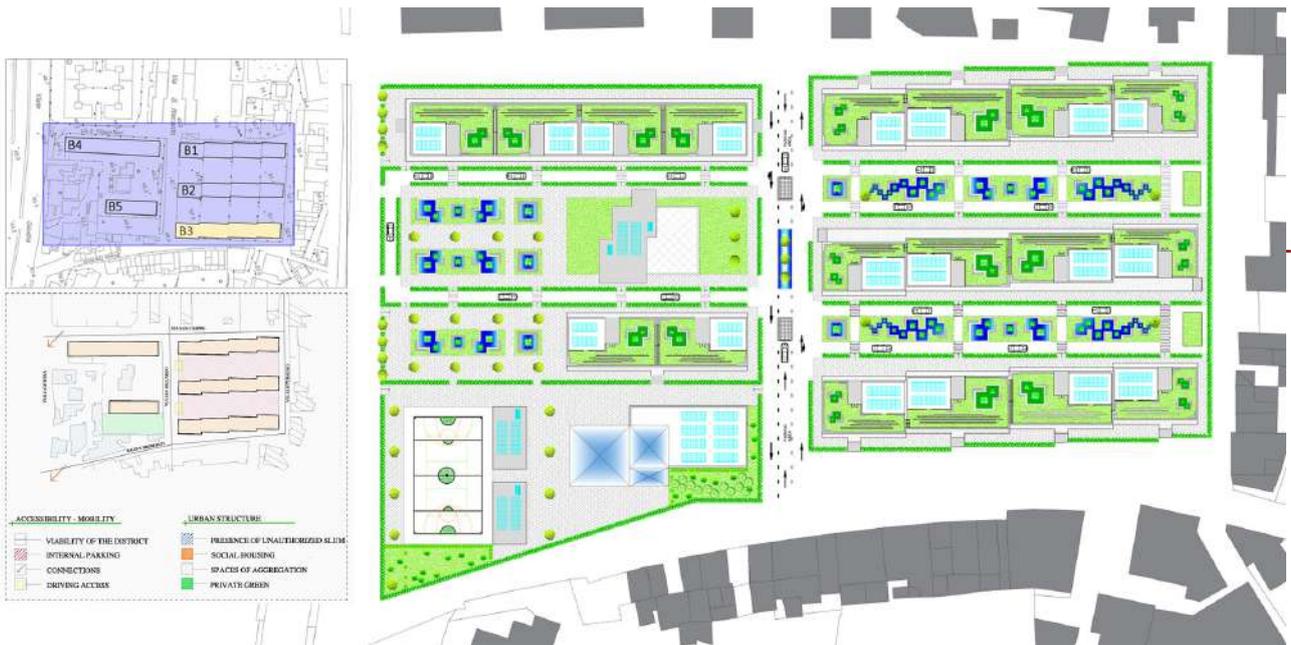


Figure 3.  
Urban regeneration of the former Fondo Basile  
(Gitto-Cingolani Proposal, 2018).

as the Vele in Naples and the Corviale in Rome - has been definitely stated. The settlement model that has shown greater resilience is precisely related to small-medium-sized neighbourhoods (such as the former Fondo Basile) for its power to approach and permeate the pre-existing buildings or anticipating urban planning guidelines (AA.VV., 2016).

Fondo Basile is not only a set of buildings to enhance but also a composite structure of interstitial landscapes potentially based on public spaces and facilities which deserves to be rediscovered and used in a very contemporary mode. The shape of these open spaces within the social housing districts outlines the transition from private to public realm through a sequence that goes from dwelling to urban shared places. The quality ensured by these intermediate spaces is marked by paths and hanging gardens of Matteotti neighbourhood in Terni (where they are still effective filters between the house and the street), by the equipped parks in the Salivoli di Piombino, by the private micro-gardens in the Costa degli Ometti in Genova.

According to a strategy to support the polycentric model - recalled many times for a city like Messina - to identify the suburbs as a strategic political goal would mean to make the public city a laboratory-trigger of regeneration. To start specifically from the places of social life within the neighbourhood or to redevelop places such as those of the former Fondo Basile could be key practices for the whole city. The endowment of inner areas - unused, degraded or underused but highly flexible to regeneration due to the lack of specific constraints - could allow to recall remodelage experiences or interventions of infilling, intensity, diversity, intended to create new density of volumes and functional, social and typological mix. The "horizontal densification", by a specific reorganization of the empty and "waiting" areas and an appropriate modelling of the buildings, could represent a good methodology to revitalize both the too large and undifferentiated areas and the interstitial fragments. Furthermore, a system of services for the community or new dwellings would be created through the overall redesign of the sharing spaces (Fig. 3).

## 5. SAS-HOUSING (SMART AND SAFE HOUSING)

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Housing should first and foremost satisfy human needs. However, with the exception of primary requirements to feed themselves, with the related organic consequences, to sleep, to wash, to reproduce, people continually evolve with remarkable speed (in reality, even the expectations of responses to primary necessities are transformed), while the home struggles to adjust and respond to economic, social and political changes, tastes, habits, fashions and desires.

Residences are a product of the building sector, one that is notoriously slow and perhaps hostile to change. We are not talking about the dedicated industry, which continually markets innovative materials and components (even going too far for the context that is supposed to accommodate them), but the construction site, which still today absorbs little or no skilled labour, and, unfortunately, is also not always able to keep up in terms of training.

While these problems are already burdensome, a question that is heavier still hovers over them: building is very expensive and changing the characteristics of a house costs almost as much, not to mention the regulatory and bureaucratic constraints (indexes, standards, building and urban planning regulations, security, etc.) which, even when they don't directly oppose them, certainly discourage substantial operations that are perhaps more welcome than the idea of moving, an event experienced by many as a misfortune, at least for us Italians.

In the past, we have studied - and we continue to study - solutions for energy and seismic adaptation or improvement, combining them with the aim of carrying out good restyling when possible. We have always had to note that budget and constraints were a real problem when faced with very rich technical-scientific literature and the enormous range offered by the industrial market.

The "challenge" we are talking about now is really worthy of the name since it imposes a different way of thinking about new houses, which is relatively

easy even if many stereotypes have to be overcome, but above all because it requires us to re-think old houses. CoViD -19 has revolutionised the domestic environment and interpersonal relationships, shedding light on defects, gaps, inadequacies and the limits of what already exists while demanding new design inputs.

We have undergone, and not yet metabolised, social housing and cohousing, which we could define as "philosophies of living" that arose as a result of profound and perhaps unstoppable (at least in the short term) socio-economic upheavals. However, the current health emergency means we are faced with three additional problems:

1. urgency, which does not work well with the slowness of the construction sector mentioned above;
2. the huge number of existing residential units, the majority of which are located in multi-family structures in urban suburbs that are often dilapidated;
3. the inevitable multidisciplinary of the approach.

The virus is here now. It could disappear or be eradicated, but also persist or even vanish and then return, and therefore we must work quickly to guarantee a house suitable for lockdown, smart working preventing the spread of infection.

This new challenge must be condensed and projected into an approach that we could call SAS-Housing, after a Smart And Safe housing proposal that we have applied to some units of the former Fondo Basile.

### **5.1 EXPERIMENTATION OF SAS HOUSING MODELS**

A domestic revolution began well before this health emergency, highlighting the inadequacy of a now stereotyped functional distribution of housing. CoViD-19 has taken urgencies to extremes and accelerated them by posing problems relating to the fluidity of spaces, functional hybridisation and the collision of people with different needs

The conception of post-World War II living centred around serving spaces that were kept separate from those being served, whereas since the end of the 1960s this was countered with an open and flexible

vision, at least in its original intentions, which offered immediate use of the living area, and access to the more intimate sleeping area without significant interpositions. This latter model has long since shown itself to have limitations with regard to the multiple composition of households, the need for real functional flexibility, the desire to be able to handle hybrid spaces and customisable furnishings, all of which finds meaningful confirmation and radical food for thought in the confinement conditions caused by CoViD-19.

Primary needs have emerged, some of which were assumed by previous housing models, others by re-elaborations of the current ones, and some arising specifically from this contingency.

Drawing on the work developed by architects, designers, startupper and trendsetters, a short "theoretical" repertoire of living themes was compared with the original typologies conceived for the former Fondo Basile, in order to assess their adequacy and to make any changes or design reviews.

As such, we proceeded to tackle this technical-health challenge through two steps:

- by analyzing housing issues and the inventory of needs that emerged during the lockdown
- by verifying the original spaces to propose solutions for functional adjustment and multiuse furnishings.

#### **5.1.1 Living trends and the inventory of needs**

##### **The revival of now obsolete entrances**

The first space found to be lacking was the entrance, in housing where the access and service filters have been reduced to the bare minimum to optimise the habitable surfaces. It is a decompression area that is easy to sanitise and to equip with what everyone considers essential to be able to get of feelings of discomfort and external "contamination" and safely regain contact with the "purified" interior spaces of the house. It has become a "vital" garrison in which to accommodate everything needed in order to: disinfect shopping; put away face masks; sanitise smartphones, glasses, keys; sterilise shoes and clothes (Fig. 4).

**The hybridisation of "flexible" environments**

In recent decades, the "theory of rooms" has been questioned: the corridor that once guaranteed access to the various rooms has disappeared, replaced by spaces that are as open and shared as possible. During lockdown, however, it became apparent that this concept can hinder the transformation of housing into hybrid, modular and flexible spaces that keeps in step with the changed formations of the family unit: from mono to polynuclear, intergenerational, temporary and/or cohabitation. There has been an attempt to emphasize the classic functions of the rooms by adding private spaces/ corners to accommodate extraneous inclusions of: remote study/work, fitness sessions, social connections, multimedia entertainment, first aid and care facilities. This is an opportunity to reinterpret any

room in such a way as to make privacy and sharing non-antithetical concepts, to reconsider proxemics and ergonomics, to enlarge or reduce each space with floating walls, retractable curtains and modular solutions, which are all easily assembled and disassembled.

The design of the 1960s-70s provided suggestions and futuristic solutions (Fig. 5).

**Life around furnishing: the affordances**

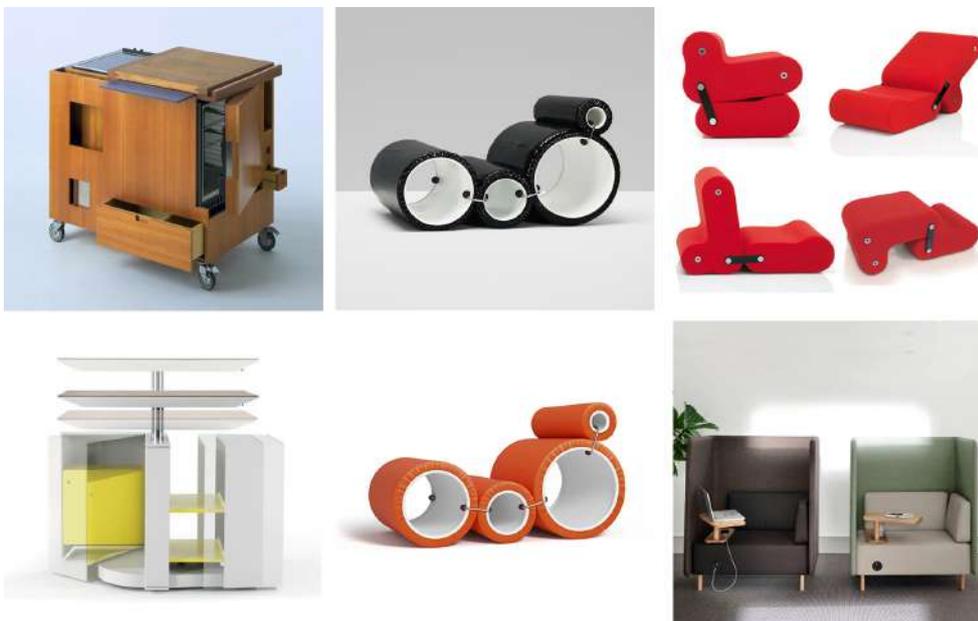
The furnishings proposed by the companies in the recent period of sanitary lockdown are transformative, nomadic, space-saving and customizable, without interruption, in keeping with digital culture, sustainable and potentially recyclable. In line with this trend, the desire to optimise the available furnishings has emerged, getting rid of

Figure 4. Sanitation devices to combat the pandemic (DOMUS, 2020) to be placed in equipped and modular entrances (Kuboline by Tosetti).





**Figure 5.**  
Joe Colombo, *The global housing unit: Rotoliving + Cabriolet bed* (Salzano, 2015).



**Figure 6.**  
Flexible furnishings: (up) Design by Joe Colombo: Minikitchen, Tube Chair, Multichair; (down) Design-Tech for Future: Touch Down Unit (Unifor); TubeChair (Cappellini); Core (Martex).

everything that has proved superfluous/static/bulky and keeping only what has shown "intelligent" versatility in performing different functions depending on the need.

Affordance, the intrinsic ability of a piece of furniture to accommodate multiple uses and to suggest the most appropriate actions to activate them, has been tested both at a company and individual level, conferring a flexible appearance (Fig. 6).

### 5.1.2 Redesigning upcoming spaces by looking to the past

Examination of the housing units (type B and C) of the former Basile Fund highlighted how the spaces are well suited to accommodating some of the requirements that emerged from the analysis carried out.

The accommodation is equipped with independent

entrances, living and sleeping areas, and can be organised into well-equipped and comfortable "independent functional stations".

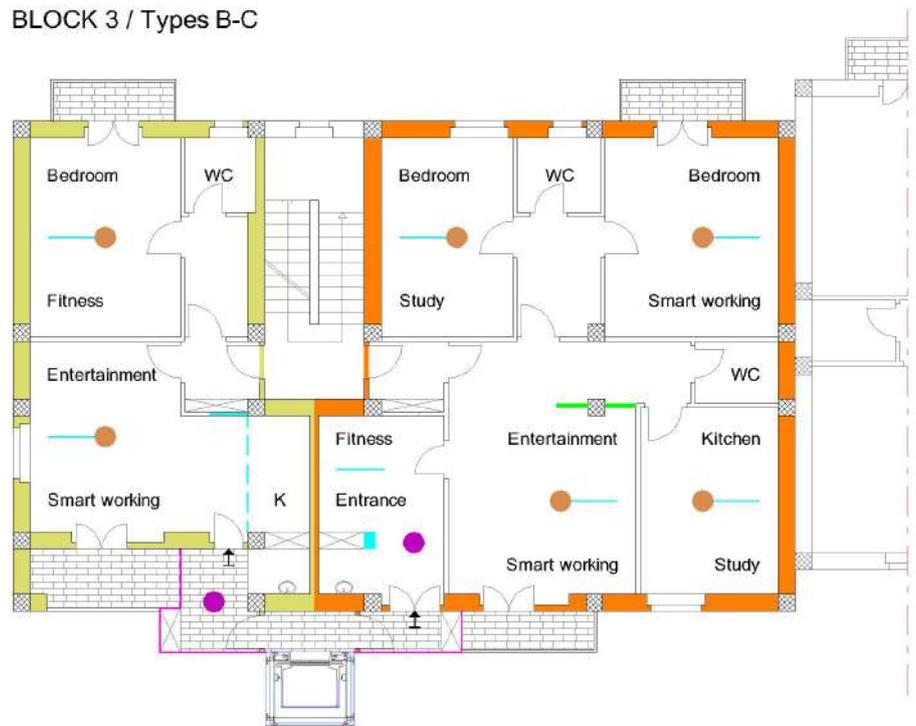
By assuming conceptual approaches from illustrious "prototypes", "pop" equivalents were sought to provide widely applicable solutions alluding to an idea of itinerant living, with maximum usability even in small spaces, minimising the possibility of hindering and disturbing each other (Salzano 2015; Di Sivo-Cellucci, 2015; Creddoni, 2020). A study of both the spaces and the furnishings has therefore made it possible to suggest some useful measures for transforming them and making them respond to the inventory of needs that emerged during the quarantine, exploiting the potential already present in each place/object that only finds expression when the inhabitant is able to activate it: the inherent affordance of a balcony, a niche, a step, a table, a bench, an anonymous barrier (Fig. 7, Fig.8).

**Figure 7.**  
*Independent stations  
proposed by Jaques Tati  
(Cubicle 1967) and revival  
of modular and reversible  
multifunctional corners.*



Figure 8.  
INA Casa accommodations  
before and after the  
"antiviral" treatment: flexible  
space and furnishings.

BLOCK 3 / Types B-C



● Sanitizers for filters  
Furniture for filters



— Green partition  
— Translucent partition  
— Mobile partition



● Modular furniture  
Flexible furniture



## **5.2 REVISITING HOME AUTOMATION WITHOUT CONTACT AND WITH REDUCED CONSUMPTION**

Recent studies have shown that the contamination of the built environment is relevant in viral spreading, underlining the fundamental and equivalent role of contact precautions compared to airway protection devices. In general, human coronaviruses can remain viable and remain infectious on inanimate surfaces for a period of between 2 and 9 hours, this variability being linked to the nature of the surface on which the virus is deposited, the initial virus concentration, humidity and ambient temperature and the type of transmission vector. It is therefore necessary to limit one of the habits that is firmly rooted in our normal way of life, namely promoting the sequence of contact between hands-contaminated surface-parts of the body (cross contamination), the cause of infections by self-injection.

A study carried out at the University of New South Wales showed that, on average, a human being touches their face about 23 times an hour, and in 44% of cases this affects a mucous membrane (the mouth 36% for an average time 2 seconds, nose 31% for 1 sec, eyes 27% for 1 sec, membrane combination 6%). During the pandemic period, these values have experienced a significant variable reduction between 30% ÷ 48% (European Centre for Disease Prevention and Control, 2020) thanks to health information aimed at persuading the population to consider their hands the most common vector for transmitting germs from a contaminated surface to the body. Although the scientific literature has shown that the viral load of the pathogen is high when there is contact with cellular organisms and decreases over time once in contact with the surfaces. It is essential for the health and hygiene of the domestic built environment to reduce interactions with the building elements that are used during the day (handles, switches, keyboards, touch screen devices, taps, handrails, etc.) with an unimaginable frequency. These results can be obtained with home automation and by integrating BACS (Building Automation and Control Systems) for computerised house management that also makes it possible to combine economic and energy savings.

The installation of web servers for managing home automation systems and the dialogue with IOT (Internet of Things) devices can also be supported by cheap and now widespread smart speakers (eg. Sonos One, Bose home speaker, Google Home/Mini/Nest Hub, Amazon Echo 3/Dot/Plus, Orbi Voice by Netgear) for voice control and the adjustment of lighting, air conditioning, ventilation, security, appliance activities or different preset scenarios, reducing contact with surfaces made from PVC, steel, metal, glass and wood, on which viruses actively persist.

We will then proceed in two steps, one theoretical, the other operational:

- by choosing a methodology capable of guaranteeing a contactless review with low energy consumption;
- by applying the solutions to the sample units to verify effectiveness.

### **5.2.1 The eu.bac system**

By assuming a residential unit as a reference, the solutions capable of reducing both the number of contacts with the surfaces and the energy requirement are analysed. Reference will be made to EN 15232 "Energy performance of buildings - impact of Building Automation, Controls and Building Management" and to the simplified methodology developed by the European Building Automation and Controls Associations, BAC factor, which uses a statistical calculation procedure to estimate the impact of implementing the BACS on the reduction in the building's energy consumption. The standard indicates four building classes, A (high performance BACS and Technical Building Management, TBM), B (advanced BACS and TBM), C (standard BACS), D (no energy efficient BACS), according to a score attributed to the energy systems' different levels of control and automation. The simplified methodology analyses 10 domains relating to various energy fields: heating, domestic hot water, cooling, ventilation and air conditioning, lighting, rolling shutters, technical management of the house and buildings, key eu.bac performance indicators, extended eu.bac functionality and eu.bac

certified products. Each domain is associated with a maximum number of points that can be obtained based on the system's level of automation and functionality (variable from 0, "Not controlled" to level 2,5, function of the domain to which it belongs, "Fully controlled", which would guarantee the maximum score); the cumulative number of points is subsequently converted into a class for the building, from A to D.

The automation will also cover the closing/opening of doors-gates-windows and will be managed by voice commands, combined with specific sensors (twilight, movement/presence, etc.) in relation to the different and variable scenarios for the use and occupation of the individual environments, to the specific needs of users and to external environmental conditions, providing the highest levels of comfort, safety and quality.

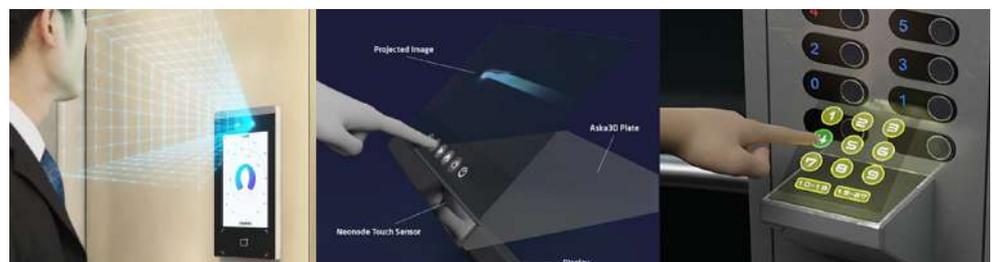
### 5.2.2 Redefining the automation class

For the sample apartment considered (type B unit), measuring 70 square metres, without any automation and control system (Class D) and with average annual consumption of 3861 kWh, the minimum automation requirements for the transition to class C have been identified in relation to heating, cooling and lighting. The Energy Plus calculation of the main energy indicators showed an average reduction in consumption of 7.5% compared to that recorded in the absence of automation. In keeping with the provisions of EN 15232, the apartment brought to class C is considered as a "reference model" for calculating the BAC factor - as a ratio between the energy needs for a higher home automation level (class B or A) and the values achieved for class C - for a comparison with the provisions of the standard. More complex and expensive actions were therefore

**Figure 9.**  
*Window frames for the transition from class C to B: to VMC and smart (Internorm, Schuco, Drutex).*



**Figure 10.**  
*Contactless elevator systems: facial and holographic recognition (Thyssenkrupp Elevator China, Neonode).*



Space	Control system	Class "D->C" EN 15232			Class "C->B" EN 15232		
		Actuator	Model	L	Actuator	Model	L
Stairwell	call	video intercom	Kerui L 16 1.3 mp 960P	-	intercom body temperature detection	Akuvox R29C-B	-
	door opening/closing	linear automatism	Faac a951 105951	-	linear linear automatism	Faac a951 105951	-
	lighting	precence sensor	SE48A Steinel	2	motion sensor	SE50A Theben	4
	ventilation	mechanical	SE31B Rehau	2	mechanical	SE32AB Rehau	3
Elevator shaft	call	kev	Kooty Germ	-	holographic	Neonode	-
	elevator	holographic recognition	Neonode	-	facial recognition	Thyssenkrupp China	-
Entrance	door opening/ closing	linear automatism	Visionis FPC-7356	-	linear automatism	Visionis FPC- 7356	-
	lighting	motion/ precence sensor	SE49A Bticino	3	motion/precence sensor	SE51A Nimbus	5
Living and sleeping areas	windows	VMC	Internorm KF 410	-	VMC	Schüco VentoTherm	3
	sun screens	automatic	SE53BC	2	combined with light- HVAC	SE54A	3
	heating	integrated control	SE1C Homatron	2	precence and air quality	SE3A Homatron	4
	cooling	automatic	SE16B	2	temperature and precence	SE17A	4
Kitchen	appliances	-	-	-	refrigerators	Samsung	-
	taps	-	-	-	mixer	Grohe	-

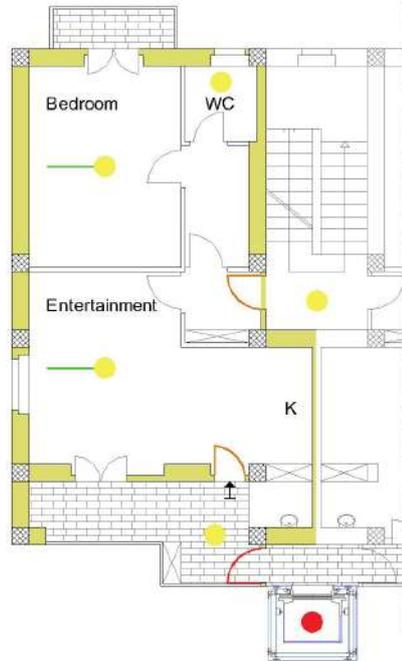
	heating	Cooling	Lighting	Heating	Cooling	Lighting
Energy consumption (kWh)	2706	349	516	2417	278	445
Calculation BAC factor	1	1	1	0,89	0.80	0.86
BAC factor EN 15232	1	1	1	0.89	0.88	0.93
Energy saving	7.5%		18.6%			

Table 1.

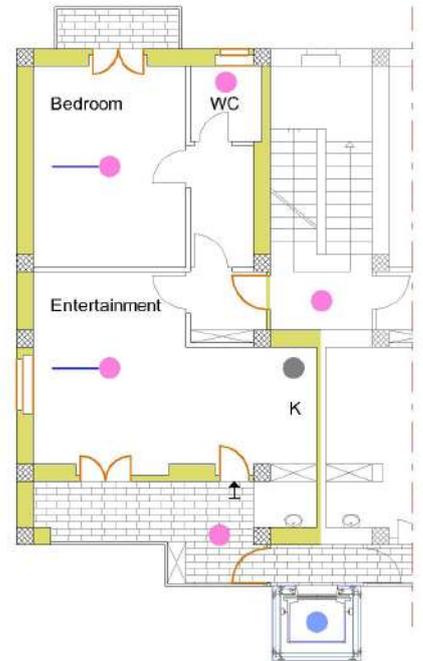
BACS integration interventions on unit type B, Case 1 (D -> C) and case 2 (C ->B): calculation of energy consumption according to the eu.bac system and attribution of the relative performance level (L).

Figure 11.  
INA Casa accommodations  
before and after the  
"antiviral" treatment: home  
automation solutions.

CLASS RANGE D→C



CLASS RANGE C→B



- Bluetooth doors-windows
- Heating integrated control
- Heating presence and air quality

- Lighting presence sensor
- Lighting bluetooth system
- Smart appliances

- Contactless elevator
- Contactless key



hypothesised for the transition to class B and the energy indicators were recalculated; the reduction in consumption was 18.6%. Table 1 details the solutions concerning the vertical communication elements and the environmental units, the transitions from class D to C (case 1) and from C to B (case 2) with the potential energy savings and the calculation of BAC factors, results that are in line with regulatory forecasts and with what has been suggested by recent studies (Engvang et al., 2020).

The choices regarding case 2 require substantial plant modernisation and the implementation of new systems and devices that certainly affect costs. The economic factor should not be omitted in the decision-making process of whether to choose BACS: the economic savings enabled by the improvements must outweigh the associated costs. Recent studies (Ippolito et al., 2014; Mancini et al., 2019) have shown that an improvement for the transition to class B involves a depreciation period of 3-6 years, which could be nullified with combined efficiency improvements on the building envelope. (Fig. 9, Fig.10, Fig.11).

## 6. THE NANOSTRUCTURED MATERIALS FOR FINISHING AND SURFACE PROTECTION

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A deep scientific study has shown that a relevant factor in determining the persistence and infectivity times of the virus is its morphological structure, depending on presence or not of the pericapsid envelope (Fig. 12), in synergy with the surface nature (Van Doremalen, 2020).

Viruses without pericapsid coating are more stable within an environment because they are more resistant to drying phenomena and, consequently, can remain infectious for longer time on a surface; even up to 2 months.

Conversely, coated viruses, such as CoViD-19, remain infectious for hours or even days. Furthermore, viral capacity can persist for longer time in non-porous surfaces (Vasickova, 2010).

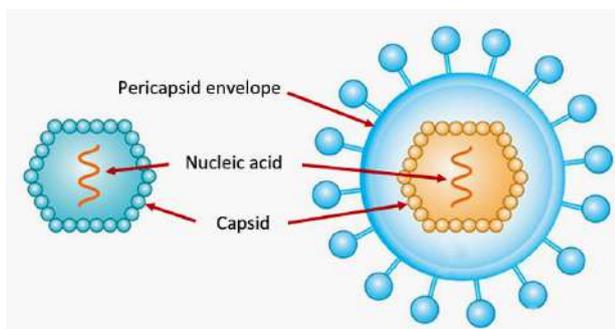
Thus, the length of time a virus remains infectious varies with the surface in which it interact. Consequently, surfaces commonly used in a living environment such as furniture, utensils, handles, taps, sinks, light switches, can represent easy vehicles for the transmission of the virus. It, therefore, becomes necessary to design living environments in which new technologies are implemented. Where this occurs, this strategy could allow contact with sanitized or limited infectious surfaces.

An effective approach can be provided by the application of coatings tailored to create a surface barrier preserving, anyway, the tactile interaction with objects. The antiviral action of the coating can be carried out in a direct (active) or indirect (passive) form.

Concerning the active coatings, the surface sanitation is guaranteed through the use of materials that are specifically coated (eg by using pattering or cospattering) to ensure the gradual release of antibacterial agents (eg ionic release).

In recent years, the materials engineering has been oriented towards new classes of materials characterized by functional physico-chemical properties. The CoViD-19 emergency has increased the need to integrate apparently dissonant characteristics in a single material. Through a multidisciplinary research perspective, that includes different fields of medical and applied sciences (such as virology, biology, medicine, engineering, chemistry, materials science), new development horizons can be outlined, such as innovative strategies based on nanotechnology. The use of nanomaterials could support the fight against CoViD-19, as well as infectious diseases in general, including future pandemics. An example can be represented by an innovative coating with antiviral, antibacterial and antifungal properties, composed of a compact matrix (glass or ceramic, such as silica, alumina, titanium or others), able to encapsulate nanoparticles with antimicrobial action (such as silver, zinc or copper) (Weiss, 2020)

Similarly, it is possible to use nanostructured thin films on metal surfaces (eg handles) to ensure durability and anti-scratch characteristics together with bactericidal



**Figure 12.**  
*Virus without (left) and with pericapsidic envelope (right).*

properties and more. In addition to the antibacterial effects, the antiviral efficacy is also proven, since the organic matrices, such as bacterial ones, contribute to stabilize and protect the viruses, making them persist for longer time on the surfaces.

As mentioned, one of the elements that can be either introduced inside a coating or used to make objects multi-use (such as lift buttons, switches or handles), is represented by copper and its alloys, thanks to the release of metal ions  $\text{Cu}^{++}$  which hinder the proliferation of bacterial or viral loads. This process is favored by surface treatments that increase the roughness and, consequently, the surface area. Another possible element is represented by titanium and its alloys. In particular, titanium oxide, when exposed to ultraviolet light, produces chemical compounds (eg peroxides) able to deactivate the metabolic and membrane processes of microbes.

Advanced developments in the use of these materials can be proposed to create the most varied antibacterial surfaces (from fabrics to tiles) with promising results for their applicability in the construction and living design sector.

As example, a prototypal ceramic tale (Advance - Antibacterial & Bio-Air Purifying by Italcer) was proposed with anti-bacterial and photocatalytic properties that do not derive from a compound applied to the surface after the first curing step. The idea is to offer an anti-bacteria effect by biomimetic

surface modification approach, whose purpose is inspired by the biological and mechanical processes observable in nature to improve human activities and technologies. In particular, some metals (titanium, copper, nickel, tin) are mixed directly in the preparation slurry and fixed thanks to a porous support similar to human bone. This allows to identify an emerging class of flooring that adapt effectively to the surrounding environment by generating a new family of products that could be defined as intelligent (smart tiles).

Furthermore, the surface functionalization interventions can be extended to the building envelope (from opaque to transparent closures) where nano-engineering can be applied to create antibacterial surfaces, preserving the energy efficiency of conventional materials.

Settef's self-cleaning siloxane paint with lotus effect, which protects facades from pollution, rain and bacterial organisms, and double anti-bacterial action (preventive and inhibitory) paint are proposed on the marked (Atria s.r.l.).

Whereas, passive coatings provide an indirect sanitizing action. Self-cleaning or superhydrophobic treatments are in this class of materials. The principle is based on significantly limiting the permanence of aerosols on the surface of objects.

Since CoViD-19 spreads mainly through both droplet transmission and contact with contaminated surfaces, a protective hydrophobic barrier can combat virus transmission through a 3-step strategy (Fig. 13):

1. droplets that are into contact with treated surfaces maintain their spherical shape by reducing their exposure to the virus by encapsulation;
2. droplets that hit a protected surface, for the hydrophobic action, bounce or roll away without to leave a trace of the virus, also providing a spontaneous self-cleaning action;
3. if traces of the virus contaminate the surface, an integrated approach by adding a low content of nanoparticles inside the coating with antiviral and antibacterial properties (i.e. copper) inhibits the viral action.

Some materials, such as titanium, are activated in the presence of ultraviolet rays. These, in addition to the activation function, represent effective virucidal

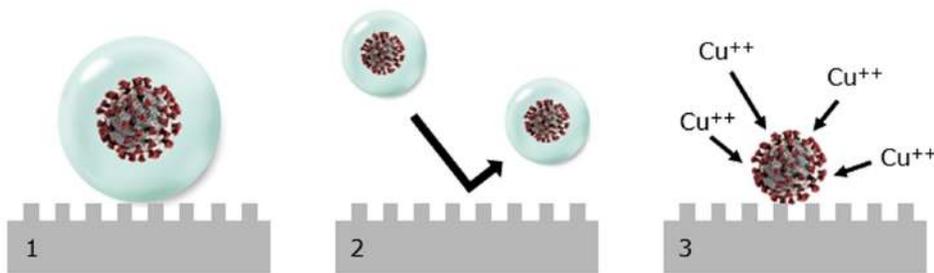


Figure 13.  
Viruses containment or  
elimination strategies.

Figure 14.  
Technological solutions for the  
confinement of viruses and  
bacteria in housing units.



1. Virucidal action LED lighting - entrance area
2. Virucidal action LED lighting . kitchen area
3. Handle with active nanostructural coating
4. Fabric with atibacterial treatment

5. Flooring with smart tiles technology
6. Self-cleaning window
7. Double antibacterial action paint
8. Hob with passive nano-structured coating

agents especially against single-stranded nucleic acid viruses, such as CoViD-19. Furthermore, the degradation rate of RnA depends on the size of the genome: the larger the genome, the greater the sensitivity to UV rays.

However, the use of ultraviolet rays is harmful for those occupying an environment and, consequently, requires special precautions, such as the integration with home automation in order to program it in the absence of people or animals. Hence the need to develop devices which can have a similar bactericidal and virucidal effect without to compromise the normal use of living environments. In this context, the development of a particular LED light that emits a natural white light with a frequency peak capable to eliminate 99.8% of CoViD-19 is interesting (De Santis, 2020). In order to reduce the economic impact of a diffused relamping which cannot be reduced to the mere replacement of a lamp, but requires a new lighting engineering calculation and a redistribution of the lamps according to the illuminance required by one specific environment as reported in the Standards (i.e. UNI 10380: "Interior lighting with artificial light"), it is possible to hypothesize to intervene only in certain key points of a building: i.e. in the entrances, in the transit areas or in the common areas.

In conclusion, a possible application of products with active or passive function in the different contexts present in a residential unit is proposed (Fig. 14).

## 7. SAS-HOUSING IN PROGRESS

The shared observations, evidently in progress, have "architected" the SAS-Housing theme to force studies and reasoning already present in-dividually in the involved disciplinary fields, but here with the desire to systematize them, interface them, produce benefits and start new collaborations.

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## AUTHOR CONTRIBUTIONS

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