



Social housing group "Antonio Rueda" today. Valencia. Architects: Valls and García Sanz. 1965-1970. Photograph of Concepción López, 2023

Social housing in Spain: obsolescence and intervention strategies

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Abstract: Social housing in Spain has its origin in the first Cheap Houses Law that was promulgated in 1911, trying to provide a solution to a housing need for the working class who flocked to the cities in waves of migration from rural areas. Since then, legislative initiatives have been taking place to mitigate the housing problem. Each one of them was contributing elements that presumably contributed to the hygiene and habitability of the house without forgetting the economic conditions. At the moment, in Spain there is a large real estate park inherited from these initiatives. In many cases, these are neighborhoods that currently show notable energy and social vulnerability. Aware of the need to adapt these homes to the regulatory requirements related to energy efficiency, comfort and the physical and technical characteristics of the construction, the Research Centers are developing multiple investigations aimed at favoring the adaptability of homes and improving the quality of life of its inhabitants. This article takes a tour of the evolution that social housing has had during the 20th century in Spain and the current state of research aimed at adapting it to the new energy, habitability and sustainability requirements.

Keywords: energy vulnerability; real estate obsolescence; housing comfort; improve habitability.

1. Introduction. Research objective

The industrialization processes that took place, both in Europe and in Spain during the 19th century, led to an uncontrolled migration from the rural environment to the cities. The large urban centers were not able to accommodate this disproportionate increase in population in a certainly short period of time. The immediate consequence on a social level was overcrowding in the urban suburbs, with living and hygienic conditions of the proletariat well below those corresponding to an acceptable quality of life. The binomial formed by the uncontrolled growth of cities and the poor housing conditions of the houses destined for the population waves had its origin with the beginning of the Industrial Revolution at the end of the 18th century in England. In Europe they would be followed by France, Belgium and Germany. In Spain, the industrial revolution did not have the success that it enjoyed in these countries, however, a housing crisis similar to the one that was taking place in the rest of Europe is observed. This phenomenon occurred uninterruptedly until the middle of the 19th century, and no similar episode had been known before (Lucas, 1987). At the beginning of the 20th century, the Administrations and Public Organizations were taking various initiatives aimed at providing housing for the large group of displaced persons who arrived in the cities. Initially, without the existence of specific legislation in this regard, companies were created for the construction of affordable housing, such as the "Housing Society for Workers" established in 1900 in Valencia. Starting in 1911, state initiatives were taken through the promulgation of the Cheap House Laws. The resolution of the problem of homelessness was adapted over the years to the different economic and social circumstances that Spain was going through.

This article aims to take a tour of the evolution that social housing has had during the 20th century and the current state of research aimed at its adaptability to new energy, habitability and sustainability demands.

2. Background: The Cheap Home Laws (1911-1921).

There are numerous studies related to the so-called "Cheap Houses" carried out from different disciplinary aspects: historians, geographers, economists, etc. And it is perhaps in the architectural field where they have been least studied. It is worth noting the investigations carried out by Luis Arias González (2003), where he focuses attention on the legislative measures carried out in the period between 1926 and 1936. 1926 is the date on which the Cooperativa de Casas Baratas "Pablo Iglesias" was established. in the Cordoba town of Pueblonuevo del Terrible



Figure 1 | Ramon de Castro neighborhood. Patraix (Valencia). Architect: José María Manuel Cortina. 1906-1910. (Photograph of Concepción López, 2023).

(Arias, 2003: 95). This Cooperative had a great boom during the Second Republic, expanding throughout the national territory (Arias, 2003: 101-107). Likewise, María Castrillo Romón (2001) exposes the housing situation in this period of time and its relationship with the socio-economic and political environment, as well as the European influence that surrounded these cheap houses (Castrillo Romón, 2003). Referring to the studies carried out in more industrialized regions, it is worth noting the research carried out by Mercedes Tatjer Mir (1997) regarding the origins of social housing in Barcelona, focusing on the housing cooperatives created to provide accommodation to the popular layers. More recently, Manuel Alejandro Ródenas López (2016) makes an extensive analysis of the origins of social housing in Murcia between 1900 and 1936. The case of the city of Madrid is extensively analyzed by Paloma Barreriro Pereira (1992) and Carlos Sambricio. (2003). In Valencia, social housing is analyzed, among other authors by Juan Blat from a legislative and architectural point of view (Blat, 2000).

Three Cheap Houses Laws were enacted in 1911, 1921 and 1924. It can be considered that, with the approval of the First Cheap Houses Law, social housing legislation began in Spain. In this Law, Cheap Houses were understood as those built or attempted to be built by individuals or communities for the exclusive accommodation of those who receive modest emoluments as work remuneration (Art. 2).

The application of this first Law was carried out through the corresponding Regulation (April 11, 1912). It specified the qualities of the materials, the height of the ceilings and the minimum size of the spaces without buildings



Figure 2 | 21 Homes in Huerta del Barrero (Seville). 1910-1921. (Rafael Romaní, 1974).

for the sake of proper ventilation and an improvement in hygienic conditions with respect to past social housing.

3. Conditions of habitability in the Regulations

Already in 1850 Henry Roberts (1867) published in England a series of proposals for housing prototypes where workers and their families could live with dignity. This objective translates into achieving dry and ventilated spaces with sufficient and adequately sized holes, with a ceiling height. He proposed three-bedroom homes and limited the minimum living room (14 m²) and main bedroom (9.5 m²) surfaces.

In Spain it will take half a century to regulate social housing. The First Law of Cheap Houses established in its art. 32 that the program of each house should be adapted to the customs of each locality, although adjusting to the dimensional limitations set forth in art. 29 and 36.

This very little innovative principle implied a lack of typological innovation in the houses that were built in this period. This law failed due to the construction crisis caused by the First World War, excessive bureaucratic obstacles, and the ineffectiveness of the local Development Boards appointed to stimulate the construction of cheap housing (Ródenas, 2016).

Within this framework, the Second Law of Cheap Houses was promulgated on December 10, 1921. As a novelty, the promoters can be cooperatives and charitable or lucrative societies. Once again, a Regulation is drawn up for the application of the Law. This new Regulation is

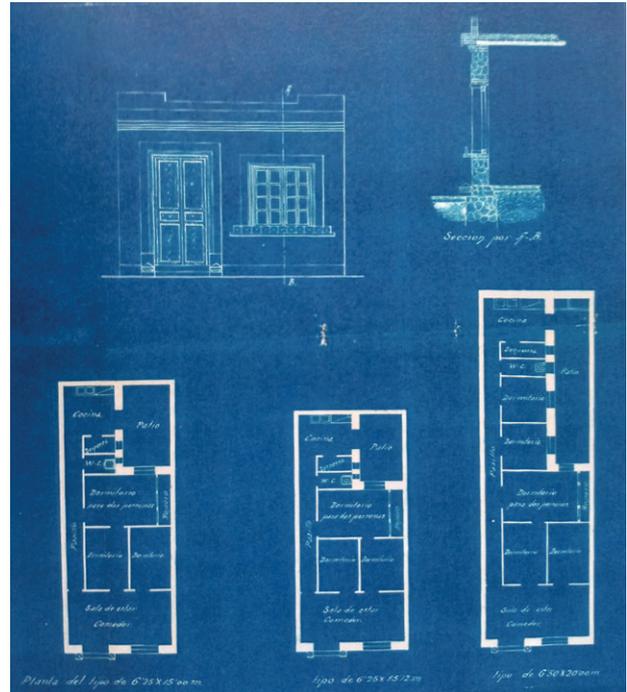


Figure 3 | Plan of a house. Peral neighborhood. Cartagena. Architect: Lorenzo Ros Costa. 1923. (ACMF CB 172/1).

stricter with respect to hygienic and technical conditions than the previous one: The height of the ground floors is limited to 3 m and of the floors to 2.80 m.

The integration of a bathroom with shower for each house is also required. Likewise, the area that each type of room should have (living room and bedrooms) is delimited, always with the intention of achieving the smallest possible area of housing in order to save costs. All these measures derive in a constraint of the project design in plan and elevation tending to standardization.

According to Blat (2000), this law contributes to the rationalization of social housing. Regarding the building typology, this law establishes three types: single-family housing, collective, garden city and satellite cities. This prompted the carrying out of large promotions that covered considerable surfaces where a large number of homes were included. The concept of a garden city, based on the economy of means for urbanization, is noteworthy. It was a meeting of cheap houses located in such a way, in relation to the adjoining roads, that they have easy access to them without the need to build streets or carry out special urbanization works. As with the previous Law, only some 1,290 homes were built in the main cities of Spain (Madrid, Barcelona, Valencia and Seville) in the period between 1921 and 1924. This inefficiency was



Figure 4 | Corner house. Benalúa neighborhood (Alicante). Architect: Francisco Fajardo Guardiola. 1929. (Archive of Alicante).

analyzed at the National Building Conference, where the elaboration of a new Law was proposed. The Dictatorship of Primo de Rivera promulgated the Third Law of Cheap Houses that did not introduce architectural changes with respect to the previous one, only innovations related to economic stimulus. Starting in 1927, new Decrees were promulgated aimed at expanding the spectrum of benefactors, including homes for the middle class, such as the so-called Houses for Civil Servants or Houses for the Military. In 1929 the aid was suspended. With the arrival of the Republic in 1931 there was a reduction in construction activity (Ródenas, 1916), until in 1935 the so-called Salmón Law was promulgated (the name refers to the Minister of Labor Federico Salmón) whose objective was to promote construction housing in general, granting significant tax benefits to developers. This law was intended to mitigate unemployment by favoring the construction of rental housing (Muñoz and Sambricio, 2008). With this Law, the occupation of peripheral areas of large cities through the construction of single-family homes ends and the expansion of blocks at medium height begins (Ródenas, 1916).

The Civil War left Spain in a situation of ruin where shanty towns in the big cities were common due to a shortage of housing. The immediate construction of new homes was necessary, however, only an average of 50 homes per province and year are built due to a lack of resources (Sambricio, 2003). The 1939 Protected Housing Act had as its purpose the construction of limited-income housing adjusted to established hygienic conditions. For this, the INV (National Housing Institute) was created. This body was in charge of drafting the Rules and Ordinances of Protected Housing. Strict regulations are established on minimum surfaces, materials to be used in construction and construction systems. In 1949 the V National

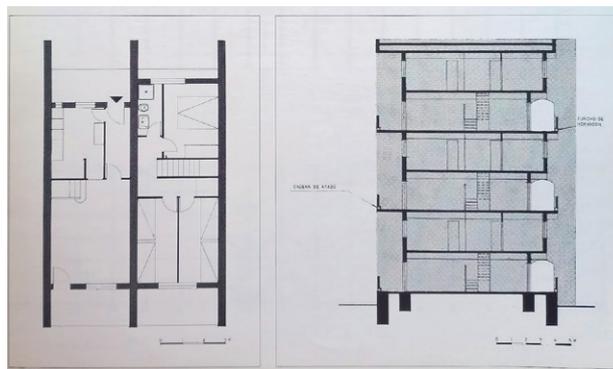


Figure 5 | Block of flats in the Virgen del Pilar neighborhood in Madrid. Architect: Francisco de Asís Cabrero Torres-Quevedo. 1948. (Climent Ortiz, X. (ed). "Francisco Cabrero, arquitecto").

Assembly of Architects is held where the housing problem is debated and the bases of social housing are established. In 1953, the OSH (Household Union Organization), under the direction of the architect Francisco de Asís Cabrero, drafted the "technical instructions for drafting projects".

The following year, the INV entrusts the OSH with the drafting and construction of a Plan that contemplates the construction of 10,000 social housing per year. The surface of each one of them could not exceed 42 m² and they had to house a living room, dining room, kitchen, three bedrooms, toilet and hall with a maximum budget of 25,000 pesetas. Immediately after, a second Plan was drawn up for the construction of 20,000 "Minimum Income and Reduced Income Homes". The Minimum Income dwellings had to have a surface between 35 m² and 58 m² including a dining room of at least 14 m², a kitchen, toilets and a maximum of four bedrooms, adjusting to a budget of 800 pesetas/m². Reduced Rent homes could have an area between 65 m² and 100 m². The price per m² could not exceed 1000 pesetas. The so-called absorption towns and the directed towns were born at this time. The first destined to relocate the inhabitants of shanty towns and the second to give housing to emigrants who arrived without accommodation.

In 1961, the National Housing Plan was approved for the period between 1961 and 1976, in which the construction of 3,000,000 houses called Officially Protected Housing (VPO) was foreseen. Its surface could oscillate between 50 m² and 200 m². The houses were divided into four categories depending on the area and the cost per m². Many owners who did not belong to the most disadvantaged class had access to these houses.

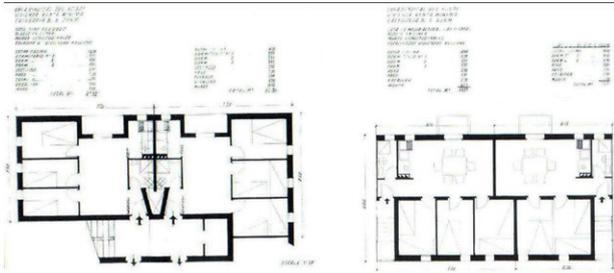


Figure 6 | “Minimum income” housing prototypes established by the OHS for blocks in line, half-rise houses and houses with 2 and 3 bedrooms.



Figure 7 | Antonio Rueda housing group today. Valencia. Architects: Valls and García Sanz. 1965-1970. (Concepción López, 2023).



Figure 8 | Antonio Rueda housing group. (Google maps, 2023).

In 1978, the previous legislation was suppressed and Royal Decree-Law 31/1978 of October 31, on Officially Protected Housing Policy, was promulgated. Once democracy was established, the powers over housing passed to the Autonomous Communities.

All this housing stock has been abandoned in many cases or has not been properly maintained because it has been occupied by an economically disadvantaged population. The development of these houses requires two initiatives that must be addressed in unison: The preparation of Use Plans to guarantee their conservation and their adaptability to comply with the SDGs

(Sustainable Development Goals) and interior comfort for their habitability.

4. Reuse and optimization initiatives. Actual state

Currently, most of these neighborhoods that were built in the first half of the 20th century are highly vulnerable neighborhoods, both economically and energetically and socially. However, there are no data that testify to the scope of the problem (Halkos and Gkampoura, 2021), not only in the energy framework, but also in the social-housing framework (Bouzarovski et al., 2021). In this context, it is necessary to develop new approaches (Castaño-Rosa et al., 2019) and develop methods to combat energy and habitability poverty in highly vulnerable neighborhoods. The current challenge consists in reusing the social housing stock, adapting it to the new sustainability and urban regeneration policies.

To address the problem it is necessary, first of all, to document, identify and understand the root of the issue. It is necessary to identify the distribution of social groups in the urban space and the housing quality of the houses. In this sense, various studies have been carried out (Hernández-Aja et al., 2017; Garcia-Almirall et al., 2021).

In 1996, the Ministry of Development created the Observatory of Urban Vulnerability in Spain aimed at classifying vulnerable urban areas. The National Institute of Statistics (INE) and the Juan Herrera Institute of Madrid carried out a first study based on data from the 1991 Census. 376 vulnerable neighborhoods were cataloged in 81 cities (of the 116 analyzed).

In 2008, a new assessment was carried out referring to the years 2001 and 2006, detecting the neighborhoods with the highest rate of immigration. A fourth study is currently underway with data from the 2011 Census. (Redondo García, 2014). Likewise, it is necessary to adapt solutions to the European guidelines (Energy Efficiency Directive -DEE- (2012/27/EU) and national ones (Integrated National Energy and Climate Plan 2021-2030). It is not a problem with a single perspective, but rather encompasses social, economic, energy, architectural and urban issues.

As the Cheap House Laws are enacted, an increase in the quality of construction is seen. As can be seen in image 8, the air chamber is incorporated under the first slab. The project reports accurately describe the levels of finishes, both for the facades and the interiors.

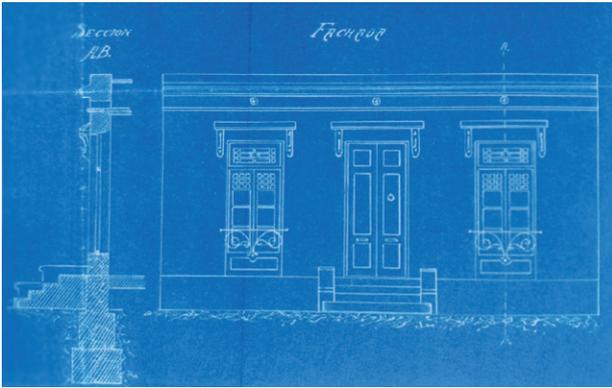


Figure 9 | Facade fragment and section. Cooperative Society “Equality”. Cartagena. Architect: Victor Beltrí. 1927. (ACMF CB 173/1).

The construction systems and techniques used in the construction of these social housing were designed to reduce costs and make them economical. The construction system used was initially the load-bearing wall, which inevitably led to planning houses with bays perpendicular to the façade wall and widths of approximately four meters. The load-bearing walls were initially built with solid brick. As the Cheap House Laws are enacted, an increase in the quality of construction is seen. As can be seen in image 8, the air chamber is incorporated under the first slab. The project reports accurately describe the levels of finishes, both for the facades and the interiors.

Later, these walls began to be made with precast concrete blocks or Ytong, as in the case of the Antonio Rueda social housing group in Valencia, designed by the architects Valls and García Sanz in 1965. It is a magnificent example of urbanism and social architecture, with clear influences from the modern movement (fig. 6, 7). This material was invented in 1927. It is a lightweight aerated concrete, impermeable to water and light in weight. This system was just as economical as brick, but it saved placement time and, consequently, execution costs.

The facades were built with the so-called “capuchin walls”. They consisted of walls formed by sheets of brick: the outer sheet is solid brick with a thickness of 12 cm and the interior is made of hollow brick placed in a “panderte” pattern, with an air chamber between them of 4 cm. All this implies a lack of thermal and acoustic insulation that does not conform to current standards and requires intervention.

In the middle of the 20th century they began to use reinforced concrete structures. The intensive use of aluminous cement in its composition caused serious long-term

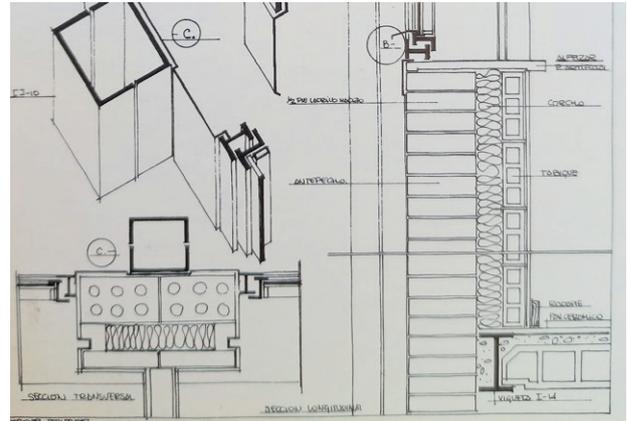


Figure 10 | Detail of the nasturtium wall with insulation in the air chamber. Architect: Francisco de Asís Cabrero Torres-Quevedo. 1961. (Climent Ortiz, X. (ed). “Francisco Cabrero, arquitecto”).

structural problems (Bernardo, 2022) that have required expensive and uncomfortable complications.

Currently, the solutions are aimed at developing tools and procedures that make it possible to quantitatively and qualitatively improve vulnerable urban environments and the energy and habitability conditions of the buildings that comprise them.

In this sense, the Ministry of Transport, Mobility and Urban Agenda has an Aid Program for the comprehensive rehabilitation of residential buildings and homes included in the Recovery, Transformation and Resilience Plan (PRTR) through which it is intended to promote the rehabilitation of residential buildings, houses and neighborhoods. This Program is financed by the European Union through the Next Generation EU. The funds are channeled through the Autonomous Communities and Cities. It is expected to carry out 510,000 rehabilitations during the entire period of application of the PRTR, which implies an average rate of 71,000 homes per year. A low level of requests is detected, probably due to the complexity of request management and the lack of appropriate channels for the information to reach the affected social groups. In this context, there are still many social housing and urban environments that remain in a state of extreme vulnerability.

Regarding the improvement of sustainability through the rehabilitation of buildings and social housing, various initiatives are being carried out. The European Union has a special interest in the intervention of the building stock to improve energy efficiency, as well as increase the comfort and quality of life of the inhabitants of the houses.



Figure 11 | The three priorities of the European Commission initiative: Renovation Wave. (https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/renovation-wave_en)

As an example, the Renovation Wave, whose objective is to double the annual rates of energy renovation in the next ten years and reduce emissions, improving the quality of life of the people who live in the buildings, as well as creating employment and contributing to economic growth.

These initiatives base their proposal on the accepted energy efficiency-vulnerability binomial (Martín-Consuegro et al., 2019). At the national level, initiatives such as the National Strategy against Energy Poverty 2019-2024 are being implemented. In parallel, research is being carried out on housing vulnerability, spatial segregation and the effectiveness of public rehabilitation programs (Saez et al., 2021)

5. The implementation of technological advances in the improvement of habitability

We are facing a scenario where a large part of the building stock built in the 20th century requires adaptation to the new models of sustainability. The causes of this necessary intervention in buildings with a certain age have two aspects: the combination of socio-economic factors of the population and technical factors of the buildings. In both cases it is necessary to implement solutions that contribute efficiently to alleviate this situation.

The wide range of techniques and prototypes that can be used to solve the problem can be classified into two large groups: a) Related to the reuse of social housing and regeneration of urban space; b) Related to improving the energy efficiency and habitability of homes.

a) Solutions related to the reuse of social housing

One of the main causes of the obsolescence of social housing is closely related to the type of housing. These are

typologies corseted in excessively rigid regulations, with the use of construction systems with load-bearing walls at the beginning that greatly prevent the flexibility of spaces. With the use of reinforced concrete structures, social housing built in the middle of the last century increases in flexibility. This has led to the establishment of analyzes and studies for the adaptation of residential buildings that were designed following a program of needs that is far removed from current requirements. The new family models, the collapse of the birth rate and online work, among other factors, mark a housing typology that is in contrast with the architectural typologies tested in the old residential estates.

In Spain, these studies regarding the residential real estate stock have started late compared to other European countries. In this area, research is being done on the possibility of defining reuse strategies that guarantee the conservation of the real estate stock (social housing) while responding to socioeconomic needs. García Vazquez (2015) analyzes the mismatches of the types of social housing built in the 20th century with respect to contemporary needs, revealing a problem of use based on three parameters: the dimensions and functionality of the houses and the changes in life. The different regulations for the construction of social housing from the Franco era considered 40-50 m² homes for families of 6-8 people, which implied 6.5 m² per inhabitant.

According to Montaner and Muxí (2006), 20% of the homes are occupied by a single person (emancipated youth or retired senior), 25% are made up of a couple, and 21% are inhabited by three or four individuals. These data confirm the need for homes with one (it was not contemplated in the social housing of the last century) and two bedrooms mostly. This change in the organization chart implies a readjustment in the spatial organization of the old houses which, for the most part, is being carried out through private initiatives.

The studies by Graziella Bernardo (2022) in reference to the flexibility of the homes of the Antonio Rueda group in Valencia and those carried out by García and Navarrete (2014) for the Orba neighborhood, also in Valencia through the UN contest, are interesting. -Habitat for the revitalization of social housing complexes.

However, the accessibility problem is being addressed through state initiatives or public bodies facilitating loans or subsidizing private actions in this regard.

The adaptation of social housing can be focused, according to García Vazquez from different prisms: accessibility; flexibility (to be able to share the house) and the hybridization of uses (to be able to work in it). Likewise,



Figure 12 | Flexibility of an H-shaped block in the Orba neighborhood. Architects: García Mendez and Navarrete Mancebo. 2014. First Place in the International Competition 'Urban Revitalization of Mass Housing' of UN-Habitat / Valencia, Spain.

methodologies are being implemented to verify the extent of the vulnerability of the neighborhoods. In this sense, the Research Group on Architecture, Urbanism and Sustainability of the Polytechnic University of Madrid, led by Agustín Hernández Aja (2018), carried out an extensive and profitable investigation, in which they propose a methodology to determine vulnerability based on two indicators: residential (accessibility and conservation) and social (unemployment and educational level). After applying it to the thirteen main provincial capitals, they were able to quantify, according to established level indicators, the vulnerability of the neighborhoods in each of them. Progress is also being made in determining and quantifying the flexibility of social housing to be adapted to current needs, understanding flexible architecture as that whose spatial organization has the capacity to modify and adapt to the needs of the user.

b) Solutions related to the physical-technical characteristics of social housing

This group includes solutions aimed at improving energy efficiency, indoor air quality, hygrothermal comfort, acoustics and lighting. All of them aimed at compliance with the European standard UNE-EN 16798-1:2020 (Spanish Association for Standardization 2020), which indicates the parameters of the interior environment to be considered for the design and evaluation of the energy efficiency of buildings, including the quality of the indoor air, thermal conditions, lighting and noise; and

the UNE 171330-2:2014 standard (Spanish Association for Standardization 2014), on indoor environmental quality and indoor environmental quality inspection procedures (CAI).

Improve energy efficiency: In this area are those solutions that seek to achieve effective and efficient thermal insulation. Reducing energy losses in buildings also implies a reduction in the carbon footprint associated with energy production. Therefore, improving energy efficiency in homes built in the 20th century represents a sustainability challenge that is part of the Sustainable Development Goals. Materials such as polyurethane or extruded polystyrene (XPS) have been incorporated for years, after verifying that they offer good insulation due to their low conductivity. The insulation they offer is greater than that achieved with the same thickness of rock or glass wool. However, polyurethane, due to its composition, is not a sustainable material. The solutions that are currently being implemented or tested are aimed at incorporating new materials and vapor barriers into the building envelope (facades, doors, windows and roofs) that help reduce energy losses, but that are approach desirable sustainability goals. In this area, mortars are being tested with the inclusion of vegetable fibers capable of increasing thermal insulation from the interior of homes and, at the same time, acoustic absorption of between 40-50% is being achieved without losing resistance capacity. Due to the recent development of these studies, its durability remains to be verified since, in some cases, the aging times tested in the laboratory do not exceed the age of existing structures (Arizzi et al., 2016). In the specific case of the inclusion of hemp fibers in mortars, it has been possible to verify that thermal insulation is considerably improved by reducing energy losses (Mercedes, et al., 2023).

To these insulating mortars we must add others that are being incorporated into the list of insulating materials that can be applied in renovating and adapting homes: silica aerogels. They are "super insulators" with a much lower thermal conductivity than that of conventional insulators (55% less than that of XPS), they are waterproof, fireproof, light and manageable. They can be applied both indoors and outdoors. The tests that are being carried out, augur a good operation. Several research projects are being carried out on this material: HOMESKIN is a collaborative project funded by the European Union in which the Technological Institute of Construction of Catalonia participates, which seeks to develop silica aerogel panels with a low production cost (Joly et al., 2017). The AEROCOINS project seeks to increase the mechanical resistance of these materials FRCM (fabric-reinforced cementitious matrix) sandwich panels contribute to significantly improving thermal insulation on facades,

placing them from the inside. As they are prefabricated panels, they have good finishes and their placement inside the home is simple and fast, which implies significant savings in execution costs (Eskenati, et al. 2021). The internal height of social housing allows the placement of floor-to-ceiling panels, hardly bothering the inhabitants during installation.

Improve indoor air quality: Social housing is not suitable for intensive use, providing little indoor space in proportion to the number of occupants and often lacking adequate thermal conditioning and ventilation and indoor air renewal systems (Dominguez-Amarillo et al., 2018). The quality of the indoor environment significantly influences the health and well-being of the occupants (Merabtine et al. 2018). There are studies on the indoor environmental quality and the operating conditions of the home in temperate climates such as Spain (Martins et al., 2018). Currently, the investigations are aimed at implementing an optimization strategy for air renewal systems. The most widespread strategy is to significantly increase natural ventilation, to improve indoor air quality (Orosa et al., 2020). It is a simple, economical and effective measure. However, if the conditions of the external environment are not favourable, the comfort conditions inside the house decrease considerably. Since the introduction of ATC, several studies have advocated adaptive models aimed at establishing quantitative indices that make it possible to improve comfort conditions (Buratti and Ricciardi 2009). On the other hand, given that interior lining materials significantly influence air quality, studies are being carried out on new linings whose heat absorption capacity, as well as their colour, do not contribute to interior overheating.

Improve lighting: Ultraviolet light (UV) lamps are an efficient means for the elimination of pathogens. The first investigations date back to 1937, when this type of lamp was used to disinfect the air in schools, proving its virucidal power (Wells et al. 1941), although at that time its carcinogenic effect on the skin was unknown. Currently, the benefits of LED lamps are being investigated, not only

because of the energy savings they represent, but also because of the health benefits they provide (Angarano et al., 2020). There is research that has shown that blue-enriched artificial light is the ideal action spectrum, competing with natural light (Veter et al., 2011). Currently, research is aimed at providing new luminaires whose spectral distribution and output power can reflect that of the sun to match the circadian cycles of people (Jingxin et al., 2020).

6. Conclusions

In Spain there is still a large number of neighborhoods made up of social housing in a state of social and energy vulnerability. Both public bodies and scientific establishments are aware of the need to preserve and adapt this building stock, optimizing comfort conditions and reducing energy losses so that they can be affordable for the most disadvantaged families. In this sense, government initiatives are being carried out aimed at reducing energy and social vulnerability through the Observatory of Urban Vulnerability in Spain and different aid programs for individuals to adapt homes to the requirements and energy saving regulations. Likewise, both from the Ministry of Science and Innovation and from the European Union, funds are being allocated for research into the renewal and regeneration of vulnerable urban environments. In this sense, there is still a long way to go. This is ONE complex problem for which there are no systematic solutions.

The adequacy of homes for their habitability with acceptable standards of comfort and energy efficiency is a subject that, scientifically, is being addressed more rapidly, seeking new materials and new technologies that contribute to improving energy efficiency, the Indoor air quality, lighting and noise. In this area, work is being done to improve covering materials so that, once implemented in existing homes, they contribute to achieving the ideal qualitative and quantitative indices for which social housing can be comfortably inhabited.

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