ISSN 1828-5961

Ignacio Puig Tarín

Architetto alla "Escuela Técnica Superior de Arquitectura" (ETSA) dell'Università Politècnica di Valencia (UPV). Master alla UPV. Coordinatore del Master alla ETSA/UPV. Manager dell' "Efitres Control S.L." per il controllo di qualità della prestazione energetica degli edifici.

Francisco Juan Vidal

Architetto alla "Escuela Técnica Superior de Arquitectura" (ETSA) dell'Università Politècnica di Valencia (UPV). Dottorato alla UPV. Professore alla ETSA/UPV, nel Dipartimento di "Expresión Gráfica Arquitectónica" (DEGA). Ricercatore all' "Instituto de Restauración del Patrimonio" (IRP) della UPV.

Begona Serrano Lanzarote

Architetto alla "Escuela Técnica Superior de Arquitectura" (ETSA) dell'Universitat Politècnica of Valencia (UPV). Dottorato alla UPV. Professore alla ETSA/UPV, nel Dipartimento di strutture. Coordinatore tecnico del settore della riabilitazione all "Instituto Valenciano de la Edificación".

La città immateriale. Esperienze ambientali in contesti storici. Il caso di Ruzafa a Valencia (Spagna)

The intangible city. Environmental experiences in historical settings. The case of Ruzafa in Valencia (Spain)

Il vicinato di Ruzafa a Valencia (Spagna) è in un processo di rivitalizzazione urbana. Gli interventi debbono sorgere la conoscenza delle particolari caratteristiche del tessuto esistente e gli utenti che risiedono in questi. Le informazioni ottenute saranno gestiti attraverso un database grafico permettendo proporre modelli alternativi di riabilitazione energetica fondata sul recupero del patrimonio esistente. Proponiamo una sistematizzazione di informazioni sensibili per la gestione della qualità dell'ambiente urbano, attraverso una banca dati grafica della città (GIS). L'utilizzo di questo strumento permette interventi sensibili alle reali esigenze degli utenti e ottenere una penetrazione reale tra la proposta della popolazione urbana.

The integration of interactive visualization with The district of Ruzafa in Valencia (Spain) is in a process of urban revitalization. These interventions need knowledge of the particular characteristics of existing urban weave and of the resident users. The information obtained will be managed through a graphical database that will allow to propose alternative models of energy rehabilitation based on existing heritage recovery. The proposal consists of the systematization of the information sensitive to urban environmental quality so it can be managed through a graphical database of the city (GIS). The use of this tool will allow to propose interventions adapted to the real needs of the users and to achieve a real penetration of the urban proposals among the population.

Parole chiave: Ruzafa; Valencia; GIS; vulnerabilità; sostenibilità; costumi tradizionali; risparmio energetico; studio

***Keywords**: Ruzafa; Valencia; GIS; vulnerability; sustainability; traditional customs; energy saving; survey*

ISSN 1828-5961

Ruzafa is an historic district of Valencia city (Spain). In 2006 this district was declared vulnerable due to his social and economic problems and it was included in the program "Áreas de Recuperación Integral" (Integral Recovery Areas) of the Spanish Government. The objective of this plan is to propose sustainable actions in order to rehabilitate the area from a social, economical and cultural point of view (Fig.1).

The "recovery program" encourages the required actions for the regeneration and revitalization of the area. This program creates a quality standards based on principles of environmental[1], social and economic sustainability, which contribute to improve the quality of life for residents. This program includes actions on three levels, urban, architectural and social.

At urban level the program aims to improve and renovate urban infrastructures and equipments, to design pedestrian routes and any other action to integrate the neighborhood within the city. At architectural level, several activities will be supported, which will preserve the architectural heritage of the neighborhood, improve the habitability of housing and increase the sustainability and energy efficiency of the buildings. And finally, the main objective at social level, is to improve the life quality of residents, stimulate cultural and educational activity, and recover the social environment.

For developing this kind of actions is necessary to have some initial information about the neighborhood, organized through graphics systems which report on the particularity of the place, the people and their customs. The analysis and interpretation of this graphical database will give an opportunity to design different holistic models of rehabilitation in Ruzafa.

The intervention models carried out currently in this district, are exclusively focused on improving the thermal behavior of buildings without participating in another aspects. The problem is that these interventions are superficial and unable

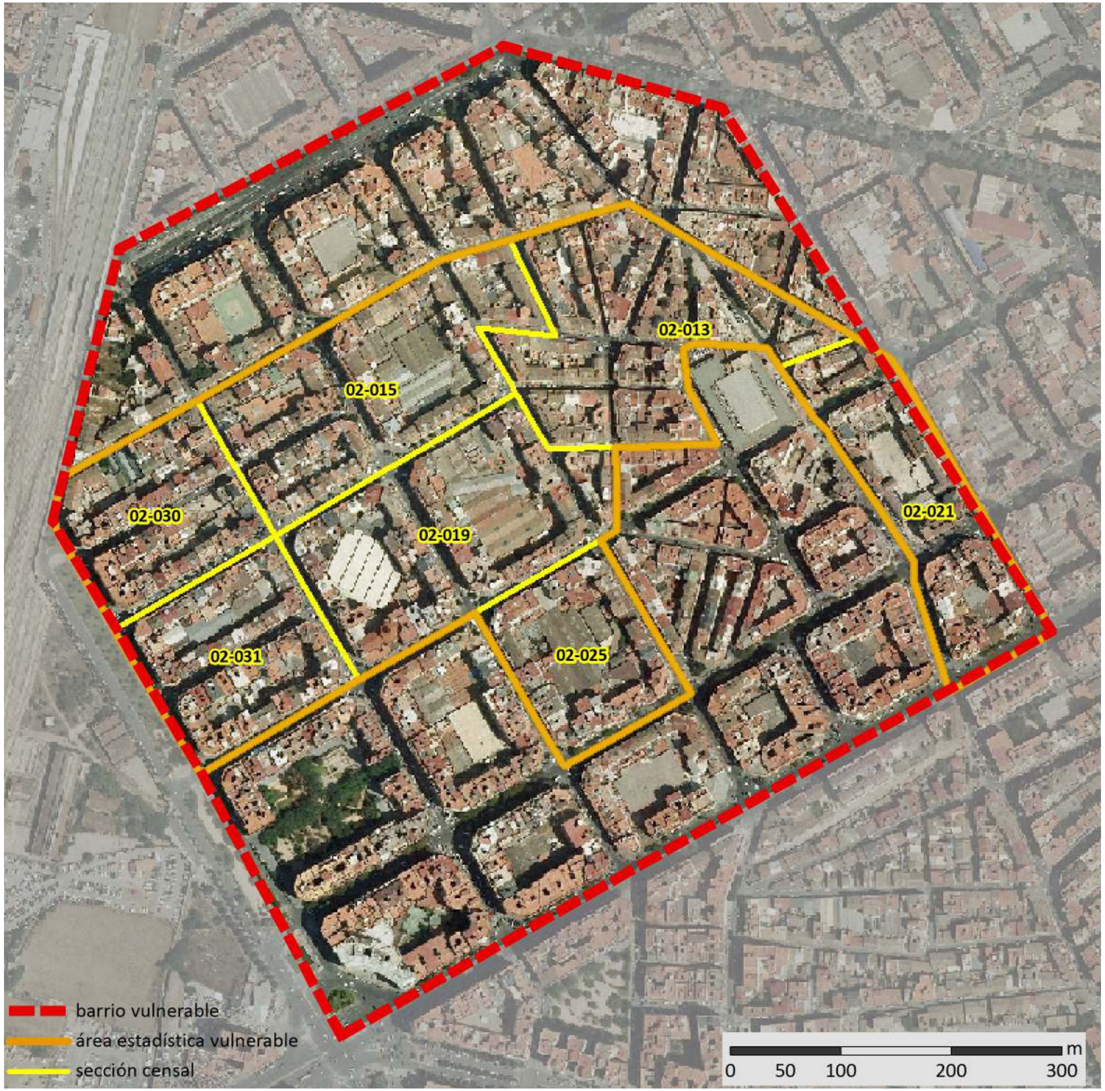


Figure 1 - An area is statistically vulnerable when one of the three indicators of vulnerability (level studies, unemployment or housing) exceeds the value established by reference. In this case the value established is 20 % and Ruzafa has 23,33 %.Stadistic File 2006. Secretaría de estado de vivienda y actuaciones urbanas. Ministerio de Fomento. Gobierno de España.

ISSN 1828-5961

Figure 2
This map represents the degrees of protection in Ruzafa. Environmental, singular and monumental protection. A big quantity of buildings in the historic core are protected, and the interventions must respect the values of the buildings. Jimenez, C. (2012). Research project: Proposed Assessment Methodology and Historic Neighborhood Building typological classification. For BRcCO2 (Russafa neighborhood almost zero energy consumption). University Politechnic of Valencia. p.p. 214

to achieve their purpose; they also make worse the situation due to the disaffection between population and intervention. These interventions don't take into account the configuration of the traditional buildings and ignore users' needs. These models produce incompatibilities between homes comfort, users' requirements and conditioning systems. In summary, the historic districts are penalized because of their special characteristics (Fig.2).

Any intervention carried out in Ruzafa must consider the knowledge of the particular characteristics of the existing buildings and their users. This information will allow taking the correct decisions due to the respect to traditional systems and the resources economy. The neighborhoods graphic database proposes an alternative model of intervention based on the recovery of traditional conditioning systems. This model comes from the analysis of the existing heritage and reveals how the neighbors have used own traditional conditioning systems, and how they have adapted them to their needs (Fig.3).

The historic district of Ruzafa still preserves in their buildings the old techniques used to maximize the sun, shade, wind, etc. These systems are typical of Mediterranean culture and there are a variety of habits and popular wisdom associated with the management of each building components. All this culture to control the external conditions to adapt them to the domestic needs is part of the intangible cultural heritage of historic districts like Ruzafa (Fig.4).

The aim of this article is to identify those parameters that encourage energy saving in the edification of Ruzafa district, using their own traditional culture in adaptation to the environment. With this information, any intervention carried out will involve a reduction of the energy use and will respect cultural values of the Ruzafa district[2], as required by the neighborhood "recovery program". The aim of the article is to identify which aspects of human activity and hygro-thermal characteristics affect energy use.

Based on these parameters, a proposal for the systematization of information sensitive to environmental quality through a graphic database (GIS – Geographic Information System) is made. First, it will allow us making analysis

ISSN 1828-5961

Figure 3
Image of a street in the City of Valencia in the early twentieth century. Most of the buildings contain sun protection systems, to harness the wind, to keep the light, etc. Historical Archive of the City of Valencia

in the improvement of energy efficiency. And then, it will develop synthetic models of the geostatistical surfaces.

The main characteristic of the early twentieth century buildings of Ruzafa is the adaptation to external environmental conditions, the type of internal activity and the existing building technology. The comfort in the indoor environment was controlled by the users, and it was different between buildings in the same street and even between flats in the same building. There are a lot of possibilities depending on many parameters, the orientation, the position of the buildings in the city, the location of the rooms inside the building, the features of the windows, the activity and even the clothing of users (Fig.5).

The energy demand in these buildings is resolved through passive systems which don't need any energy contribution to condition the housing. The building is an energy modulation system between the person and the external environment. The traditional systems used to obtain the necessary comfort level and do not require the use of energy, because they depend on external conditions and the needs of users. Residents of these buildings have an active role to evaluate the comfort of their homes and to adapt them using traditional mechanisms. The positive effects of this traditional culture are the control of the buildings by the users and therefore the reduction in energy consumption.

The intervention model proposed is based on traditional conditioning systems which use all the possibilities offered by the environment[3]. All required information to recover these systems is organized into three levels depending on the location in the neighborhood[4]. At urban level, the parameters used describe the environmental conditions, at the architectural level the parameters used are the features of the energy envelope, and at user level the parameters used are the comfort requirements. The results define the intervention strategies to be carried out in the rehabilitation of every house at the neighborhood .

The parameters describe the quality of the urban environment and is divided into two distinct databases each are interlinked[5] (Level building - EMU and city level - UMU). The information given concerning the characteristics of the different elements involved in producing thermal comfort and energy consumption. The databases are organized across different fields and allows filtering into different categories homogeneous[6]. We propose a data architecture by establishing a "one to many" that relates the information unit at different edges (different forms). Through these structures can track any data that characterizes the urban environment.

ISSN 1828-5961

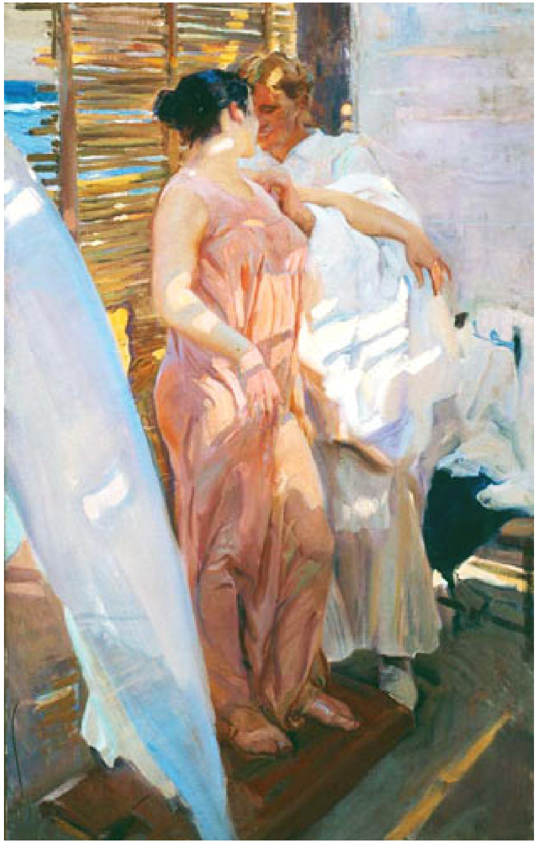


Figura 4
The Mediterranean traditional homes adapt the external conditions through the architecture. The light, the shadow, the breeze, the clothes are part of the elements that influence the comfort of the homes. Joaquín Sorolla y Bastida (1863-1923). "Después del baño, o la bata rosa" (1916), Museo Sorolla, Madrid. http://museosorolla.mcu.es/catalogo.html

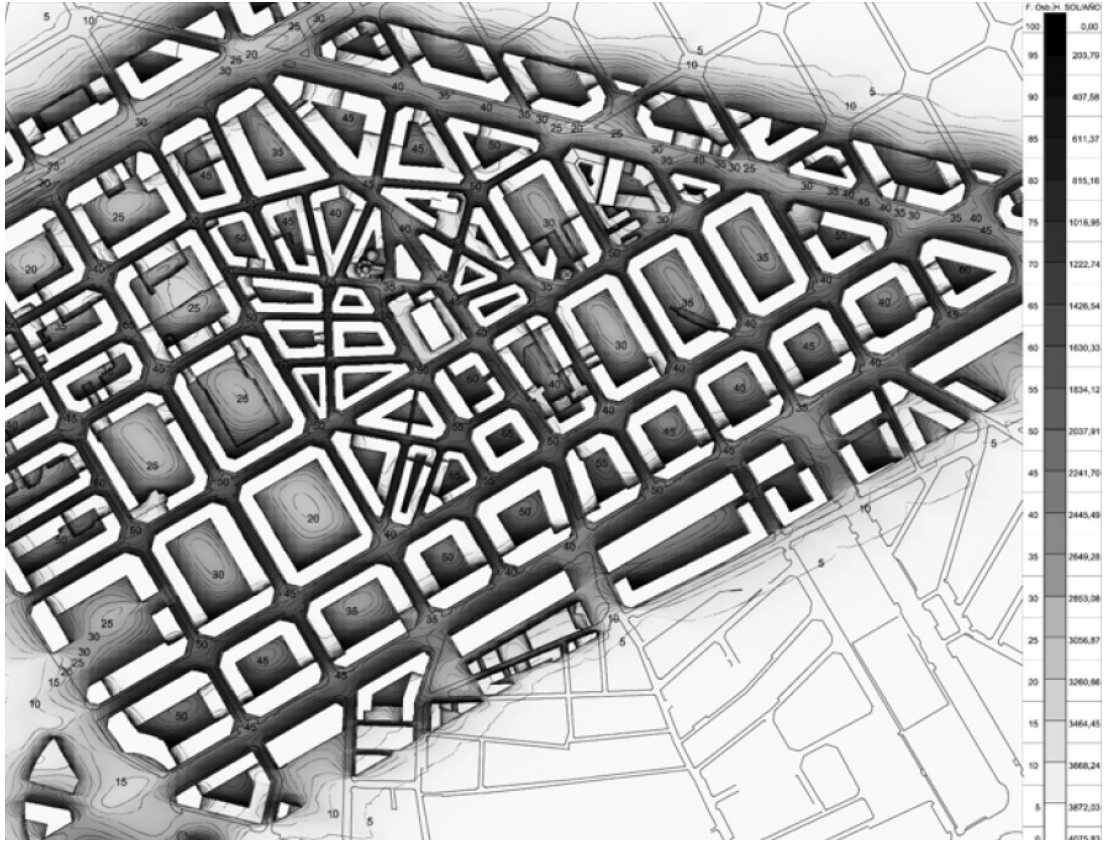


Figura 5
The influence of sunlight in the preindustrial city becomes very important for their ability to condition the housing. The urban design favors sunlight in winter and shade in summer. ABCD Developpment. Community Initiative INTERREG III C, 2002-2004

ISSN 1828-5961

URBAN LEVEL: ENVIRONMENTAL CONDITIONS IN THE CITY

U1. Sunlight: To determine the advantages and disadvantages about sunlight is necessary to study the course of the sun throughout the year. We can use the solar radiation when it arrives to the external envelope of the buildings, then the inner temperature increases and it is possible to achieve thermal comfort conditions.

U2. Solar obstruction in urban configuration. The shadows between buildings prevent the radiation in certain times of the day (Fig.6).

U3. Relative humidity: percentage of humidity in the air respect of the maxim quantity. Humidity affects the transpiration ability of the organism. The higher the humidity, the lower the transpiration. In moderate environments is considered that an increase of 10% relative humidity, increases the sense of heat around 0.3°C in the thermal sensation.

U4. Air Velocity: This parameter affects the convective heat exchange between a person and its environment. The air velocity increases the cool feeling. Air velocity should be limited to 0.25 m/s in cold conditions, and to 0.5 m/s in hot conditions.

Indicator	Indicator definition
U1. Average irradiance Solar Solar height	Average irradiance Solar on vertical and horizontal surfaces (W/m2). Solar inclination and orientation (degrees)
U2. Solar obstruction	Number of hours of sunlight in each plant every month (inclination/shadow hours /month)
U3. Humidity	Relative humidity in every hour (%)
U4. Air velocity (m/seg)	Air velocity (m/seg) Frequency of wind direction %

Figura 6
The buildings have systems which allow users to control the environmental parameters. These elements have a high heritage value because they represent the cultural values of the place. Any intervention in these elements for reducing energy consumption produces a distortion of the historical values. But the recovery of the traditional customs involves an energetic improvement of the neighborhood. Puig, I. (2012). Research project: Who lives there? Identification and valuation of conditioning systems of traditional architecture in the current energy certification of existing buildings. Application to a block in historic core of Ruzafa. University Politechnic of Valencia. p.p. 394

ARCHITECTURAL LEVEL: FEATURES

A1. Exterior walls: In traditional building, the composition of the facades is different depending on their function and the contact with the outside. These facades are generally heavy, and the solar gain is not instantaneous, but the heat flow comes inwards with a certain time difference and quite reduced. These heavy facades help to keep indoors the thermal stability[7].

A2. Color in the walls. The characteristics of the facades determine the level of solar radiation reflection, and therefore the quantity of energy absorbed by the facade. The increase of the reflectivity decreases the absorptivity and the transmissivity through any material element. The walls absorptivity produces the increase of the outside temperatures due to solar radiation. The color of the building facades has a large influence on summer. The sun-air temperature can be controlled by the color. Light colors do not increase excessively sun-air temperature.

A3. Presence of shutters. These elements protect against solar radiation and heat transmission. They are made of wood, so they have low conductivity and thermal inertia. They are placed in front of windows, to stop direct radiation and allow ventilation, keep views and generate a controlled lighting. They can be adapted to many different conditions and orientations.

A4. Presence of internal shutters: These elements are opaque to light and they are adjusted in the windows. They are used to isolate the indoor environment form the external conditions.

A5. Use of windows opening: they are mechanisms for thermal exchange with the outside. When the windows are opened, the temperature inside and outside are equalized.

A6. Presence of curtains: A large percentage of the solar gain through the glass is due to the

ISSN 1828-5961

greenhouse effect. Most of the solar radiation crosses the glass and heats the rooms. The curtain is an element ewhich stops the sunlight and transforms it in diffuse light.

Resident User Level: Behavior

Indicator	Indicator definition
A1. Time lag Heat damping	Time for the heat wave to cross the walls (hours) Quantity of wave energy which penetrates the walls (%)
A2. Absorptivity of each color	Level of reflection of solar radiation, and therefore the quantity of energy absorbed by the wall
A3. Solar factor	Percentage of windows shading in summer and winter (%)
A4. Correction transmittance	Correcting the transmittances (%)
A5. Correction transmittance	Number of hours with the temperature comfort (hours)
A6. Hours of comfort	Correction of the solar transmittance (%)

The thermal comfort of residents depends on several parameters as temperature and humidity. The residents control the conditioning systems and the relation between the indoor and outdoor environment, in order to satisfy their physiological and psychological needs.

R1. Level of activity of the buildings users: The heat of the users increases with the intensity of the activity developed. In buildings, the metabolic rates of users go from 50 to 150 W/m2.

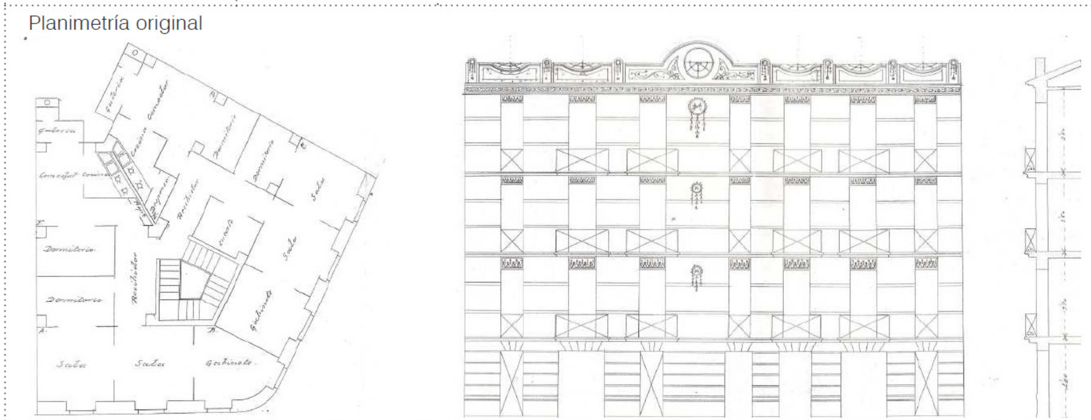
R2. Clothing insulation of user: This parameter measures the thermal transmission coefficients applied to clothes. In Mediterranean climates the values used are usually 0.5 in summer, 1.5 in winter, and 1 in spring and autumn. In summer,

Indicator	Indicator definition
R1. Metabolic rates	Defining activities of users. Metabolic rates (met or w/m2)
R2. Clothing insulation (clo)	Definition of clothing used by users in each activity

the ideal temperature ranges are from 23 to 26 º C. While in winter we use range between 19 and 24 º C

Identificación

Situación	Calle Tomasos, nº 1
Año de construcción	1910
Nº de viviendas	8
Nº de plantas	Pb + 3
Referencia Catastral	6015410YJ2761E
Grado de Protección	Fachada y escalera
Expediente archivo municipal	AHMV, Ensanche, año 1910, caja1, exp. 127

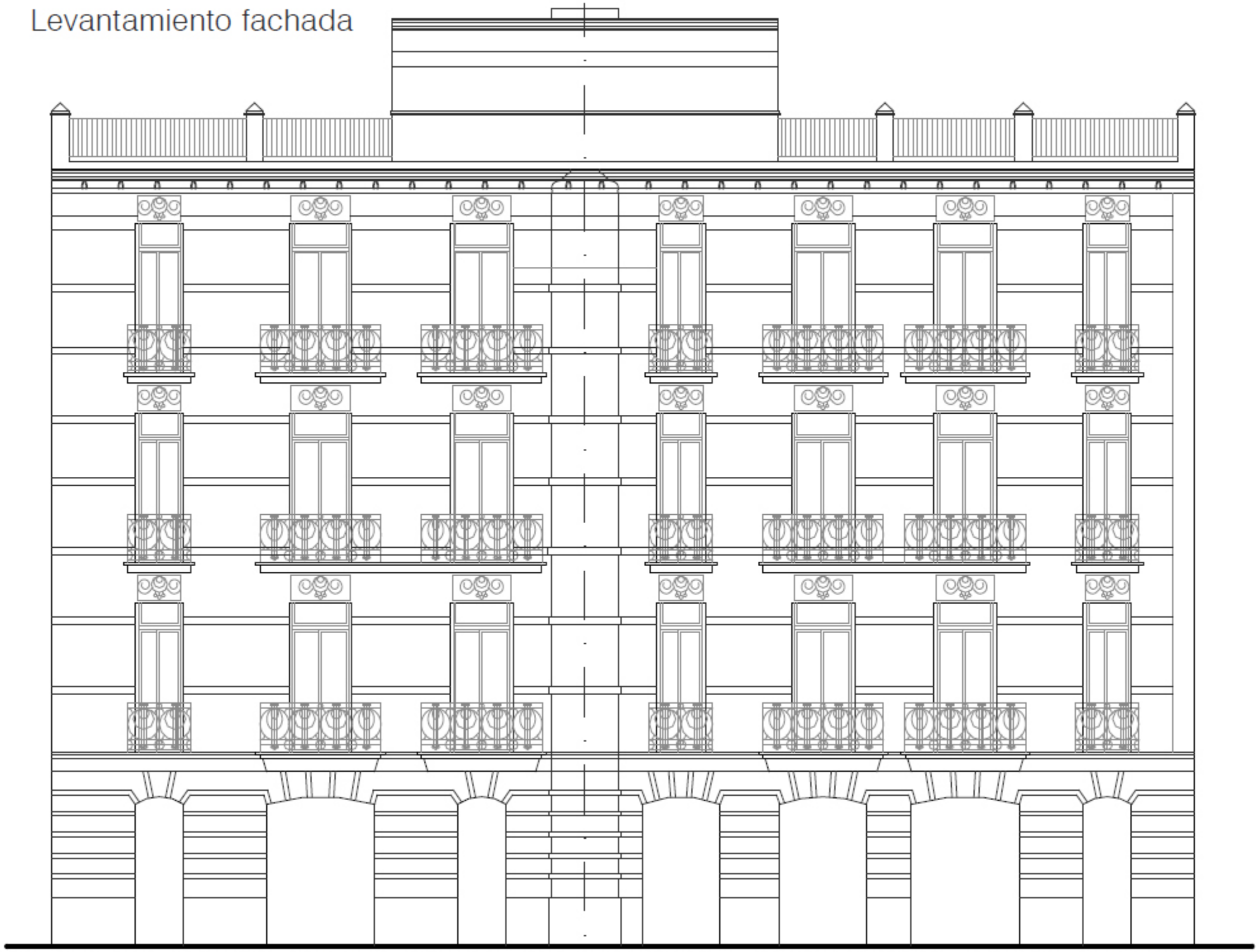


Cuadro 8.1.1-1: Información Administrativa del edificio Tomasos 1. Fuente propia.
Figura 8.1.1-1: Situación del edificio dentro de la manzana. Fuente propia.
Figura 8.1.1-2: Planta, alzados y sección edificio Tomasos 1, esquina con la calle Cádiz. Fuente: Archivo Histórico Municipal de Valencia.

Figura 7-8-9-10
Through the characteristics of each building, architects can identify the protected elements and their impact on energy consumption. These actions encourage interventions that respect cultural values of buildings and recover local traditions in environmental management of housing. Puig, I. (2012). Research project: Who lives there? Identification and valuation of conditioning systems of traditional architecture in the current energy certification of existing buildings. Application to a block in historic core of Ruzafa. University Politechnic of Valencia. p.p. 344.

ISSN 1828-5961

Levantamiento fachada



Protecciones fachada principal

Persianas		
Dimensión	Alto	3,00 m
	Ancho	1,30 m
Material	Madera	
Estado de conserva-ción	Se mantiene	0%
	Eliminado	48%
	Sustituido	52%
		Toldos
Contraventanas		
Dimensión	Alto	3,00 m
	Ancho	1,30 m
Material	Madera	
Estado de conserva-ción	Se mantiene	100%
	Eliminado	0%
	Sustituido	0%
		-

Figura 8.1.1-3: Levantamiento del edificio Tomasos 1 E1:150. Fuente propia.
Cuadro 8.1.1-2: Protecciones existentes edificio Tomasos 1. Fuente propia.

ISSN 1828-5961

Características dimensionales

Altura de forjado. Planta vivienda.	Planta 1ª: 3,70 m. Planta 2ª y 3ª: 3,50 m.
Altura de forjado. Planta Baja.	4,00 m.
Superficie útil habitable	800 m².
Volumen habitable.	2940 m³.
Orientación fachadas.	SO-S / N

Características de los equipos

Sistema ACS	Caldera eléctrica	Potencia ACS	24 Kw
Sistema Calefacción	Bomba de Calor	Potencia calefacción	4 Kw
Sistema Refrigeración	Bomba de Calor	Potencia refrigeración	4 Kw
P. Sensible Refrigeración	2,6 Kw	Potencia eléctrica	1,6 Kw

Características constructivas

Fachada Principal			
Orientación	SO-S	Trasmitancia térmica	1,46 W/m² °K
Superficie	78,4 - 78,4 m²	Muro de un pié y medio	
Fachada Posterior			
Orientación	N	Trasmitancia térmica	3,06 W/m² °K
Superficie	39,2 m²	Muro de medio pié	
Medianera			
Orientación	E-NO	Trasmitancia térmica	2,24 W/m² °K
Superficie	250,9 m²	Medianera adiabática	
Cubierta			
Orientación	-	Trasmitancia térmica	2,66 W/m² °K
Superficie	68,4 m²	CubiertaPlana	
Cubierta			
Orientación	N - SO	Trasmitancia térmica	6,09 W/m² °K
Superficie	56,8 – 56,8 m²	Cubierta inclinada	
Huecos fachada principal			
Orientación	S-SO	Vidrio	Monolítico 6 mm.
Superficie	34,43 - 34,43 m²	T. térmica Vidrio	5.70 W/m² °K
Carpintería	Madera	T. térmica carpintería	2.20 W/m² °K
Caja Persianas	No	Retranqueo	0,30 m.
Huecos fachada posterior			
Orientación	N	Vidrio	Monolítico 6 mm.
Superficie	14,40 m²	T. térmica Vidrio	5.70 W/m² °K
Carpintería	Madera	T. térmica carpintería	2.20 W/m² °K
Caja Persianas	No	Retranqueo	0,15 m.

Cuadro 8.1.1-3: Características dimensionales del edificio Tomasos 1. Fuente propia.
Cuadro 8.1.1-4: Características constructivas del edificio Tomasos 1. Fuente propia.
Cuadro 8.1.1-5: Características de los equipos del edificio Tomasos 1. Fuente propia.

Resultados

Resultados sin aplicar medidas pasivas		Resultados aplicando medidas pasivas: Persianas, cortinas y contraventanas.	
CALIFICACIÓN E		CALIFICACIÓN E	
Demanda Calefacción	44657,0 KWh/año	Demanda Calefacción	39076,0 KWh/año
Demanda Refrigeración	6135,5 KWh/año	Demanda Refrigeración	4470,7 KWh/año
Demanda ACS	13403,0 KWh/año	Demanda ACS	13403,0 KWh/año
Emisiones Calefacción	11520,0 Kg/año	Emisiones Calefacción	10160,0 Kg/año
Emisiones Refrigeración	2160,0 Kg/año	Emisiones Refrigeración	1600,0 Kg/año

% de Ahorro

Comparativa de ahorro	
Demanda	Porcentaje
Ahorro Calefacción	12,54 %
Ahorro Refrigeración	27,27 %
Emisiones	Porcentaje
Ahorro Calefacción	11,81 %
Ahorro Refrigeración	25,93 %

Gráfica comparativa

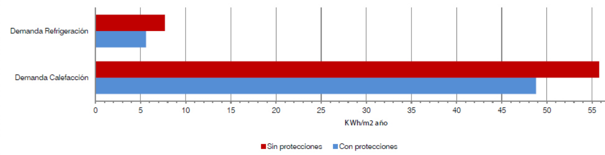


Imagen termográfica

Edificio en esquina orientado Sur, Sur-Oeste: Debido a la cantidad de radicación que la esquina, recibe el mecanismo de protección ha producido grandes ahorros de alrededor del 27%.

Cuadro 8.1.1-6: Resultados de demanda y emisiones CO2 aplicando medidas pasivas en edificio Tomasos 1. Fuente propia.
Cuadro 8.1.1-7: % Ahorro en demanda y emisiones CO2 aplicando medidas pasivas en edificio Tomasos 1. Fuente propia.
Figura 8.1.1-4: Gráfica comparativa. Fuente propia.

RESULTS

This compiled information, provides the knowledge of all the elements which influence the thermal behavior of the buildings, and their impact in the global demand. The indicators mentioned previously give a description of the energy behavior of the buildings.
The indicators U1 and U2 can be obtained directly, or through simple "plug-in" applications on graphic bases as GIS. Indicators A1, A2, A3, A4 and A6 can be introduced in the database as vinculated information to buildings or homes. The other indicators are more arbitrary and exceed capacities of ordinary urban management, but they are known at all times by the user who, ultimately, could introduce them in future device applications (Smart Phone), in order to know the specific recommendations of behavior for optimizing their comfort.

Spain has transposed the Directive 2002/91/EC[8] in the law "Código técnico de la Edificación" (Technical Building Code) of the Spanish Government, in order to draw up and send Energy Performance Certificates. This work regards the geostatistical analysis of the distribution of the Energy Performance Index and the primary energy consumption.

By using these databases GIS, designers would also have the opportunity to analyze the impact of the interventions in rehabilitation projects, knowing the global influence of their intervention and getting good energy behaviors without distorting the heritage values of the building.

At urban level, it will evaluate the potential impact of any save energy study based on best practices and management of traditional conditioning systems.

Every building has several data files, at GIS system. These files are divided into three levels of information. The first level identifies the buildings within the city and indicates the law applicable. The second level describes the formal characteristics of the buildings. And the third level describes the influence of each building element in the total energy demand (Fig.7,8,9,10).

Ruzafa is a neighborhood with a considerable heritage value. Currently it is suffering a process of vulnerability, and therefore it requires interventions sensitive to the neighborhood needs. Given these conditions, it is required the knowledge of the real behavior of the buildings and the users who live in the neighborhood.

In the future, this GIS system will also contain the data of the thermal comfort using the calculation of the PPD (Average Percentage of People Dissatisfied). The survey will give us an idea of what are the real needs of the resident comfort. The result will evaluate the success of the implementation of the intervention model.

Using these data previously compiled, interventions are proposed which reduce the energy demand with a small financial contribution destined to recover traditional conditioning systems. With this model several objectives are achieved: recovery of traditional culture, reduction of energy demand, reduction of greenhouse gases emissions, stimulation of craftworks (carpentry or making curtains ...) which are still maintained in the area...

The introduction of the data in the GIS system will allow the knowledge about good practices and past habits. This will help to evaluate proposals for energy improvement through the recovery policies of traditional culture. The recovery of these traditions is a good strategy for the improving the future.

NOTE

1 Garagnani, Simone, Bravo, Luisa (2010), Observing Nature: La rappresentazione parametrica della città, in DISEGNARECON, Università degli studi di Bologna, 3(5). p. 126

2 Jimenez, Cesar (2012). Trabajo de investigación: Propuesta de Metodología para el Diagnóstico de Barrios históricos y Clasificación Tipológica de la Edificación. El caso de Russafa BrcCO2. University Politechnic of Valencia. p. 214

3 Garagnani, Simone, Mingucci, Roberto, Muzzarelli Aurelio (2008), Cartografie, Web-GIS e modelli interattivi: verso un sistema "globale" di referenziazione dei dati di rilievo architettonico, in DISEGNARECON, Università degli studi di Bologna 1 (2). p.5

4 Puig, Ignacio (2012). Proyecto de Investigación: Quién vive ahí? Identificación y puesta en valor de los sistemas acondicionamiento de la aquitectura tradicional en la actual certificación energética de los edificios existentes. Aplicación a una manzana de del núcleo histórico de Ruzafa. University Politechnic of Valencia. Valencia. p.p. 344-347

5 Merlo, Alessandro (2010), Il Castello di Sorana, Quaderni di Rilievo Urbano, Edizioni ETS, Pisa. p.p. 195-202

6 Merlo, Alessandro (2012), Il Castello di Pietrabuona, Quaderni di Rilievo Urbano, Edizioni ETS, Pisa. p.p. 183-212

7 Serrano, Begoña (2011), Catálogo de Soluciones constructivas para la Rehabilitación, Generalitat Valenciana, Conselleria de Medio Ambiente, Agua, Urbanismo y Vivienda. Valencia. p.p. 34-65

8 EU directive 2002/91/EC of the European Parliament and of the Council on the energy performance of buildings.

BIBLIOGRAFIA

Garagnani, Simone, Mingucci, Roberto, Muzzarelli Aurelio (2008), Cartografie, Web-GIS e modelli interattivi: verso un sistema "globale" di referenziazione dei dati di rilievo architettonico, in DISEGNARECON, Università degli studi di Bologna 1 (2).

Garagnani, Simone, Bravo, Luisa (2010), Observing Nature: La rappresentazione parametrica della città, in DISEGNARECON, Università degli studi di Bologna, 3(5)

Jimenez, Cesar (2012). Trabajo de investigación: Propuesta de Metodología para el Diagnóstico de Barrios históricos y Clasificación Tipológica de la Edificación. El caso de Russafa BrcCO2. University Politechnic of Valencia.

Merlo, Alessandro (2010), Il Castello di Sorana, Quaderni di Rilievo Urbano, Edizioni ETS, Pisa.

Merlo, Alessandro (2012), Il Castello di Pietrabuona, Quaderni di Rilievo Urbano, Edizioni ETS, Pisa.

Puig, Ignacio (2012). Proyecto de Investigación: Quién vive ahí? Identificación y puesta en valor de los sistemas acondicionamiento de la aquitectura tradicional en la actual certificación energética de los edificios existentes. Aplicación a una manzana de del núcleo histórico de Ruzafa. University Politechnic of Valencia. Valencia.

Serrano, Begoña (2011), Catálogo de Soluciones constructivas para la Rehabilitación, Generalitat Valenciana, Conselleria de Medio Ambiente, Agua, Urbanismo y Vivienda. Valencia.

EU directive 2002/91/EC of the European Parliament and of the Council on the energy performance of buildings.