SUSTAINABLE CONSTRUCTION OF PUBLIC SPACE:

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Key words: water, green, materials, atmosphere, energy.

Abstract:

This research stems from the need to know how to build a sustainable public space, without compromising the resources of future generations and ensuring existing resources.

The research is a reflection on criteria to build an efficient Public Space : a harvester, manager and optimizer of the resources for the city with the minimum resources.
Thus, public space becomes not only a social-leisure place but also a vital organ for the city as if it were a living entity; a living entity with vital functions such as: recovering the water cycle, managing it according to our needs (drainage, harvesting, transportation, etc. ..), harvesting and managing energy resources reducing its consumption, preserving green ,optimizing life cycle of the materials used in its construction or reducing the climate impact in the atmosphere as much as possible.

The article is a summarize of a major research. It's just structured under an environmental responsibility point of view. It's divided in 5 areas or resources: water, green, subject, energy and atmosphere. Each area has two different parts. The first one analyzes the general concepts and quantifications which are always a study case (by experts or Phd researchers) or a real monitored case. Once it's demonstrated the effectiveness of these general concepts, the second part is about the construction systems that respect these concepts. These construction systems will allow us to build this smart public space for the city.

This reflection is a regard of the public space construction from another point of view, thanks to the seed and the concern that others have cultivated and shared before.

Bases for the research:

First of all I'll define some *general concepts*, which are the foundations of this article.
The first concept, "Public space" has been considered as open areas ,at least, in one of the sides of their enclosure, accessible to all residents and users ; spaces of public use and domain.
A second basic concept is "sustainable development" **:** Dr. Gro Harlem Brundtland, described "sustainable development" in the Brundtland Report (1987) as a process of change in which the exploitation of resources, prioritization of investments, the orientation of technological and the institutional reinvention match the present and future social needs.
Thus, the combination of two concepts "sustainable construction of public space", is based on the following principles (based on the criterion of Kibert, 1994, Professor of Sustainable Construction at the University of Florida):Resources harvesting; Resources conservation; Resources reusing; Recyclable, Renewable, Recycled Resources Utilization in construction; Life cycle management of the raw materials used considerations, with the prevention of waste

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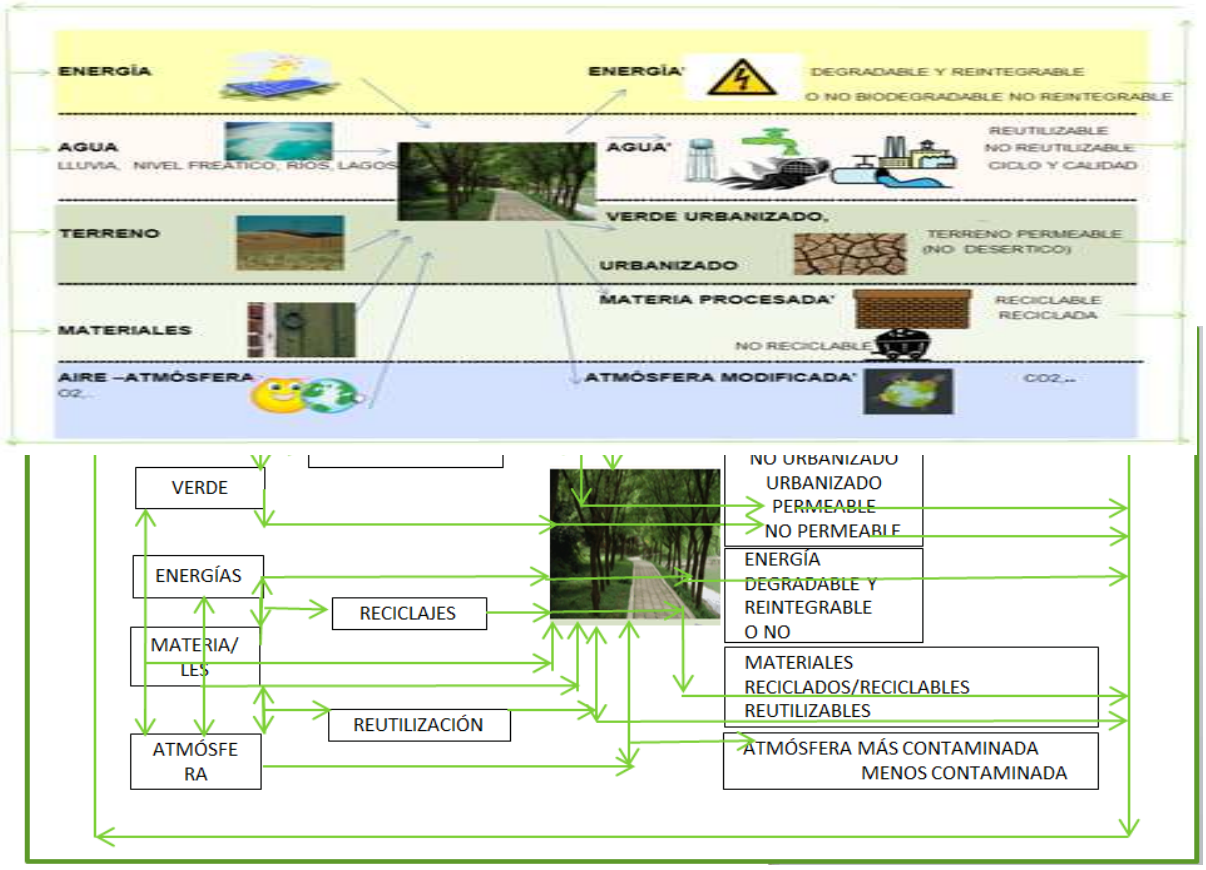
and emissions; Reduction of the energy consumption; Environmental Protection: quality improvement of the urbanized environment and comfort.
These principles apply not only in construction but also in their use for optimizing urban scale resources.The main concept is to transform the linear cycle construction Public Space in a circular construction in a circular cycle to achieve the "Reincarnation of resources".
The following schemes explain graphically, how to transform the linear cycle of Public Space construction into a circular one, including the concepts of Recyclability, Reusing and Reduction (the three “R”)..
Figure 1: “The reincarnation of the resources for public space V.1.”



The water is collected is stored in public spaces, transported to the rest of the city through irrigation canals and waterfalls generate for uses such as mills. The construction of these spaces is done without diminishing the resources of future generations. In fact, in the twentieth century Shustar falls were used by the new electricity factory inaugurated by the Shah of Persia.

Figure 3: Shustar Waterfalls and mill.


Source: Google Earth.

1.Water.

1.1. General Concepts: study cases for water.

The first area to analyze is water. If the Who predictions for 2050 are true, in 2050 the 70% of the people who live in developed countries will do so in urbanized areas. [1]

It's not necessary to jump to 2050 in order to find water problems in urbanized areas. In 2013, we can already find some related to water such as: water scarcity, floods or environment changes.

Water scarcity happens when the hydrological balance of the city is negative, it means that inhabitants consumption is higher than the aquifer recharge of the city. Then, if the phreatic level is lowered, construction pathologies can appear due to differential settlements in buildings.

Floods happen when the precipitation rates show heavy rain that can't be drained with the traditional drainage systems, water becomes a problem and emergencies then might not be assisted. Occasional flooding can also happen if the drainage system is not prepared for the current requirements of any city (due to its population growth, etc..)

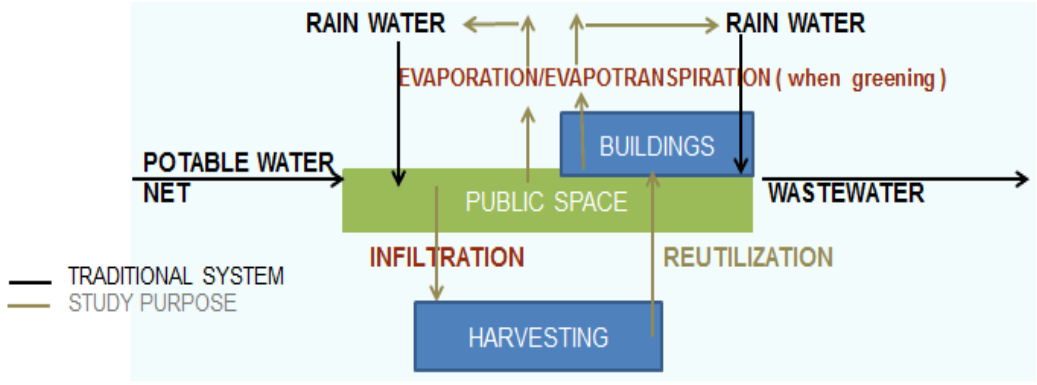
Environment changes inevitably happen when we urbanize. First of all, we break the water cycle when we urbanize. The surface, the city skin becomes mainly impervious. According to the studies of Dr. Coupe, S.J. ,in highly urbanized areas, a 95% of the rainwater becomes run off to drain, and only a 5% goes to the aquifer reserves. In not urbanized areas, the percentage is reversed. In not highly urbanized areas, a 70% becomes run off and a 30% goes back to the aquifer reserves. Another environmental change is due to the climatic change that happens when we change a surface that allows the evapotranspiration (evaporation and transpiration) and we build a surface that doesn't allow this evapotranspiration and it's impervious.

Could it be possible then to urbanize and recuperate, at the same time, the strategies that happen in the natural water cycle?. The question means if it would be possible to recuperate : the surface infiltration, the retention of the infiltrated water, to allow this infiltration to arrive to the aquifer , the water harvesting and its reutilization (when water makes the complete cycle). My personal Phd research is about this question, specifically focused on the decrease of water consumption and environmental improvement through sustainable rainwater drainage systems in public space. The study of public space as a harvester of resources, in this case of water, and as an environmental improvement generator for the city of Barcelona (Mediterranean climate) thanks to the use of sustainable drainage systems. To study how to reduce water consumption is a first goal. Barcelona has a quite balanced hydrological cycle nowadays. It has water reserves in the subsoil, to reduce just a percentage of water consumption. However, in May 21th of 2008 a ship with 36.000m3 of water arrived to the Barcelona Port from Marseille.

1. Who, Volume 88. "Urbanización y Salud". April 2010. http://www.who.int/bulletin/volumes/88/4/10-010410/es/index.html

Therefore, alternative water sources are worth to be studied: in this case, the transformation of Barcelona in a water sensitive city regarding the use of water. Studying public space in Barcelona as an alternative of water source harvester thanks to the water sensitive drainage systems, ant the reuse of this water to decrease the consumption drinking water from the public supply is a main goal.
The second goal of my phd research is study how this construction systems affect to the environment, in terms of climate change, surface and global temperature (city metabolism), evapotranspiration and floods.

Figura 3: "Recuperation of water cycle in urban areas"



Source: "Decrease of water consumption and environmental improvement through sustainable rainwater drainage systems in public space in Barcelona" (Phd Research, 2010 .Mar Pérez).
Before tasting it in our Mediterranean climate, it's important to show the real study case of Melbourne, Australia.
Melbourne has reduced its water consumption a 37% in 10 years (it's been monitored) while it has increased its population in a 67%. (Sources:Total Watermark.City as a catchment" [2] and City of Melbourne, getting the Source from the Australian Bureau of Statistics[3]).
A difference with Barcelona is that the water consumption reduction has affected not only to Municipality purposes (cleaning and watering the public space) but also to supply the commercial and residential water needs.
Melbourne strategy is building and monitoring Water Sensitive Urban Design systems in the Public Space to harvest and manage water as a resource for the city. These systems include the Sustainable Water Urban Design Systems amongst others.

2. City as a catchment". City of Melbourne. "Total Watermark. http://www.melbourne.vic.gov.au/ .2008. 3. Australian Bureau of Statistics. www.abs.gov.au

An example is Fawkner Park, in this case the monitored reduction of the water consumption for watering the park has been a 32% or 33% if we consider the green roofs in one of the edges of the park as harvesters, according to the draft of "City as a Catchment" Melbourne Government publication.

1.2. Construction systems for water:

There are some some construction systems that allow the goals exposed before. The following scheme of concepts is based on Ciria publications about Suds, but it has some changes: First of all there are the construction systems that allow the infiltration at the origin of the rainfall. These are pervious surfaces. These pervious surfaces are: green roofs and urbanization systems that allow this infiltration. Green roofs can also harvest water. There are also some urbanization systems that allow the infiltration of the rainwater at the origin which are: continuous pervious surfaces such as pervious pavements and joints; impervious pavements and joints; pervious joints and impervious pavements and impervious joints and pervious pavements. There are also other infiltration construction systems besides of pervious surfaces which are : soak aways and infiltration trenches. And the last infiltration construction systems of the rainfall at the origin are infiltration basins which allow the run off storage and drainage pollutants elimination through infiltration, absorption and biological transformation.
Secondly, we can find construction systems of our city skin that allow recuperate the natural cycle water which are the pervious transportation systems. These systems are : filter and French drains, wet and dried swales (depending on the impervious or pervious soil and/or base of the swale) and filter strips (vegetated wide belts that support a maximum flow of 4,5l/s per ml.).
Finally, there are the passive treatment systems which are: detention basins , temporal harvesting systems of the run off to reduce the maximum flow; retention ponds: 1-2-2m. deep vegetated (above and below of the water) systems that allow the retention of the run off for 2-3 weeks and help to the sedimentation and absorption of the food for the vegetation and the wetlands: less deep than 1,2m. and vegetated.
Some of these systems will be studied in a specific area of the city of Barcelona quantifying, not only the decrease of water consumption or the environmental benefits, but also the Return of the Investment in order to know its economic viability nowadays, and just in case, for a future water crisis.

2. Green:

1.1. Study cases for green:

The **second area of study is "green"**; the second subject to be studied as an element to be considered for our "sustainable construction of public space".
First of all, we'll check the global context of green areas in Spain.The minimum green areas surface recommended by WHO , is between 10 and 15m2 / population ratio distributed proportionally on the population density.
In the specific case, Barcelona has 6.6 m2 per capita and only 15 provincial capitals have an urban green space within the ranges indicated by WHO. Barcelona has 6.6 m2 of green areas per inhabitant; which means less than 10m 2 - 15m2 of green areas per inhabitant recommended by WHO. [4]
Does these green areas have any added psychological and emotional comfort value?. According to Kaplan,R. and Kaplan S. ' Art Theory, 1980 [5] and to Ulrich's Pet Theory,1981 [6], we can find the answer to this question.
Attention Restoration Theory ("Art" by Rachel Kaplan) describes a person as being in several states of attention: directed attention, directed attention fatigue, effortless attention and restored attention. These tasks, that require mental effort. Rachel Kaplan quantifies in her studies that exposure to natural environments and wilderness has psychological benefits including attention

restoration. Thus, “Art” shows how nature can help reduce a person's stress, as well as improve attention. For instance, after medical surgery, patients resting in rooms overlooking trees recovered better than those in rooms with only a view of a brick wall. They experienced fewer complications from the surgery, recovered faster, and asked for fewer painkiller drugs. Similarly, natural scenes can reduce stress before an event. Therefore, according to “Art”, the natural environment has restorative qualities (people are ‘drawn’ to these particular qualities). Psycho evolutionary theory (PET) by Ulrich studies how nature reduces stress reactions and increases positive emotions. His theory studies the psycho-physiological benefits from viewing water and nature.

Another comfort aspect derived from “green” is thermal comfort studied by Dr. Ochoa de la Torre (Etsab,UPC ex Phd Researcher) who quantified the climate comfort, in a micro climatically scale, in green porches (amongst other quantifications) in his Phd Thesis “City, vegetation and climate impact”[7] .

4. Equipo OSE. “Sostenibilidad Local. Una aproximación urbana y rural”. Chapter: “1.1.4. Superficie de zonas verdes urbanas por habitante”. Page 76. NIPO:770-08-129-3.

5. Kaplan, R.; Kaplan, S. (1989). *The Experience of Nature: A Psychological Perspective*. Cambridge University Press. ISBN 0-521-34139-6.

6. Ulrich, R.S., (1979). Visual landscape and psychological wellbeing.Landscape Research 4, 17–23.Ulrich, R.S., and (1981). Natural versus urban scenes: somepsychophysiological effects. Environment and Behavior13, 523–556.

7. José Manuel Ochoa de la Torre. “Ciudad, vegetación e impacto climático”. Ed. Erasmus Ediciones. 2009 Pages: 146,147,148,149,150 y 151. IBSN: 978-84-936973-3-5

He quantified the temperature of a pavement under a green porch and without the green porch, both cases, in summer and winter. The difference between the green porch shaded pavements in summer and the non-green porch shaded ones achieved 20ºC and, 4,2ºC in winter.

In the same research we can find quantifications that reveal that green is not such an effective as an acoustic isolation “material”. Thus, it’s not a relevant acoustic comfort resource.

2.2. Construction systems for green:

As specific construction systems that respect these principles we have the following ones: green facades, which absorb CO2 and they can isolate between 1-5ºC to the building. (Source: Patrick Blanck and Biofiltex España for instance); inside green facades: they refresh microclimates due to the fact that 0,64Kwh is produced per every evaporated liter(Source : Urbanarbolismo[8]); vertical green filters in buildings: they can decrease the temperature 7-8 degrees ºC in summer (source: Intemper quantifications).The UPM research group ABIO-UPM has worked on vertical green systems with Technal that work as vertical sun filters on the windows of the buildings **(**source: Technal and Abio-Upm) [9]; if we take a look at horizontal green filters: according to Dr. Ochoa de la Torre Phd Thesis quantifications, they can reduce the temperature from 4,5-20 ºC in winter and summer respectively and green roofs (intensive and extensive ones): they absorb CO2, they insulate the buildings and they can harvest water .

There are some other benefits to use “green” ; for instance, the conventional grass as green in the layer 0m., a ground surface: It helps to drain, to reduce the temperature of the ground ant of the lowest levels of the atmosphere and it also absorbs the sound in a 20-30%; another less conventional way to use green is as an structure. For instance, bamboo is used as scaffold material mainly in Asiatic countries due to its resistance characteristics. Besides, in Asia it regenerates very easily due to the fact that it grows in wet and hot climate . Slopes can also be covered with green surfaces, for instance: with geocells (to contain the ground and avoid its

erosion), reinforced ground (to contain the slopes and the ground force) , organic blankets (to avoid the erosion of the slope; the material of these organic blankets will depend on the slope and durability) and the urban orchads, which improve the insulation of the building when they are in its roof and reduces its transmittance. When it happens, it reduces the CO2 emissions of the artificial heating and refreshing systems.

8.www.urbanarbolismo.es/blog . (2013)
9." ABIO-UPM Group": "Tecnologías verdes como instrumentos de rehabilitación arquitectónica" Conference.

3. Materials:

3.1. Study cases for materials:

The third area to study in order to build our sustainable construction system *is materials.*

The concept of sustainable materials for the public space construction is based on three principles(1) the life cycle analysis of materials; (2) increase of renewable raw materials and renewable energy in its production; (3) and the reduction of resources, materials and energy used in the extraction of natural resources, their exploitation and destruction or in the waste recycling.

Therefore, sustainable construction materials are those durable and need little maintenance (1.) generated from renewable raw materials and (2.) from a small amount of material resources and energy used to the extraction of natural resources, their exploitation and exploitation, reuse and recycling (3.).

Materials life cycle , according to the Setac (the society of environmental toxicology and chemistry, 1993): "it's the assessment of the full life cycle of the product, process or activity, from extracting and processing materials, manufacturing, transportation and distribution, use, reuse and maintenance, recycling and final disposal" **.**

The objective of sustainable construction materials is to have a more circular life instead of a lineal life cycle, as much as possible (see figures above). The new concepts to get this goal are: durability, recycling and recycled, reusing and reduce ("the three R"). Check: **Figure 2** "The reincarnation of the resources for public space V.2."

3.2. Sustainable materials and construction systems:

There are some data bases to choose "sustainable materials and construction systems for public space" (and buildings as well).

There are some data base of materials and construction systems for the public space construction such as the following ones.

Cradle to Cradle: c2c : cradle to cradle: http://www.mbdc.com/

In the late '80s, Michael Braungart and William Mcdonough conceived Cradle to Cradle, a principle of design that took into account the full life cycle of materials, from extraction and reincarnation. Perhaps an utopia, based on c2c, the Netherlands minister of environment is developing a strategy for the provision of governmental organizations based in cradle to cradle as a criterion for their purchases.This success of cradle to cradle in Holland due to a television film, "Garbage is food" by Rob Van Hattum in 2006**.**

The key concepts of philosophy "Cradle to Cradle" are rooted in the imitation of nature: materials life cycle , materials recycling, renewable energies.

10. Michael Braungart y William McDonough .(2003)Cradle to cradle: Remaking the way we make things. Ed. North Point Press. ISBN 0-86547-587-3

The “mbdc” certification system can be found in http://www.mbdc.com/ . It has four product levels: basic, silver, gold and platinum. all the “mbcd” certified products must accomplish a minimum of each level: health responsibility, materials reutilization, renewable energies and social order and water use and management.

Another data base of sustainable construction systems and materials is “csostenible”:http://csostenible.net/productes/productes/ . It’s a blog created by:the "Environment and Sustainability Unit “ of the”Col • legi d'Arquitectes Tècnics i Aparelladors de Barcelona“ plus the Technology section of “Construccions Arquitectòniques I “, the "Institut Cerdà” and the "Geobiological Studies Association Gea”.

The third sustainable materials and construction systems data base is : “Producto sostenible” born thanks to the eco design studies of the Basque country and the Mondragon University. http://www.productosostenible.net/pags/productos/index.asp?cod=8fd41194-6270-4638-9876-53a08029b7e

A fourth data base is the “Col·legi d’Arquitectes de València” they offer an ecological assessment (parameters are shown in the web) and economic and information about the companies that manufacture the products: http://www.ctav.es/icaro/materiales/materiales_lista_categ.asp?clasificacion=categorias&modo=ecologicy

The last sustainable data base is related to water. It was created by Insmed: it was a project of "European Territorial Cooperation "MED” Programme conducted between 2009-2012, with European funds (FEDER). Its web http://marketplace.insmed.eu/shows an eco-design construction cluster marketplace to diffuse the related innovative technologies in the Med Area.

All these sustainable materials and constructive systems data bases help us to find public space materials and constructive systems to build our sustainable public space.

For instance, we can find benches and basins made by recycled glass: security pavement and children playing game areas made with recycled rubber; benches, containers, pavements and bins made of recycled plastic and acoustic panels made with automotive carpets. There are also recycled arids that can be used as sub bases materials for routes, etc…

4. Energy.

4.1. Study cases for energy.

The *fourth area* to build our sustainable public space is *energy.*

Renewable Energies Development Plan in Spain (2000-2001) is the development of renewable sources of energy . It’s one of the key aspects of national energy policy, for the following reasons: it’s an effective contribution to the reduction of emissions of greenhouse gases, particularly CO2; it’s the largest share of renewable energy in the energy balance reduces our dependence on petroleum products and diversifying our sources of supply to promote indigenous resources; the Spanish policy of these energies is contained in the Development Plan of Renewable Energies in Spain (2000-2001), approved by Resolution of the Council of Ministers of December 30, 1999.

Electricity production systems using alternative sources of CO2 emissions avoid to produce the power to heat the water which generates steam under pressure to move mechanically coupled

to the turbine generator to generate electricity (combined cycle). It is estimated that 39% of the global emissions come from the electricity
The Plan provides for the following types of energy: Electricity generation, such as wind, hydropower (<10 a.3. Solar thermal), solar PV and secondly, heat utilization such as low temperature solar thermal, biomass, biogas, biofuels and energy recovery from municipal solid waste.
Renewable energy that can be applied in an urbanization project written and directed by architects in Spain.
Renewable energies applicable to public space and on which an architect can develop in a public space project and direct in the construction yard are mainly related to the generation of the electricity produced by solar PV (Solar Photo Voltaic Energy amongst all the listed before).

We can also build construction systems (i.e.: porches) based in electrical energy produced by non- polluting sources, such as: wind (Windbelt case) or by the piezoelectricity phenomenon. The use of a specific type of lighting technologies (e.g.: LEDs)are also be subject to this study in the specific analysis of building elements for the public space, as they contribute to lower power consumption.

4.2. Construction systems that follow a Renewable Energies Plan:
There are some specific construction systems that follow the Plan of Renewable Energies proposed by the Spanish Government (http://www.minetur.gob.es/energia/desarrollo/EnergiaRenovable/Paginas/Renovables.aspx).
First of all let's see some photovoltaic solar energy construction systems. Lighting of public space can be made by solar light is a traditional lamp to which is added a solar panel, a battery and low energy fixture adapted to run on solar power. Here we have some examples for public space electrical systems fed by alternative energy sources, such as PV panels: "Solar tree" by Artemide (www.artemide.com . It's a photovoltaic urban streetlight with the battery under the bench to sit), signage such as traffic signals with PV source and battery (and leds that allow their visibility at night) or traffic lights with PV panels that can be an additional or an independent energy source. There are larger scale lighting systems such as large PV pergolas like the one built for the Barcelona 2004 Forum. This "pergola" is at the newest part of the city, the end of the Diagonal street , the edge of the city.It has a total area of 5,704 The Great Central Total PV has 10,700 m2 and 1.3 MW of power is, it can meet the needs of 1,000 homes. The electricity produced by this structure represents an annual reduction equivalent to 440 tons of CO2 emissions.
There are other alternative energy sources for lighting such as the solar floor called "Solar Road" (www.solarroadways.com). It's project born in Holland. The bike pavement, built with concrete of 1.5 by 2.5 meters, is a top layer of glass an inch thick. Underneath that layer of tempered glass are the crystalline silicon solar cells that collect energy from the sun. "Solar Road" generates 50 kWh/m2 per year for domestic and street light uses. There are other projects that aim the electric cars plug source to be supplied with renewable energies (such as PV systems).

There is another alternative source to be considered for our sustainable public space which is wind . There are researches like the "Windbelt", a device that converts wind power to electricity

through a magnetic field that generates the power (www.humdingerwind.com) . There are also , the popular mini wind mills .
Another way to produce electricity without polluting is the piezoelectricity . It's a phenomenon presented by certain crystals . It happens when they are subjected to mechanical stresses. Then ,they acquire an electrical polarization in its mass, popping a potential difference and electric charges on its surface. This electricity caused by this physical phenomenon has been use for several applications (for radars in the roads, for lighting floors then they are stepped, etc…).

5. Atmosphere:

5.1. Study cases for atmosphere:

The *fifth* and last , but never the least, *area of study is atmosphere.*

Climate change is the environment modification regarding a global or regional scale. Such changes occur at very different time and over all climatic parameters: temperature, precipitation, cloudiness, etc.. In theory, are due to both natural and anthropogenic causes.

The Convention United Nations Framework on Climate Change climate change uses the term only to refer to human-caused change "Climate change" means a change of climate which is attributed directly or indirectly to human activity that modifies the composition of the global atmosphere and which is an addition to natural climate variability observed over comparable time periods.

The Greenhouse effect is a term used to denote the fact that the short-wave solar radiation can easily pass through the atmosphere to the earth's surface as a part of the resulting heat is retained in the atmosphere for long waves reflected back to the outside can not penetrate as easily in the atmosphere, especially when there are clouds coverage.

Another important environmental impact is the effect of a particular human action on the environment in its various aspects. One of them is the ecological footprint. The ecological footprint is a measure of human demand indicator which makes putting the planet's ecosystems in relation to the Earth's ecological capacity to regenerate its resources. It represents "the air or water area ecologically productive (crops, pastures, forests or aquatic ecosystems) needed to generate the necessary resources and also to assimilate the waste produced by each given population according to their specific way of life, indefinitely ".

Regarding these concepts we have some study cases. One of them, by Albert Cuchí is " Informe Mies" [11] .It gives us an idea of the proportion of the impact of CO2 emissions in the construction of the building just to transport about users of the Centre: The report quantifies the CO2 tones produced in the Vallés Architecture University construction (4555 Tones; 150 Tones /year) and the CO2 transportation to the school students emissions/year (715TN). The proportion is a 20%. Nowadays it's possible to quantify the CO2 emissions of a public space construction system in Cataluña, thanks to the Itec (Institut de Tecnologia de la Construcció de Catalunya. www.itec.cat) budget database, which quantifies the CO2 budget emissions of each material when you make the economical budget.

~~11. Albert Cuchí, Department~~ of Architectural Technology I. Escola d'Arquitectura del Vallès. Isaac López Caballero. Scholar student of the Mies Project .1999. "Informe MIES". ISBN: 84-7653-870-7. http://www.upc.es/mediambient/

Another study case is “green as a CO2 sink”. A carbon sink or CO2 sink is a natural or artificial reservoir of carbon, which absorbs carbon from the atmosphere and contributes to reduce the amount of CO2 from the air. A carbon sink is not intended to reduce emissions of Co2, but to reduce its concentration in the atmosphere. Trees, oceanic plankton and peatlands, the main natural sinks of the planet, are essential for the carbon cycle.

The Professor of Ecology at the University of Seville, Dr. Manuel Enrique Figueroa Clemente and Dr.Susana Gómez Redondo, doctors in Biology from the University of Seville, in their book "Los sumideros naturales de CO2" [12] (The natural CO2 sinks), quantify the amount of CO2 that can be absorbed by some trees and shrubs, especially Mediterranean species. In their study shows the characteristics of the trees for which we calculated the amount of CO2 they set. Some of the most effective are: the Melia azedarach, that for every 10 fixed 5.969 Melias kg.CO2/yr. = 10,373 cars /day; the Jacaranda, which sets1832 per 10 Jacarandas kg.CO2/yr.=1405cars/day. As for shrubs, the most significant are: the durum, which sets 46kg. of CO2/yr, equivalent to 77 cars / day, the palm, which sets 40kg.de CO2/yr, equivalent to 63 cars / day and specific use of algae: volume of 1.5 m³ could absorb as much CO2 Q1.
Some specific construction systems that regard the CO2 low emissions are materials with CO2 savings. For instance: Rubber for safety flooring: 11.34 Kg CO2/Kg. pneumatic saved in the construction equivalent to 58km. Run by a conventional car.
or Recycled Plastic: 1.5 Kg.CO2/Kg. plastic saved in the construction equivalent to 7.7 m. Tours of a car.
This reflection pursues to build a more effective public space in a more efficient way becomes collector and manager of resources. We can try to recover the water cycle, manage it according to our needs (drainage, harvesting, transportation, etc. ..), harvest and manage energy resources reducing its consumption, preserve green and take advantage of its psychological and thermal comfort, optimize life cycle of the materials used in its construction or reduce the climate impact in the atmosphere within certain limits.

This reflection is a regard of the public space construction from another point of view, thanks to the seed and the concern that others have cultivated and shared before.

12. Dr.Manuel Enrique Figueroa Clemente and Dr.Susana Redondo Gómez.2007. “Los sumideros naturales de CO2. Una estrategia sostenible entre el Cambio Climático y el Protocolo de Kyoto desde las perspectivas urbana y territorial”. Ed. Muñoz Molina Editores Extremeños. I.B.S.N.: 978-84-8019-165-4.

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SUSTAINABLE CONSTRUCTION OF PUBLIC SPACE: a reflection on criteria to build Public Space as a harvester, manager and optimizer of the city resources. It is based in the analysis of 5 elements: water, materials, green, energy and atmosphere. It's a reflection of how to build the public space under an environmental responsibility trying to improve its metabolism, comfort , resources and habitability. This public space becomes a vital organ of the city that helps the strategic growth of the se living entities, the cities.
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