Environmental and energetic operation in "El Ensanche" of Valencia

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Abstract. *The present paper focuses on the urban parameters we need to study, in order improve the environmental behavior on our cities. It goes deeper on how density and urban compactness can deal with some of the most important urban issues on environmental point of view. On the one hand they permit a better social cohesion due to urban proximity spaces including pocket parks, local trade, public facilities and allows identity social progress. First, it is necessary to make a brief introduction of Valencia urban morphology consolidation through the years, it is needed to begin with an accurate understanding on how does it is urban form on every case study, to could achieve our propose. Secondly, we need to do a climate analysis for Valencia weather conditions. It will detect the best bioclimatic strategies to reduce energy needs, and to create better microclimatic urban conditions. Finally the paper will show studies on the "El Ensanche" urban grid on solar passive gains strategies, internal gains and sun shading. Every strategy will demand form us to taking into account an evaluation on the limits between urban changes and the heritage protection. So this paper will link climate conditions with the urban form of the "El Ensanche" grid to clarify how the city leads with the energetic and environmental parameters. Thus, will allow us to put on the table most effective proposals for improve our cities.*

Keywords: High density, environment, energy, Valencia

Introduction

Urban high density is one of the most important parameters we required to our cities now a day, in order to increasing sustainable levels. Almost everyone believes the benefitsof high density against the low-density models. Benefits concerns both social and environmental function. On the one hand, they permit a better social cohesion due to urban proximity spaces including pocket parks, local trade and public facilities and allows identity social progress. On the other hand, compact urban fabrics, reduces energy need because of the lack of large fuel transportation where an important part of it is lost along the pipelines, moreover transportation of people, medical or cleaning services, increases their costs both economical and energetic in the diffuse city model.

The present case of study focused on "Ensanche" of Valencia, takes for real the above said which is enough contrasted, however it goes one-step further. The main idea of the study is to elucidate if high-density model in "Ensanche" has the same good functioning on some of the most important environmental parameters such as solar energy irradiation, natural ventilation, sun shading or wind protection, and how can those urban models be rehabilitated in order to reduce energy

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dependence. Urban heritage in European cities claim to be renewal, regenerated and rehabilitated putting the eye on the energy consumption without destroying its historical essence.

Methodology

In order to achieve the main goal investigation, and to communicate it successfully, full paper adopt an easy structure. First, it is necessary to make a brief introduction of Valencia urban morphology consolidation through the years. If we need this kind of studies to make better cities, to make them work efficiently and have an ecological behavior, it is fundamental to understand main environmental problems. Those only can be solved by acomprehension urban sense. This urban way of understand the problem, encourages us to analyze urban development to find out better improvement strategies. It is time to prevent from a non-consideration urban knowledge methods, because inside urban heritage and its knowledge is written those better and efficient urban solutions.

Secondly, environmental urban analysis would not be correctly done, if we do not know how does Valencia city climate conditions and territorially conformed. Thus, the second point will focus on the territorial analysis especially related on climatological data bases. Valencia has one of the typical Mediterranean climates, with soft winters and warm summers, that has to be understood. Once we have climate dates analyzed, we can come with comfort diagrams connecting climate with human comfort sense, that will gave us better bioclimatic strategies. Then we will be able to contrast those climatic strategies with the El Ensanche urban conformation. We can study how sunshades works with width and height streets or how does block compactness affects energy consumption or how does affect wind in our geometry. The idea is not to criticize urban masterplan, made hundred years ago and trying to fix quick urban development problemsinstead being energetically efficient. This study has been made to draw near the possible solutions for a sustainable city transformation, taking in consideration those which would be more efficient regarding our urban heritage.

Valencia: El Ensanche urban development

Investigation main goalconsists on clarify some aspects about how does affect urban morphology to energy need and environmental quality, especiallyindoor spaces, where most of the energy will be demanded, consumed and contaminating, at the end. The process to understand how does interact urban form with energy, is generally done in the wrong way. Energetic studies are mostly focused on the energy consumption inside architectural spaces, forgetting matters that will be fundamental, such as climate, orientation, street width or urban compactness, every one concerns on urban morphology.

The present work lies over an important area of Valencia city, The Ensanche. In order to be consequent, It is necessary to make a brief introduction related on Valencia urban development. It is not possible to standby urban form and energy without understanding urban configuration process.

Valencia steels being fluvial instead of seaside, despite its coastline nearness. Originally grew as an island generated by the Turia River near the coastline on an extensive plain.As a roman foundation city, it had not such relevance as other important roman villages on Iberian Peninsula. Although, steel today, it is possible to recognize roman perimeter and the Cardo and Decumanusaxes too, withSan Vicente Mártir and Caballeros streets. The place where both axes crosses wasthe roman Forum being Almoina plaza today, Valencia has been built through roman axes, layer by layer over time, letting its urban lecture till now. Arabic and medieval traces finally draw the existing downtown, that we can see today.

El Ensanche first step:In 1858 Calvo, Monleón and Sancho proposed the First Valencia Ensanche. Although, it was not since 1884 when the second proposal from Calvo, Ferreres and Arnau won urban planning competition launched by Valencia city council, that El Ensanche took its definitelyform. (fig.1)Competition fixed strategically the main

Figure 1. Calvo, Ferreres and Arnau. Valencia 1884 Master Plan

boulevard position in the city, Gran VíaMarqués del Túria and Gran Vía Fernando el Católico will be the new Valencia bounder line for the First Ensanche, with 50m width. Block size from the 1884 project wascompletely enlarged, thus allowed connection between both urban traces, historical and El Ensanche in radial sense from downtown to city external medieval walls growth. Urban blocks were projected with 100m street axes distance while streets width goes between 11m and 16m, which refers directly to Barcelona CerdáEnsanche. At that point, Valencia south-west development had to deal with out of controlled built neighborhoods, trying to fix urban problems by the boulevard construction. Thus, made important differences between south-west and south-east Valencian urban growth, where the second one would have a better environmental and under control urban quality, because of the orthogonal and homogeneous urban greed.

El Ensanchesecond step: Commonly known by MorasEnsanche, Proposed by Francisco Mora in 1924, he projected Valencia growth till Transitos avenue.(fig.2) It marks the second Ensanche development in a polygonal form and approaches urban strategies over the north side of the Turia River. This polygonal urban form seams easy to read in south east and west orientations, but gets not so easy when it crosses the Turia River, because of the rail ways traces. Analyzing MorasEnsanche, it is possible to see the main road system as a traffic lines distributor, with no more than 25m street width, and how are being drown block structures of 100mx100m. Finally, between Gamazos Plan in 1946 and the Plan General

Figure 2. Francisco Mora. Valencia 1924 Master Plan

Renewal adapting South solution, Valencia will finish its huge urban development, that still giving todays structure appearance.

Climate and territorial configuration

Under climate considerations, it is important to point that climate changes are affecting nowadays in Valencian territory, "several studies on Spanish regions coincide in an essential fact: the warming from the decade of the 70's is visible and significant" (M. Castro, 2005). Hereby, future climate conditions in Valencia would probably extreme the present study dates, encouraging us to be more effective on our conclusions and improvement strategies. In this study the climate data have been used for Valencia weather conditions are IWEC data file, from the United States Department of Energy. This file is the same used by Spanish Technical Building Code.

Rain seasons are far to be homogeneous year by year, Although Autumn uses to be the wet season one, specially November where it could arrive till 350-450mm. It is a meteorological regional phenomenon called cold drop, based on cold winds from north of Spain coming from the Atlantic ocean with two or three days rain forecast, that rises usually in Autumn.

In the year 1957, took place the Turia River "Big Stream" in Valencia with its dramatic inundation after one cold drop period. This accident will change the strategies of Valencia urban growth, changing old Turia channel bya new one placed outskirts south on the city.At the same time, people encouragement, made possible the transformation of the old river in a large green park for the urban structure of Valencia, instead in a highway as it was firstly proposed by municipality.

Winter average temperatures goes around 10ºC while summer average temperatures rises till 25ºC, annual averages stays over the comfortable 18ºC, specially being outside. Between February and April, uses to come another rain period, softer than the first one, bringing with them a wet summer. High humidity is one of the most important problems to rise comfort sense in Valencia climate, thereby we will take care about how can density blocks orientation, in El Ensanche, get down wet ambient or not. However, Valencia has another climate reason to be benefited, it is the sea breezes. The used to come just in summer time, luckily when they are needed, east winds came from the sea that has lower temperatures than the earth, cooling freely the city.

Those climate conditions described before, are not only data base to make thousands of calculation without control. Those are made by an earth location in the world, then transformed by La Albufera lake, changed by the Mediterranean sea and definitely conformed by its fluvial character. Furthermore, those climatic data base, can explain how people are, what people cultivate or cooks and of course which urban models have they use through the time in order to face climate conditions. Attending to Olgyay ideas of climate, progress and culture, "The spread of population and modern communication have accelerated the age-old interchange of ideas and technological effects. We must realize, however, that the wide dissemination of Western forms evolved from the challenge of cool climates, and pose grave problems when adopted as undigested and inappropriate symbols of culture progress"(Olgyay, V. 1963) .

Next step had consisted on apply those climate parameters and territorial configuration, inside Climate Consultant 6.0 software. With Climate Consultant energetic results, aim has been to translate inside dwellings energetic behavior obtained for Valencia climate into El Ensanche particular urban morphology. Results was has follows.

Bioclimatic strategies in the Ensanche urban morphology

Energetic calculations allow us to visualize how comfortable Valencia climate is, 13,2% of the year, dwellings in Valencia did not need any energetic income to be comfortable spaces, which means that 1.145 hours per year are inside comfort temperatures and humidity. At the first time, results could be unexpected, but we can contrast with the real consumption made by the Instituto de Diversificación y AhorroEspañol IDEA, to evaluate its coincidences.

Passive Solar Gains bioclimatic strategy gave important benefits for elevate human comfort, 29,9% of the time and 2.628 hours a year. But, how does our morphology works on this way? Ensanche morphology is based on big square blocks (100m)x(100m) with a patio inside surrounding entire dwelling block, and its 45 degrees corner cuts as well as Barcelona´s Ensanche. Streets canyons between 11 and 16 meters width and 18-25 height are the main sunshine constrictors on the façades. Although, streets orientation with 45 degrees from the North pure, made a kind of equalization on how does every façade orientation works. Moreover, every dwelling cell has both orientation, one over the street and another over the central patio, because of that Valencia Ensanche morphology equalize every square block façade sun energy heating. (fig 3) In a first step analysis, we got a street canyon that difficult sun radiation because of his straight streets, only solved at corner cross blocks. But if we go further, we can realize the great opportunity given by the square blocks roofs, in order to improve sun heating energy for inner dwelling comfort. Roofs are plane and footable surfaces, without sun shading neighbor buildings and freely open for every neighbor by vertical communication cores in every building that includes one square block.

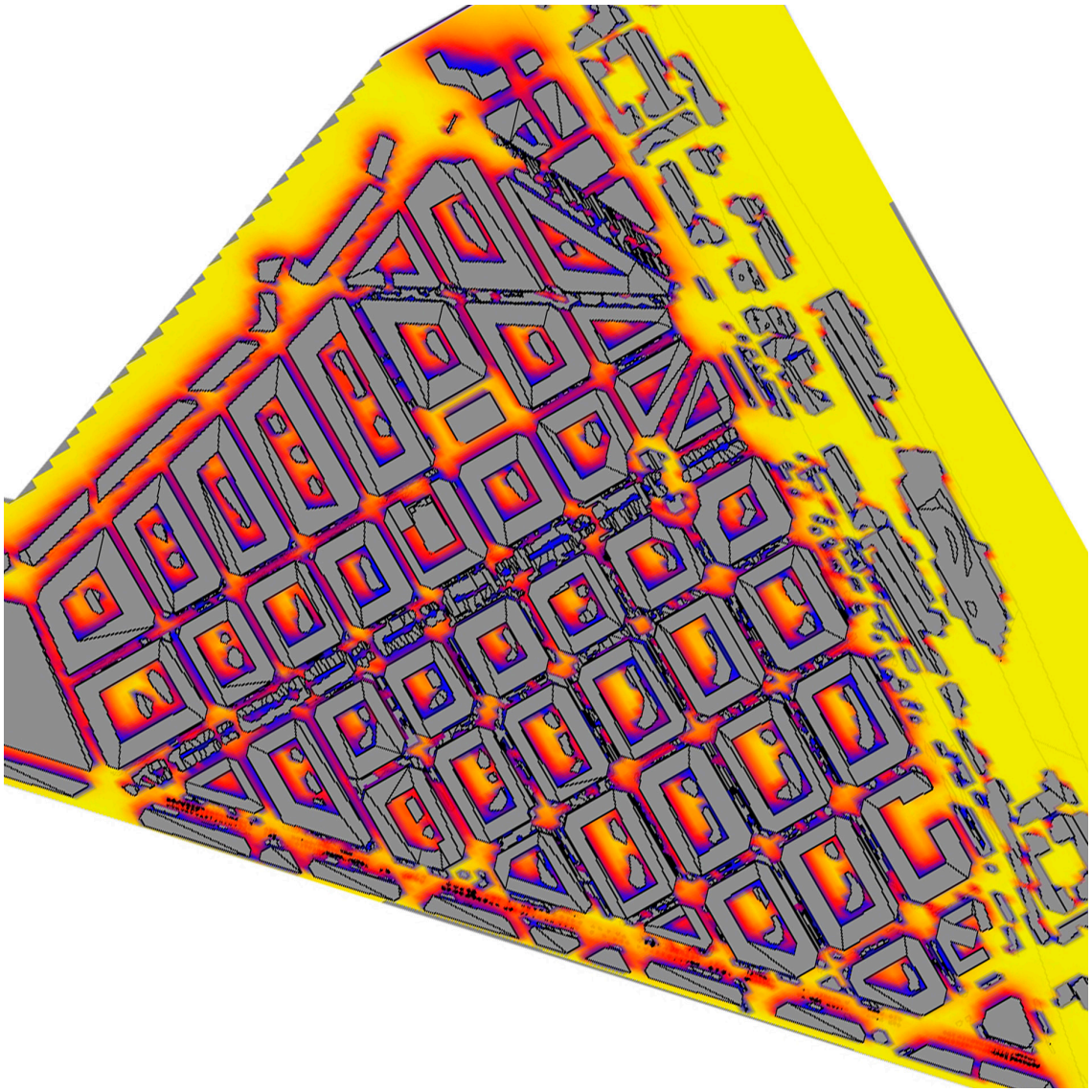

Figure 3. Energy simulation. Watts solar radiation/average hours. on Valencia Ensanche Urban Grid model)

Thus, square blocks roofs are really easy to be improved by solar panels, where energy could be used both, electricity or water heating generation. Last improvements told, are to be included in an active solar gains strategies rather than passive solar once.

Despite 45 degrees streets orientation was not an energetic goal in the original Ensanche Master Plan, it has homogenized in some way the energetic behavior. There is not a south façade so much better than another north one that penalize the grater and the worst orientation. It is important to point up, that every square block is made by many buildings, which conforms its administration function.

Internal Gains. This is the most efficient bioclimatic strategy. If we do not waste the energy made by occupation and activity levels by inhabitants, lightness or home appliances, it is possible to reduce 36,3% of the heating energy needed in winter times. This result, has been unexpected one, and realizes the importance of the passive house system as a real possibility, even on Valencia soft climate.

This strategy seems to be far away to take part on urban planning consideration, in a first stage it could be true, but not if we stare beyond. If we try to stop leaking energy by the thermal envelope, we will be requiredto improve thermal isolation and airtightness as

a main parameters to upgrade in our buildings. It is true that almost everyone will accept that point of view as real, and thousands of energetic certificates in Valencia are wright at the same point. Although, the way of improve strategies are completely failing at one extremely important issue, the lack of urban scale comprehension of the metter. Spanish energetic certification law, encourages citizens to have their certificates flat by flat, forgetting that dwelling cells are part of a higher entity called building, which belongs into a higher urbanentity such as square blocks with patio inner space, that finally draws Ensanche urban morphology. Changing glasses and frames quality on exterior walls in a flat or even in a building, will affect only partially for the energy need improvement, because there are too many surfaces that are exchanging energy with other flats or buildings. Energetic simulations commonly takes an adiabatic function for those surfaces, in order to be operative, but that is not them real behavior.

When we study energetic needs in the correct scale, the city appears as a hall matter comprehension. The benefits of focuses isolation and airtightness improvement with the whole urban entity, such as square block is, is not only in an energetic direction, it generates an economical benefit too. While hundreds of neighbors participate as a group in the same strategy, economical numbers begins to be realizable and sustainable.

Sun shading. Only by using correctly sun shading strategy, it is possible to reduce 11,5% of energy needed in summer time, which means more than 1.000 hours a year in Valencia. This strategy fails again when we study it in our analyzed Ensasnchemorphology. Narrow urban canyon casts shadows on façades, but it is especially true when the sun goes down, just in winter when the sun heating is welcome. Summer days and middle day hours, are heated without any urban shade projected, so it is need to protect the sun on the window plane after come into inner spaces.

Urban vegetation plays an improvement role at that point. Green structure in El Ensanche, has too different behaviors, a positive one on streets environment quite well solved and another and another on the inner square block patio completely forgotten of green structure. Streets green canopy are solved with enough caduceus tree cop in almost every way, specially giving shadows over the pedestrian urban line. Only fails where streets crosses on chamfel place, here buildings increases their façades separation opening small places of heating sun just on road pavement where trees cop cannot arrive. (fig 4)

On the other hand we have inner square block patios, those urban areas have been always forgotten from any kind of structured vegetation, only sometimes a neighbor individually decides to vegetate a small place on a terrace surface. However, almost every roof surface is built with hard finished material, leaving under its structure commercial inner spaces.

Transform those patio surfaces in green areas, would benefit neighborhood in several directions. In addition to reduce sun heating with sun shading green vegetation, we are able to adapt a useless place in a pocket park requalified urban area. Certainly, urban life on Ensanche is really needed of this kind of urban space. Its lack of green, open and near relationship spaces, would be enormously fixed with the uses of this forgotten surfaces. Moreover, it will not suppose a huge extra money , attending to the many neighbors sharing this small green area.

Conclusion

El Ensanche urban morphology, was not projetced to reduce energy needs and energy consumption as a main goal to achive. Calvo, Ferreres and Arnau Master Plan, was projected to solve many other urban problem, specially how to absorbed Valencia huge population growth, at the end of the XIX century, and it focused the powerfulon every hygienic matter more than energy issues.

Although, we have detected some unexpected goods and at the same time we have contrasted other expected failures, proposing environmental and energetic strategies in order to save some of them. The main energetic benefit, has been the original idea of turn 45º the urban grid. We have illustrate, how that

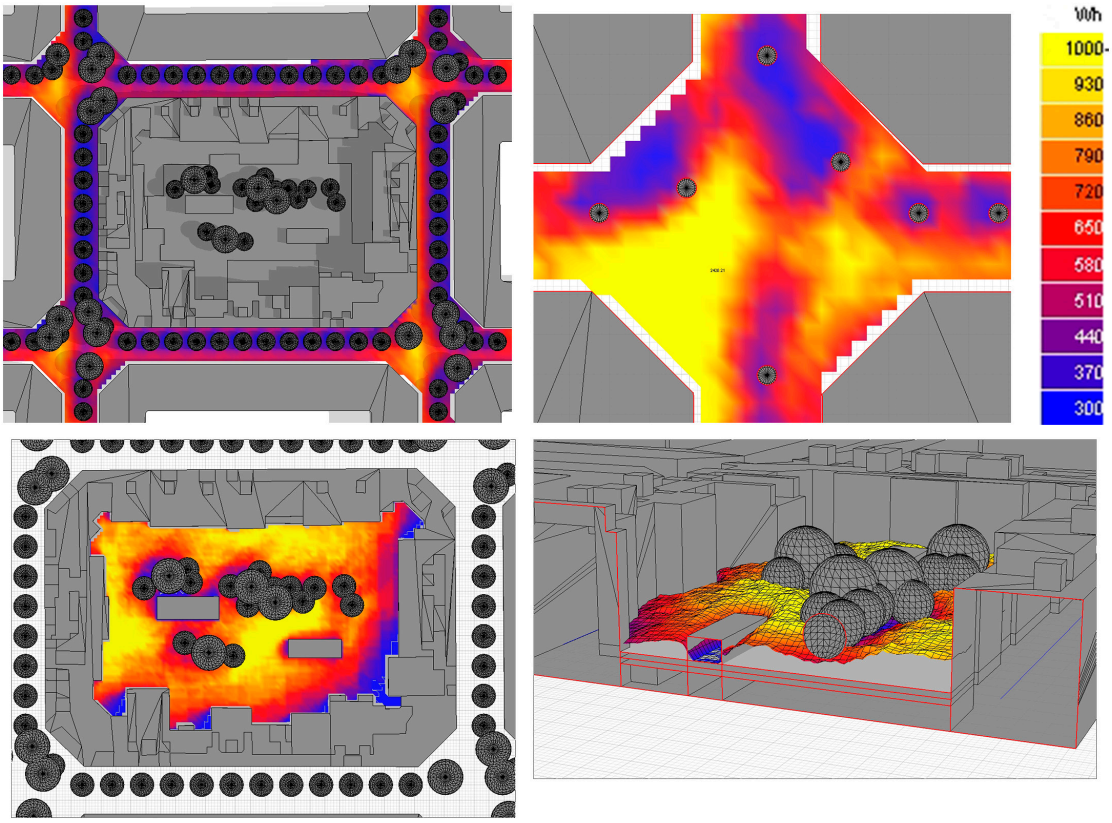

Figure 4. Energy simulation. Watts solar radiation/average hours. on square block Ensanche model

urban grid gyre distribute equal sun radiation, without punish any square block façade too much. However, it is impossible to extract all the sun radiation benefits when we are studding a square block urban grid such as El Ensanche, because of the narrow street canyon prevent it. Finally, it would be both social and environmental solution, transform inner square blocks patios in green urban structures, getting out several urban benefits, with an small economical effort.

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