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INCIDENCIA DE LAS ESTRATEGIAS PASIVAS DE DISEÑO ARQUITECTÓNICO EN LA ETIQUETA DE EFICIENCIA ENERGÉTICA EN ARGENTINA

IMPACT OF PASSIVE ARCHITECTURAL DESIGN STRATEGIES ON THE ENERGY EFFICIENCY LABEL IN ARGENTINA

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RESUMEN

El trabajo presenta un análisis comparativo realizado entre el Índice de Prestaciones Energéticas (IPE), definido por el Programa Nacional de Etiquetado de Viviendas basándose en la Norma IRAM 11900, y las Estrategias Pasivas de Diseño Arquitectónico (EPDA) definidas en dicha norma. La comparación es aplicada a soluciones de rehabilitación energética para la evaluación de mejoras en Eficiencia Energética (EE) en una vivienda en San Miguel de Tucumán, Argentina. Tiene como objetivo evaluar la incidencia de las EPDA en el valor de IPE de la vivienda. Se realiza una valoración con respecto a la importancia que tienen las mismas como punto de partida para lograr una arquitectura más confortable, más eficiente desde el punto de vista energético y más sustentable. Se concluye que las estrategias pasivas no influyen sustancialmente de manera numérica en el IPE el cual determina la etiqueta de eficiencia energética de unidades residenciales en Argentina.

Palabras clave
arquitectura bioclimática, vivienda, renovación arquitectónica

ABSTRACT

This work proposes making a comparative analysis between the Energy Supply Index (IPE, in Spanish), defined by the National Housing Labeling Program based on the IRAM 11900 Standard, and the Passive Architectural Design Strategies (EPDA, in Spanish) defined in said standard. The comparison is applied to energy retrofit solutions for the evaluation of the improvements in Energy Efficiency (EE) in a dwelling in San Miguel de Tucumán, Argentina. Its goal is to evaluate the incidence of EPDAs on the IPE value of the dwelling. An assessment is made regarding their importance as a starting point for achieving a more comfortable, more energy efficient and sustainable architecture. It is concluded that passive strategies do not have a numerically substantial influence on the IPE, that determines the energy efficiency label of residential units in Argentina.

Keywords
bioclimatic architecture, house, architectural renovation

INTRODUCTION

The reduction of environmental impact is a global concern which has awoken the commitment of many governments, to guide their laws towards sustainable development (Aragón, de Olivera Pamplona and Medina, 2012). The global environmental issue has led many countries to incorporate Energy Efficiency (EE) policies to reduce energy consumption, an aspect that can be seen in measures like EE passports or labels (Alonso-Frank & Kuchen, 2017). Internationally, the residential sector consumes a significant amount of energy. For this reason, it is essential to develop and implement bioclimatic architectonic systems that contribute towards the reduction of energy consumption (Manzano, Montoya, Sabio-Ortega and García-Cruz, 2015). This considers reducing consumption without affecting the building's thermal comfort. In Argentina, to contribute towards reaching the national energy savings goal, the implementation of EE measures in the residential sector is essential, as this sector represents 27% of the total consumption of the country. In addition, this sector can be addressed using multiple approaches, reason why there is a great potential for improvement (Production Development Ministry, 2017).

Energy certification schemes for buildings appeared at the beginning of the 1990s as a key method to improve EE; minimizing energy consumption and providing greater transparence regarding the energy use of buildings (Pérez-Lombard, Ortiz, González and Maes, 2009). These certifications play an important role in EE improvements, as they allow appraising and comparing different buildings and their features vis-à-vis energy consumption and demand (López-Asiain, García, Fernández and de Tejada Alonso, 2020). Energy ratings also appeared as tools to minimize energy consumption and greenhouse gas emissions and to promote greater transparency regarding energy use in buildings (Reus-Netto, Mercader-Moyano and Czajkowski, 2019).

In Argentina, the first legal precedent of a guarantor in the application of EE-related regulations, is the Provincial Law of Buenos Aires N°13.059/03 (2003) and its regulatory Decree 1030/10 (2010). Said law sets out the requirements for all new constructions processed in the province, including checking the hygrothermal performance levels stipulated by the IRAM 11600 series guidelines. Its application has been limited, with the main problems being the variety of construction requirements, the autonomy of municipalities and the decentralized control and inspection system (Chevez, Martini & Discoli, 2016).

In 2007, the "National Program for the Rational and Efficient Use of Energy (PRONUREE, in Spanish) was created through Decree 140/2007. It aimed at achieving an efficient use of energy, which implied adapting the energy production, transportation, distribution, storage and consumption systems, looking to obtain the greatest sustainable development with the technological means available, to lessen environmental impact and optimize energy conservation, thus perceiving a reduction in costs (Ministry of Energy and Mining [MINEM], s.f.).

The first edition of the IRAM 11900 standard: "Heating Energy Efficiency Label for Buildings" was released in 2009. The standard established eight levels of thermal efficiency of the envelope following the household appliance EE label format. It proposed a simplified methodology to calculate the EE level of building envelopes susceptible to being heated (IRAM, 2009).

Later, other legal documents were developed, like Law N°3246 (2009): "Energy Consumption – Reduction and Optimization", of the Government of the Autonomous City of Buenos Aires; Ordinance 8757 of the Municipality of Rosario (2011): "Hygrothermal Aspects and Energy Demand of Constructions"; and Law 4458 (2012) "Thermal conditions standards in building construction", of the Autonomous City of Buenos Aires.

In 2017, a new version of the IRAM 11900 standard was released, which establishes the calculation of energy supplies for residential use properties, integrating a higher number of variables compared to its first version: heating, cooling, sanitary hot water, indoor lighting and renewable energies. The main difference regarding its previous edition is that it considers both passive and active EE strategies.

A year earlier, through an Agreement Act signed between the Ministry of Mining and Energy of the Nation (Undersecretary of Energy Efficiency and Savings), the Government of the Province of Santa Fe (State Energy Secretariat), the Municipality of the City of Rosario and the Professional Colleges of the Province of Santa Fe (Civil Engineering, Specialist Engineers, Architecture and Skilled Workers and Technicians), decided to cooperate in public EE policies in end uses. This document gives rise to, among other goals, the running of a pilot EE certification test in properties destined for housing, during 2017 in the city of Rosario (Agreement Act, 2016).

To implement the first pilot test, professionals were trained in a certification process, to then evaluate already built dwellings. In August 2018, a second test was run in the city of Santa Fe. Starting from both experiences, and an agreement signed with the National Energy Secretariat, the model was rolled out to other cities in the country, to adjust the calculation procedure and IT application using different bioclimatic areas and different construction techniques. The tests were run in the cities of San Carlos de Bariloche, Mendoza-Godoy Cruz and San Miguel de Tucumán. In 2019, it also reached the city of Salta (Government of Santa Fe, 2020).

In 2018, with the goal of introducing the EE label in the country, the National Housing Labelling Program was created, based on the IRAM 11900 Standard. It aims at obtaining an estimation of the primary energy consumption in already built residential homes, to satisfy the demands generated by heating, cooling, sanitary hot water production and lighting requirements, during a typical year. In this way, people can know the EE level of a dwelling, with this new tool becoming a very important piece for decision making when it comes to buying, renting or building a property meant for housing. It is worth highlighting that it is also a useful tool to evaluate a new project or to suggest retrofits for an existing one.

Law 13903 (2019) "Energy efficient labeling of properties destined for housing" enacted by the Legislature of the Province of Santa Fe in November 2019, is the main legal framework and record in the country, which consolidates a specific EE policy. This law regulates the application of the Energy Performance Index (IPE) and the Energy Labeling of properties destined for housing; it creates a Labeling Registry, a Certifiers Register, and a Commission that works as a consultancy entity, and even determines bonuses for its implementation. To date, the compliance to the Law of Districts or Municipalities, and both the IRAM 11900 standard (2017) and the National Housing Labeling Program, do not have an obligatory nationwide implementation, being only a tool for professionals and users.

The goal of this work is comparing the IPE, defined by the National Housing Labeling Program, with the Architectonic Design Passive Strategies (EPDA, in Spanish), established in the first modification to the IRAM 11900 standard (2019), to assess the impact of these strategies on the IPE value of a dwelling.

METHODOLOGY

The methodology used in this research corresponds to a normative analysis and a case study. First, a complete normative analysis of IRAM 11900:2017 and its modification made in 2019 is done. The EE label and the EPDA weight are studied (the latter suggested in the first modification). Then, the web application developed by the Energy Secretariat to obtain an EE label that determines the "Energy Efficiency Class" is analyzed, providing as a result the IPE characteristic value expressed in kWh/m^{2}year. The impact of the passive and active design strategies on the IPE value is examined, to then compare the passive variables that influence the EPDA and IPE. Finally, both variables (IPE and EPDA) are analyzed from a case study. From this, the IPE value is obtained, and consequently, the EE Class through the web app. While, the EPDA weighting is made using the EBioDA calculator (Fernández & Garzón, 2019) for a better understanding of the results. Then, an energy retrofitting proposal is developed using the passive strategies, and the aforementioned values are calculated again, using the same methodology. To finish, the percentage improvement of the IPE and EPDA is compared from the improvements made.

ANALYSIS OF EE EVALUATION MECHANISMS IN DWELLINGS

THE IRAM 11900:2017 STANDARD

The new issue of the IRAM 11900 "Energy Performance in Housing. Calculation Method" was published in December 2017. This document, prepared by specialists and professional sectors that are part of the Subcommittee on energy efficiency in buildings, establishes a change in paradigm regarding EE evaluation (IRAM, 2017). In it, the bases are set for housing labeling. In January 2019, a modification was introduced in the standard, which was defined as: "Energy performance in housing. Energy efficiency labeling and calculation method".

There, a calculation method to determine the energy performance of residential units is outlined, where the notion of "energy performance" refers to the end use of conventional energy that contributes to the dwelling's energy demand through the following services: heating, cooling, indoor artificial lighting and sanitary water heating. The design bioenvironmental strategies are mentioned as an effective way of contributing towards EE, presented, initially, when outlining the calculation of energy performance, as follows:

> Passive design resources included in the architectonic project and the composition of construction elements, effectively contribute to the energy efficiency of housing and to the reduction of energy demand through different mechanisms, like: the reduction of the energy demand required for heating, through heat conservation in periods with low temperatures with thermal insulation; the shape, the compact design and the control of air renewal; the capture of solar radiation at times when its contribution to heating is beneficial; the control of the entry of solar radiation in summer through, thermal insulation; clear-colored roofs and solar protection on glazed surfaces; the incorporation of natural cooling with crossed and selective ventilation. In this context, the bioenvironmental strategies and passive design resources, together with the contributions of

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efficient installations and the additional contribution of renewable energies integrated to the project, contribute to improving the energy efficiency of the dwelling (IRAM, 2017, p.11).

It can be seen that IRAM considers the contemplation of passive design strategies as essential.

Immediately after the bioenvironmental strategies, the specific requirement of primary climatization energy (heating and cooling) is mentioned, which consists of the calculation for the thermal evaluation and EE evaluation for air-conditioning. Third is the sanitary hot water calculation, whose purpose is to characterize the systems used and determine their efficiency. Fourth, the indoor artificial lighting; and finally, the contribution from the use of renewable energies, where only solar energy is considered: thermal solar to heat water and photovoltaic, to produce electricity.

The total energy performance of the dwelling is defined from the results of these calculations, as the difference between the specific primary energy requirement (annual energy demand for air-conditioning, water heating and lighting) and the energy contributions generated by renewable sources.

IRAM 11900 ENERGY EFFICIENCY LABEL

As a result of the energy performance calculation (EP) of the dwelling, the EE label is obtained. The variables considered in the label are: the annual primary energy specific requirement for climatization (EP $_C$); annual primary energy specific requirement for sanitary hot water (EP$_{S.H.W.}$); annual primary energy specific requirement for lighting (EP$_{IL}$); renewable energy contribution (EP$_{REN}$); and valuation of the level of Architectonic Passive Design Strategies (EPDA in Spanish).

The EE class is rated from "A" to "G". This is determined from the EP numerical value in kWh/m^2, which considers in its calculation: contribution of renewable energies, in kWh; primary energy requirement for air-conditioning, in kWh; primary energy requirement for sanitary hot water (SHW) production, in kWh; and primary energy requirement for indoor lighting, in kWh.

Although the standard prioritizes the weight of EPDA passive strategies, these do not have an influence on the result of the label. It is worth noting that passive strategies are mentioned in the norm first, and in the design of the label they are left at the end.

IRAM 11900 - ARCHITECTONIC PASSIVE DESIGN STRATEGIES (EPDA)

EPDA are defined as: "Characteristics of the architectonic design and of the construction elements that adapt the building to weather and environmental conditions, and

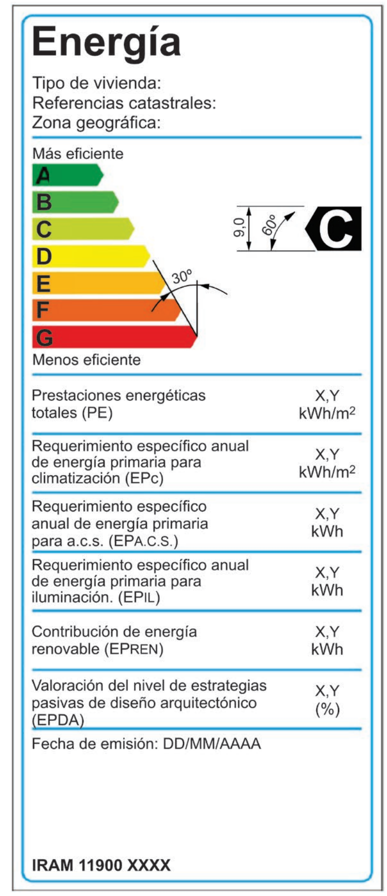

Figure 1. EE Label Model.
Source: Modification N° 1 to the IRAM 11900:2017 standard.

that allow improving the sensation of hygrothermal comfort and reducing conventional energy demand" (IRAM, 2019, p. 2). The EPDA that can be evaluated are thermal insulation; thermal inertia; solar protection; natural ventilation; solar capture; humidification; and surroundings. The weighting of the relevance of the bioclimatic strategies depends on the climate of the region where the building is located.

To determine the weight of the EPDA, a series of characteristic parameters are identified, called "architectonic-construction resources" (RAC, in Spanish), that reduce the energy demand and optimize the hygrothermal comfort through the natural conditioning of the building in summer and winter (IRAM, 2019). The relevance of each RAC varies depending on the climatic characterization of the analyzed area. For example, for the resource, "Thermal insulation of the floor", in a warm climate, the score is one (1) for any type of construction solution, while for a cold climate, this score varies from zero (0), uninsulated floor, to one (1), floor with full thermal insulation. The RAC considered are: roof thermal insulation; outside walls thermal insulation; window thermal insulation; floor thermal insulation; external roof color; outside wall color; window shading; direct passive solar systems; indirect passive solar systems; floor-to-ceiling height; contact with other dwellings; outside obstacles; summer sun; compact shape; window-to-wall ratio; crossed ventilation, selective ventilation, outside ground vegetation; wind breaks; roof window surface; and airtightness level.

The GHabSS (Healthy and Sustainable Habitat Group) task force of FAU-UNT developed a *C-EBioDA* calculator (Fernández and Garzón, 2019), to simplify and systematize obtaining the weight of passive strategies for the city of San Miguel de Tucumán. This carries out a simple systematization, through a calculation spreadsheet, of all the qualitative variables with their corresponding values that influence the EPDA weighting. To do this, the only variables that can be chosen are the qualities of the construction elements for each RAC. The score of said resource is obtained thanks to this process. The advantages of using it are the simplification of the calculation process and the reduction of possible errors due to the number of numerical values involved. Using this calculator, it is also possible to calculate, starting from the total EPDA percentage, the percentage impact of each passive strategy, so that a quick visualization is achieved that allows defining improvement strategies.

NATIONAL IT APPLICATION

The national IT application is an *online* tool, based on the IRAM 11900 standard, designed to carry out the EE evaluation of a dwelling in any place in the country, starting from a survey of it, and to obtain the corresponding Label, following the guidelines established nationwide. Likewise, it contributes towards formulating improvement recommendations and quantifying their impact in terms of potential savings (Ministry of Production Development, s.f.). This application classifies the EE of the dwelling in seven categories.

To validate the application and make adjustments that guarantee its correct adaptation to all construction practices in the entire country, contemplating the particular climatic, socioeconomic and construction practice aspects, tests were run in locations in different provinces and regions of the country. The certification of 1410 dwellings were made, as a pilot test (Ministry of Production Development, s.f.), to weight the current values and, starting from this, to define the different ranges of the label. However, the application is still not available for all locations in the country.

ENERGY PERFORMANCE INDEX (IPE)

The IPE is a characteristic value of the property, expressed in kWh/m^{2}year. It represents the theoretical primary energy requirement to satisfy the heating needs in winter, cooling in summer, sanitary water heating and lighting, during a year and by square meter of surface, under standardized conditions of use (Ministry of Production Development, s.f.).

Different design variables influence the IPE value: These are: orientations; materialization of the envelope; characteristics of the openings; finishing of the outdoor and indoor surfaces; floor-to-ceiling height; shading elements; lighting devices and type of activation; characteristics of the air conditioning equipment; water heating system, use of photovoltaic energy and water heating with solar energy.

These variables, thought of as energy saving strategies, can be classified into active and passive. Passive ones are those that must be implemented initially to reduce energy demands (Martín-Consuegra, Oteiza, Alonso, Cuerdo-Vilches and Frutos, 2014). There are studies that show that the application of passive strategies considerably reduces the energy consumption of a built building (Aguilera, Viñas, Rodríguez and Varela, 2018). It is important to say that said reduction is independent from the energy source used.

The classification of the variables that affect the IPE characteristic value can be seen in Table 1.

Incidental Variables	Passive Strategy	Active Strategy
Envelope composition	•	
Characteristics of the openings	•	
Orientations	•	
Outdoor surface finish	•	
Indoor surface finish	•	
Floor-to-ceiling height	•	
Solar protections	•	
Lighting devices		•
Type of activation for lighting devices		•
Characteristics of the cooling equipment		•
Characteristics of the heating equipment		•
Sanitary Hot Water System		•
Use of photovoltaic energy		•
Water heating using solar energy		•

Table 1. Classification of incidental variables in IPE.
Source: Preparation by the authors.

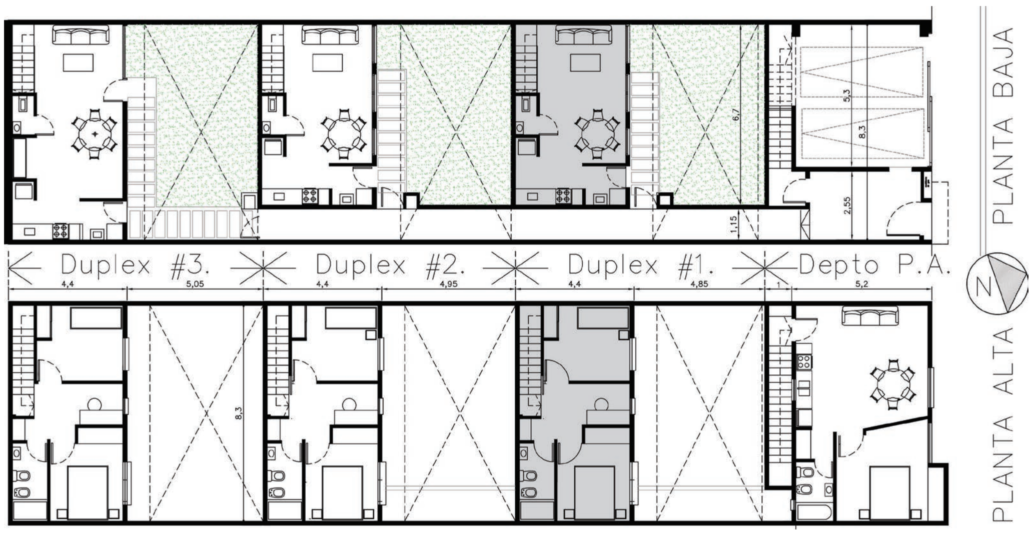

Figure 2. HP ground and top floor plan.
Source: Elsinger & Garzón (2019, p. 250)

COMPARISON OF PASSIVE DESIGN VARIABLES IN IPE AND EPDA

Diverse passive design variables have an impact on both the IPE characteristic value and the EPDA valuation since the active variables are not considered in EPDA. Table 2 below lists all these variables and indicates whether they are considered in each value or not.

According to Table 2, it is seen that there are passive variables not considered in the IPE, and also that the value "Indoor surface color", regarding passive strategy for lighting energy savings, is considered in the IPE and not in the EPDA.

Variable	EPDA	IPE
Thermal insulation of the envelope	Considered	Considered
Thermal inertia of the envelope	Considered	Considered
Outside surface color	Considered	Considered
Inside surface color	Not considered	Considered
Solar protections	Considered	Considered
Natural ventilation	Considered	Not considered
Humidification	Considered	Not considered
Solar capture	Considered	Not considered
Surroundings	Considered	Not considered

Table 2. Passive strategies present in IPE and/or EPDA
Source: Preparation by the authors.

ANALYSIS AND ASSESSMENT OF PASSIVE VARIABLES THROUGH A CASE STUDY

To analyze the correlation of both variables (IPE and EDPA), a case study is used as an application example. The case is located in the city of San Miguel de Tucumán, in the province of Tucumán, in the northwest of the country. It is specifically located in the IIb bioclimate zone, where summer is the critical season, with average temperatures above 24°C, maximums above 30°C and amplitudes of less than 14°C. Winter is drier and has low amplitudes and average temperatures between 8°C and 12°C (IRAM, 2012). The study is applied to a single-family dwelling, whose energy performance had been analyzed previously to generate a thermal-energy retrofitting proposal, which was published in ASADES 2019 by David Elsinger and Beatriz Garzón.

CASE DESCRIPTION

The dwelling is part of a horizontal property. This comprises three "duplex" type units, developed on two levels, and one unit on the top floor (Figure 2). It also has a common access, an easement to reach all the units and a garage for two vehicles. It is north-south facing, with all its openings facing north (Figure 3).

The existing construction was built after the demolition of a dwelling; therefore, the existing divides (East and West), using 30 cm thick common solid masonry bricks, were recycled with at least one face plastered (indoor face). The rest of the vertical envelope was built using 20 cm ceramic hollow masonry bricks (18x18x33 cm) with both faces plastered. The building has an independent reinforced concrete structure and

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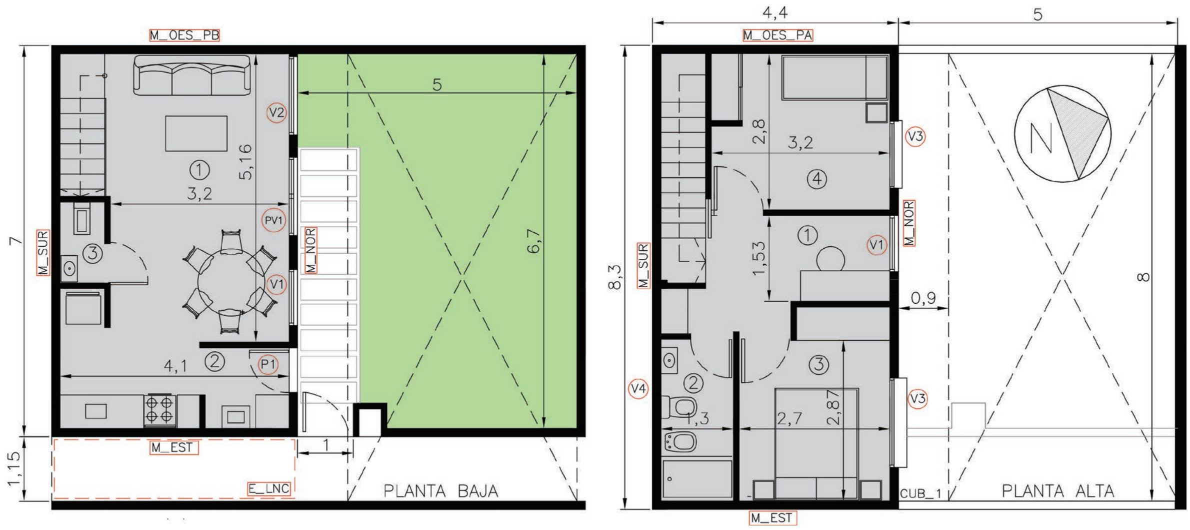

Figure 3. Unit of study - ground and top floor plan.
Source: Elsinger & Garzón (2019, p. 251)

a caliber 24 sinusoidal plate roof, with 5 cm glass wool and a "C" metal profile structure placed on the plates. The roof is formed on a single north sloping gable, which has a 0.90 m overhang towards the internal yard of one of the properties. The indoor divisions are made using different techniques: 15 cm common brick masonry on the ground floor, 8 cm hollow block masonry and cardboard plasterboard sheet partitions with 10 cm thick galvanized sheet metal profiles on the top floor. Both floors have tiled baseboards and floors. The indoor surfaces have a fine whitewash and light color paint and the ceilings are plaster applied on the ground floor's slabs and suspended on galvanized sheet profiles and drywall enclosures on the upper floor. The external vertical surfaces have a thick whitewash with "splatter" finish, which has its own color, in this case, one that is similar to "light beige" (Elsinger & Garzón, 2019).

RETROFITTNG PROPOSAL

The retrofitting proposal considers the following measures:

- Increase of the thermal insulation of the envelope (Table 3).
- Reduction of the glazed surface to reduce solar capture. For this, one of the north-facing ground floor windows is removed (Figure 3: V1-Ground floor)
- Generation of crossed ventilation. This is achieved by opening two transom windows on the south face of the building: one on the ground floor and another on the first floor

Envelope element	Original situation	Retrofitting proposal
Carpentry	Sliding doors with 3 mm thick transparent glass	Opening with double airtight glazing
North Wall	Ceramic hollow brick plastered on both faces (20 cm)	Incorporation of insulation on the outer face: 7 cm of expanded polystyrene + cementitious plate
South Wall		
East Lower Level Wall		
East Upper Level Wall	Solid ceramic brick plastered on the indoor face (30 cm)	Incorporation of insulation on the inside face (on being divides). 5 cm glass wool + 12 mm plasterboard
West Wall		
Roof	Sinusoidal galvanized plate + 5 cm of glass wool + 8 mm plasterboard ceiling	Incorporation of 5 cm more of glass wool (this is placed from the external face removing the roof's plates)
Street Level Slabs – East E_LNC	Pre-tensed joist floor slabs with expanded polystyrene overhangs (17 cm)	Incorporation of a 5 cm glass wool lower face + plasterboard

Table 3. Thermal insulation proposals on the envelope.
Source: Preparation by the authors.

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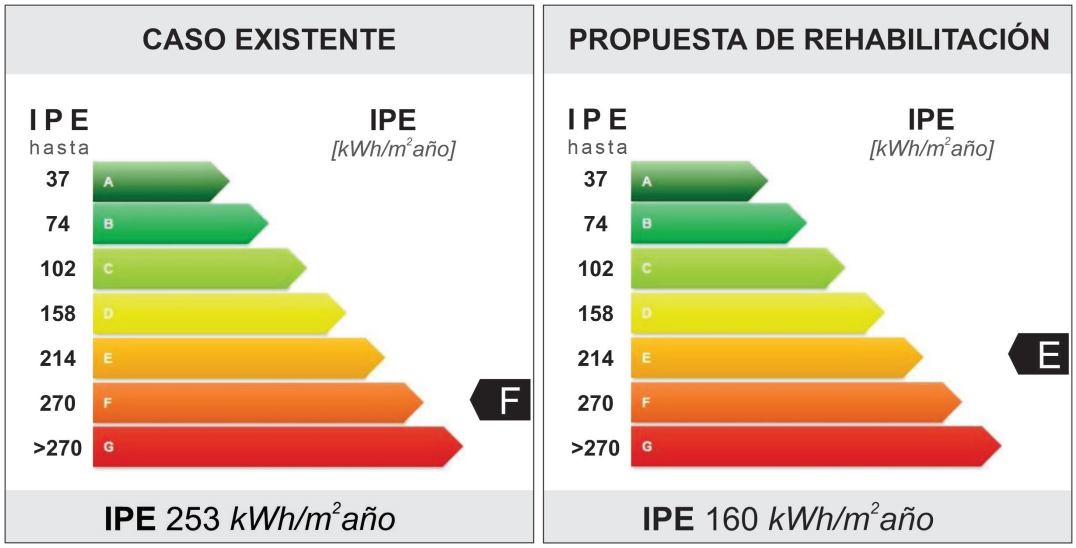

Figure 4. IPE value for the existing case and retrofitting proposal.
Source: Preparation by the authors

EBioDA <		EBioDA >>	
% EPDA	23.76 %	% EPDA	48.69 %
Aislación térmica	28.75 %	Aislación térmica	83.75 %
Inercia térmica	24.90 %	Inercia térmica	24.90 %
Protección solar	30.70 %	Protección solar	30.70 %
Ventilación natural	5.00 %	Ventilación natural	32.50 %
Captación solar	17.20 %	Captación solar	32.20 %
Humidificación	0.00 %	Humidificación	0.00 %
Entorno	35.00 %	Entorno	35.00 %

Figure 5. Determination of the EPDA % using the EBioDA calculator.
Source: Preparation by the authors

COMPARISON OF THE EPDA ASSESSMENT AND IPE RESULTS FOR BOTH CASES

The IPE value is calculated through the web application. The results that are obtained are the following: for the existing situation, 253 kWh/m²year, and for the retrofitting proposed, a total of 160 kWh/m²year. With this, the original prototype is left with an "F" rating and retrofitting proposal, with an "E".

The EPDA valuation was then made for both cases, using the C-EBioDA calculator as a tool (Fernández & Garzón, 2019). The percentage values obtained are 23.76% for the original case, and 48.69% for the retrofitting proposal.

It can be seen in Figure 5, that substantial improvements occur in the thermal insulation (from 28.75% to 83.75%), in the natural ventilation (from 5% to 32%) and in the solar capture (from 17% to 32%). This is the result of the retrofitting strategies implemented. In insulation, the behavior of the entire envelope is optimized (walls, roof, and windows). The natural ventilation is achieved incorporating transom windows on the south wall, which benefits cross ventilation in almost the entire dwelling. Finally, the solar capture is reduced, on reducing the glazed surface, removing a north facing window.

On comparing both values, it is seen that, regarding the passive strategy valuation, the analyzed case improves by 52.1%, while, in terms of the IPE, it only does so by 36.6%. As a result, the optimizations in the passive strategies do not imply an improvement, at the same level, as the energy supplies of the dwelling.

DISCUSSION

It is fundamental to consider that any intervention in a dwelling generates increases in the thermal comfort, which provokes a broad margin of action (Fernández, Rubio & Guevara, 2019). The energy retrofitting of dwellings is focused on improving the building conditions considering the economic possibilities of the user, the characteristics of the building, and other possible limitations (Pérez Fargallo, Calama Rodríguez and Flores Alés, 2016). The commitment of investing in the retrofitting of dwellings as an EE improvement of the residential sector must not fall back on the good intentions of the user, but rather must be accompanied by real public supporting policies and of an amount that is proportional to the cost required so that the thermal-energy modernization process of buildings is sustainable and does not become a social problem (Lizundia, Etxepare, Sagarna & Uranga, 2018).

The energy retrofitting proposal outlined here is feasible from the local socioeconomic and technological point of view. However, there are diverse limitations, among them: the layout of the building at the site (between divides); the lack of specific materials and/or specific products in the local market (thermal insulation, high performance carpentry services, etc.); and technological limitations, related to local construction practice knowledge.

On the other hand, the preliminary conclusions obtained aim at reinforcing the low impact of passive strategies on the building EE label. Given that, in this case, only the variations produced by said strategies have been analyzed, it would be important to also analyze the impact of active strategies on the energy label to carry out a more suitable weighting.

CONCLUSIONS

Starting from the analysis of the IRAM 11900:2017 standard, and from the energy labeling web application, which mainly allowed evaluating the weighting of architectonic passive design strategies, and after the later analysis of a case study and its resulting energy retrofitting proposal based on passive strategies, it is confirmed that, although this type of interventions has an impact, it is not of great importance.

The Housing Labeling Program constitutes, without any doubt, an authentic domestic policy to face the energy conditions of the modern world. On the path to the implementation of a Housing Labeling Program throughout Argentina (Renewable Energies and Energy Efficiency Undersecretary, s.f.), it is necessary to revise the ways in which the data that helps obtain the IPE is weighted, to obtain a label that fits the different socioeconomic realities of the country.

The IPE determines the EE of residential units in Argentina. Even though its implementation is not obligatory, it is expected that it is of collective interest, since, on being recognized by the property market, is constitutes an added value for the purchase-sale, rental or construction of a property destined to housing, regarding its degree of efficiency.

On the other hand, it is valuable to consider that the improvement of the thermal insulation of the envelope implies improvements in the IPE, but this is the only passive measure that leads to this goal, omitting the other variables. It would therefore be very positive, that the consideration of the passive strategies had a more significant role, to generate awareness and greater knowledge about bioclimatism.

It is highly questionable that the fact that improvement strategies which involve energy production costs and generate relevant waste (like the change of air-conditioning equipment or lighting) is considered. The possibility of reaching the highest standards, essential to guarantee a safe and energy efficient habitat, is feasible through passive design that ensures noticeable improvements in the natural comfort and in the reduction of conventional energy use. Therefore, the use of a tool that favorably weighs the passive strategies is required and that does not entail including air-conditioning equipment, renewable energy generation equipment or other active systems, just to reach a better label.

Considering this, and understanding the Energy Label as a tool to suggest dwelling retrofitting processes, the study made ends up setting the following questions: What are the final impacts of passive and active strategies on the Energy Label? Is it necessary to check these impacts to adapt the Label to the diversity of local socioeconomic-technological context of the Argentine Republic?

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