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**Designing Ecological Urban Shapes
Water as Conductive Wire**

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Professor and Researcher

**MAP-Maacc: Laboratory of Modeling for assistance in
cognitive activity of design -UMR 3495-CNRS-MCC**

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Abstract

Architecturology is a scientific french field of research in architecture anchored within the cognitive and the design sciences.

Specific to the field of architecture, Architecturology offers a scientific systemic language that describes how shapes and measurements are attributed to the architectural and/or urban space. It primarily serves to implement research methods by which examining cases of architecture and urban space design, with the aim to explain the cognitive operations undertaken by designers to conceive their shapes.

This paper presents an outline of these research methods implemented to understand the ways in which it is possible to design ecological spaces. It is built on previous works which draw kinds of identity cards on the possibilities to consider ecology in giving shapes and measurements of future space. These works decorticate pioneer texts of Sitte, Cerdà and Unwin and show that, even before an awareness of issues related to environmental protection and sustainability, theories of urban design took into account this dimension. They also explain how Hammarby Sjöstad, GWL terrain, the neighborhood of Vauban and Bedzed were eco-designed.

The study analyzed here is the current typically French case of *Sénart*, a New Town close to Paris, within which diverse eco-neighborhoods are in design.

Methods of collecting and analyzing data are explained and the first results are presented. It shows how the requirements and perspectives of regional policies are involved in the design, what are the mechanisms for judging architecture developed in these cases and what are the preferred cognitive operations of designing ecological urban spaces. It also identifies the mechanisms of cooperative and collaborative design involved in these cases and approaches the analysis to the Pattern language of Alexander and his team.

Key words: Eco-conception, Architecturology, cognitive operations of conception, designing shapes

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Introduction

« Sustainable design » is nowadays largely used as a label to promote new products. In France, with the work of the Grenelle Environment, the new rules and the national strategy on sustainable Environment, architecture and urbanism are impacted by sustainability. Each project, regardless of its scale, must be sustainable and must respect environment. But, what does it mean to be sustainable and to respect environment for an architect? How the space must be designed to be sustainable and to respect environment? That are the questions that this paper approaches in order to explain what we can call *eco-conception*, i.e. architectural or urban design including ecological relevancies within its process.

This proposed definition of the concept *eco-conception* is built on the hypothesis that sustainability and environment respect can be achieved in architecture and urbanism by designing in a specific way with ecological data.

To enlighten these two questions, we have chosen to explore a case through a french scientific field of research on architecture called Architecturology. This scientific field is presented in the next section of the paper. The case studied is the development of eco-neighborhoods in the French New-town of *Sénart*, located in the Parisian Region. This case is presented in the section following the one on Architecturology and opens on first results and a discussion. These first results show how water is primarily taken into account as a conductive wire in urban *eco-conception*.

Architecturology

Architecturology is a scientific French field of research initiated by Boudon in the 70ies and developed within his team called LAREA (Laboratory of Architecturology and Epistemological Researches on Architecture) until 2005, and since, within the MAP-Maacc (Boudon 1992) (Lecourtois 2011).

Based on the principle of epistemological break of Bachelard (Bachelard 1934) and operating from the disjunction between scientific object and natural object made by Canguilhem (Canguilhem 1975), Architecturology has built its scientific object with the question: How do designers give measurements to their projects? To build scientific tools by which enlighten this question, Architecturology examines also the viewpoints of Zevi (Zevi 1959), Focillon (Focillon 1934) and Panofsky (Panofsky 1967) and questions architecture as it proceeds from cognitive activities by which shapes and measures are assigned to a future space.

So the scientific object or Architecturology is architectural *conception*, i.e the cognitive activities by which giving shapes and measurements to the space, evoked above.

The scientific tool built by architecturology to explain architectural *conception* takes the form of a scientific language composed with concepts describing the different possible ways by which giving shapes and

measurements to space from an ecological viewpoint (Lecourtois 2013). This scientific language is used as a grid of reading of collected data about architectural conception, by which it is possible to detect the cognitive operations of conception of the design process.

In the precedent work we have done about *eco-conception*, we have shown that ecological data can be included within different reference domains convoked to implement cognitive operations of conception (Lecourtois 2012) (Lecourtois 2013). The first step was to study the texts of Unwin, Cerdà and Sitte in order to show how, at their respective epoch, they had an attention about ecology in urbanism. Ecological data were mentioned by these three urbanists within three major reference domains or urbanism: geography, economy and parceling. For them, density, economy of means, respect for nature, the integration of nature, the use and benefit of geographical data, etc. are all components of ecological urban area or urban *eco-conception*.

From this observation, we have analyzed the French state requirements about eco-neighborhoods design. These French state requirements are expressed in terms of eight goals: 1) Inserting the project harmoniously in its environment, 2) Rethinking the density / Choosing the shapes of housing, 3) Saving energy in buildings, 4) producing and consuming renewable energy, 5) Controlling the costs of construction and development, 6) Focusing on alternative modes of travelling, 7) Ensuring social, generational and functional diversity in the project, 8) Encouraging the establishment of economic activities in the area (ground floor and / or lots reserved).

The architecturological analysis of these goals shows that ecological data must be integrated within urban eco-conception through the three first reference domains evoked above and four others: the function, the model, the technics and the vicinity. Accessibility, models of the diversity sizes and status buildings, system of energy production and of the management of resources, the continuity of the network, regionalism, etc. are also important for urban *eco-conception*.

The second step of the work was to study four eco-neighborhoods to precise the architecturological model of urban eco-conception: BedZED, GWL Terrein, Hammarby Sjöstad and the Vauban neighborhood. This work was to identify architecturological identity card for each case, ie to list the cognitive operations of conception implemented for each, relatively to the reference domains implied in their design process (Lecourtois 2012). The models obtained allow to compare the design process of these eco-neighborhoods and to build a new general scientific model of the cognitive process of urban *eco-conception*.

For example, we have found that the parceling has been systematically minded but in specific ways for each case. The cognitive operations of conception implemented relatively to this reference domain aimed at preserving the existing frame rail system, densifying the territory and privileging the “green” modes of transportation (cycling and walking feet) or the public transit. At BedZed the parceling is accompanied by a Green Travel Plan which leaves little space for cars. At GWL Terrein, the car is parked on

the perimeter, freeing the feet of buildings and public spaces, leaving space for the revegetation of outdoors. At Hammarby Sjöstad, the division of space follows the ground once built and the building height is limited to 5 floors to avoid the suburb aspect. Finally, at Vauban, the parceling and the planning emphasize short distances (between the houses, shops, kindergartens and other services) to make all accessible by foot. The sense of short and pleasant distances by feet was evaluated between 300 and 700 meters. Space is saved (up to 20%) by the installation of collective garages near the area. Small bike parking in front of buildings were also designed. Finally, the plots are created relatively small size and allow focus on architectural diversity by multiplying the architectural interventions without forcing aesthetically.

Even if we did not find all the reference domains in each case, we have made clear our urban *eco-conception* model by including all those that have been implemented in the design process. For us urban *eco-conception* is to implement in design, cognitive operations of *conception* built on reference domains including ecological data in order to eco-parceled the project, i.e., from our analysis : the geography, the economy, the function, the space models, the technics, the society, the culture, the vicinity, the visibility.

Cognitive operations of *conception* is for us a scientific concept that means mental operations that allow to give shapes and measurements to space by linking a measurement support (element of the project like a length, a shape, a radius, a height, a side, a distance, etc.) with a reference domain in a relevant way. They can be : 1) to choose a reference domain to refer to, 2) to cut the project in different measurement supports and/or 3) to give size to the measurement supports by a relevant link. All this constitutes what we call the complexity of the measurement in architecture. The architecturological concept of Scale has been built to explain it.

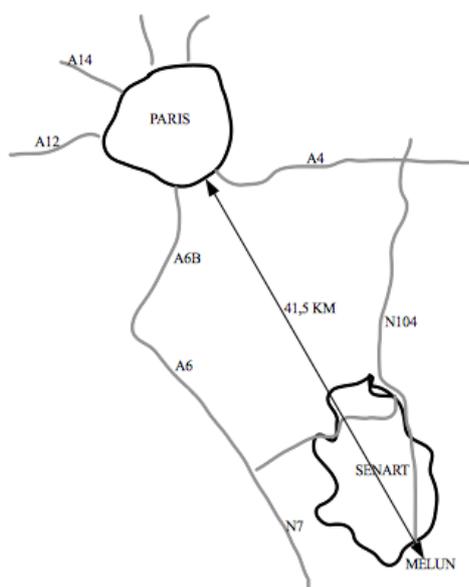
So, our research on *eco-conception* points that taking account the sustainability in urban design has an impact on the data of the reference domains from which measurements are given. In other words, it implies a new mind of the existing reference domains but not include a new specific reference domain that could be the ecology.

The existing reference domains have been identified to the number of 21 by architecturology: the geography, the geometry, the human size, the economy, the function, the models, the technics, the society and culture, the vicinity, the visibility, the optics, the formal symbolic, the dimensional symbolic, the integration, the globality, the representation, the level of conception, the cartography, the parceling, the semantics, the evolution. The reference domains impacted by *eco-conception* are those evoked above.

From these studies, we have decided to question new approaches aiming to build sustainable urban spaces in order to pursuit our initial knowledge on *eco-conception*. We have chosen to analyze the projects currently developed at *Sénart* (a French New-town located in the Parisian Region) because of their relationship with the project of the Grand Paris and their “Row Controlled” name of *éco-quartier*.

Case Study and First Results

Figure 1. Schema of the situation of Sénart in the Parisian Region



Sénart is a New-town created in 1973 and composed with 10 municipalities: *Combs-la-Ville, Tigery, Lieusaint, Moissy-Cramayel, Réau, Saint-Pierre-du-Perray, Savigny-le-Temple, Nandy, Cesson et Vert-Saint-Denis*. It nowadays has 108 000 inhabitants on 126 km² (Fig. 1).

The specificity of *Sénart* is to be composed at 75% with green spaces. Sustainability is one of the major words of its development. Within each project, water, green spaces and green paths (for bike or on foot travelling) are the heart of the *eco-conception*. This situation is in contradiction with one idea of the sustainability that is to promote the density to do not waste space and economize means and resources.

Our analysis tries to explain the cognitive operations of *conception* implemented in the urban *eco-conception* of *Sénart* and shows our they are specifically linked with the treatment of the main problem of sustainability : the management of water.

Several eco-neighborhoods are currently under study within the municipality of *Sénart* in order to densify the urban space : *L'eau Vive, la ZAC de la Clé Saint-Pierre, Chanteloup, Le Balory, Plessis-Saucourt*. For each project, the *EPA* of *Sénart* (Public Establishment for the development of the new Town of *Sénart*) organizes its actions around the four major dimensions of urban sustainable planning: the environment, the social, the economics, the citizen participation.

This analysis proceeds from the interviews of principal actors of the *EPA Sénart* realized in 2012 december and informations collected in some publications of this institution (*EPA Sénart* 2011 and 2012). The communication of the projects focuses on the creation of new urban shapes and

of innovative public spaces. Our question aims to explain how they have been conceived.

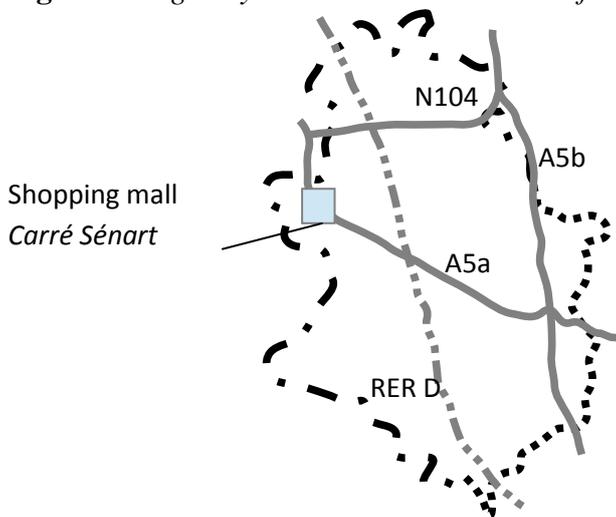
Global Urban Eco-conception of Sénart

All these projects concern the urbanization of a new space in between existing urban spaces. The connection and the continuity between the old and the new neighborhoods are the first goal of the projects. These connection and continuity are treated through the design of the networks (streets, roads, paths, energy-giving, etc.), of the public spaces and of the architectural *modenature*.

Concerning the networks, roads, streets and paths are defined from the layout of the existing roads, streets, paths and the stations (railway and bus). A mesh is designed in order to develop the green displacements (pedestrians, bicycle, roller, etc.). The Bus is an important key of the global conception of the urbanization of *Sénart*. New bus lines have been recently introduced (2011) in order to limit the individual car displacements and to solve the problem of lack of parking spaces around the Bahn stations.

Sénart is crossed by the Bahn (RER D) that connects the municipalities of *Sénart* together, to *Paris* and to *Melun*. It is also crossed by two Highways (A5 and N104) that create a strong road network joining *Sénart* to the airports, to *Paris*, and to the East and the south of France (Fig.2).

Figure 2. Highway's and Bahn's Networks of Sénart



Concerning the bus network the problem to solve is to connect the center of *Sénart* (*Carré Sénart*) with the RER stations of each municipality on one hand, and each neighborhood of each municipality to its RER stations on the other hand. This should limit the individual displacements and the use of cars.

The question of the networking implies a collaborative work in between the diverse municipalities of *Sénart*. If each municipality manages its networks

(road, street, paths, buried), their continuity on *Sénart* supposes to create connections in between each municipality. These connections can not be properly thought without an agreement between the actors of the management of the networks: municipalities, New Town Trade Union of Sénart (SAN) and the General council of Sénart. A Green Travel Plan has been established to better manage these networks.

The work on the mesh of the various modes of transportation proceeds from a functional scale. This architecturological concept designates the class of the cognitive operations of conception by which providing a measurement to a piece of the project, corresponding to some external element that sets the destination, the use, or adapted it for a use. At *Sénart*, a work on the ways to go from one point to another (the site to *Paris*, the site to *Melun*, the site to *Carré Sénart*, the site to the RER stations), by bus, cycle or afoot is developed. Public and/or green modes of transportation are developed as a priority with the creation of new paths and bike parking. Nevertheless, it does not fully work and too many people use yet their own car to get around.

Concerning the architectural *modenature*, the model of the traditional architecture is rethought under modernity and the use of sustainable materials. A local plan constrains the urban design by imposing the heights, the *épannelage*, and things like the percentage of parking and of green space. The *EPA Sénart* gives also some little instructions about the architectural *modenature* to the promoters of the projects as to respect or not a model, to include flat roofs, the ways to treat the green spaces and the water.

The rural character of the existing *Bourg* is as much as possible maintained. The work about architectural *modenature* is coupled with the social dimensions of the sustainable development and the citizen participant. In Architecturology, these reference domains correspond to the implementation of a socio-cultural scale, i.e. taking account conventions, traditional shapes or other socio-cultural heritage to give shapes and measurements to the project.

For example, the design of the eco-neighborhood of *Sénart* called “*L'eau Vive*” includes the construction of an operation of grouped habitat. This operation is inspired by the experience of the residential building of Pluspunkte Haus B realized within the Vauban neighborhood at Fribourg in Germany. It comes to imagine and to create Buildings Low Consumption (called BBC in France: *Bâtiment basse consommation*) with the future inhabitants: here, 12 wooden houses and a common room. This operation implies new relationships between the actors of the projects and new social relation between the inhabitants that will share common spaces to live. This operation is called: operation of *auto-eco-construction*. It is coupled with the creation of shared gardens. This collaborative work is supported by a cooperative called *Habitats Groupés Ecologiques* and the *EPA Sénart*. It is made with an architect specialized in eco-construction and the implicated inhabitants have to work to build their houses.

This socio-cultural scale has also been implemented in the urban design process through the implementation of techniques of citizen participation. Workshops gathering the members of *EPA Sénart* (architects and urbanists),

the elects of the municipalities and transport companies for the development and enhancement of the territory have also been realized.

One technique of citizen participation developed here is the listening at home by which the inhabitant viewpoints have been collected by professional and elects of the municipalities. This technique aims to build cooperation between different actors and to collect different kind of data to engage the urban conception.

Cooperation is for us one of the activities of collective design. It's different than collaboration, coordination or communication that are the three other activities of collective design. By cooperation, we mean a collective activity aiming the production of a common object or project within which each actor has his own role and his own tasks (Soubie and al. 1996).

By collaboration, we mean a collective activity conducted at several within which the actors work together, at the same time, to solve common problems of the project or the conception of the object (Allwood and al. 2000). By coordination, we mean an activity of iterative adjustment of the results of individual activities by the communication between the actors.

So here, we can say that the urban conception proceeds from cooperation of diverse actors that supposes moments of coordination and tools of communication.

The implementation of this socio-cultural scale driven by sustainable design has then led to think of a new lifestyle centered on community life, friendliness, calmness, meeting and the promenade. So lots of public spaces are conceived to allow this: landscaped square, playgrounds, shared gardens,...

The architectural *modenature* proceeds also from an economical scale, i.e. regarding the costs (of manufacturing, of management, of consumption) of the project to imagine its shapes and measurements. To minimize the impact of the project on the environment and to promote the diversity of the inhabitants, the architectural shapes will be compacted and gathered with houses on the roofs, balconies, garden level. The biodiversity will be architecturally built with the diversity of the inhabitants and of buildings.

We also find consideration relative to the implementation of a geographical scale in the urban conception. The bioclimatic approach takes care about the orientation and the strength of the winds, the rainfall, the sun path, etc. The work on the public spaces results from this bioclimatic approach.

The choice of the tree species and of the vegetation of the public space is also thought from a technical scale, ie using technical consideration to give shapes and measurements to the project. It must: allow an easy maintenance, participate to the water regulation and to the friendly atmosphere of *Sénart*. This technical scale is also implemented by: the use of materials with low environmental impact for the lighting and the urban furniture, the reuse in construction of existing materials (silts, demolition concrete), and the reuse of the rainwater. The worksites are organized to respect the environment by limiting the risk of nuisance, the pollution, the risks to the health of workers and the waste management.

The urban design of the eco-neighborhoods of *Sénart* is also thought through a temporal scale implemented in relation with an integrating scale with the realization of the master plan. *“To carry out all the pre-operational technical studies, it is necessary to plan in time the progress of operations and the rhythm of realization with the economical capacity of the municipalities.”* said Ph. L. of *EPA Sénart* interviewed in 2012 december (*EPA Sénart*, Ph.L. 2012).

This planning with time must be thought relatively to the ways to connect the neighborhood with the existing. In other words, the realization of the neighborhood must start with the network (buried, road, street and paths) and the construction of the plot close to the existing urbanization. This way of thinking allows the future residences a better and faster integration into the local life. It also helps to think of the evolution of the construction and of the progressive integration of the equipments and shops in order to not perturb the existing running.

All the eco-neighborhoods projected aim to create a new housing supply constituted with private and public (social) accommodations to diversify the inhabitants and build the diversity. *Sénart* had been developed as a countryside town, mainly made up of private individual houses. It is no longer appropriate to the inhabitants of *Sénart* that some would like to buy an apartment, not more than to *Sénart* itself that needs to host people of various socio-professional categories: low categories on privileged zones and high categories on other social zones. The goal is to rebalance the population. This proceeds from what we call in Architecturology, a socio-cultural scale, i.e. taking care about the lifestyles to give shapes and measurements to space.

This socio-cultural scale has also been at work to think of the activities of the future *Sénart*. The question was to create jobs on site. Office buildings and 14 business areas have been included in the global projects. A specific *écopôle* is created to host companies of power generation, concerned by energy efficiency, mobility and flow management. Diverse parks have been created for small and medium businesses or small and medium industries and others existing, have been reconditioned following the sustainable requirements. These reconditioning consist in designing new public spaces with landscape, public lighting and new public furniture. It is also to connect the business areas with the urban zones by rethinking the networks: especially by creating new pedestrians and cycle paths, parking and bus stations.

The public space is the main object of *EPA Sénart* because it is what it can master and what gives the atmosphere of the neighborhood. Ph. L. of the *EPA Sénart* speaks about it, in these terms: *“It's the theme of great concern in these early phases of urban design process. We wonder how much space will be created, what quality we will be able to give to the public space to create the identity of the new neighborhood. The public space is what the developer can master the most because the buildings and constructions are mastered by someone else, which we will try to frame but not to constrain... Then, after, and that is just fine, diversity moves...”* (*EPA Sénart*, Ph.L. 2012)

The Water in the Projects of Eco-neighborhoods of Sénart

The *EPA Sénart* acts therefore as a developer preparing the architectural design process by commissioning pre-operational technical studies on hydraulics, traffic, air studies, biodiversity (fauna, flora), etc. These studies are realized by consultants. The *EPA Sénart* designs the schema of the neighborhood and prepares the documents of specifications including all the environmental requirements, for the consultants. The schema is a kind of indicative master plan that presents the segmentation of the neighborhood with habitat, activities, equipments and all the connections, roads, pedestrian and cycle paths. This master plan is realized with the municipality by cooperation: the *EPA Sénart* proposes and realizes the master plan and the municipality discusses it for modification.

What we have found is that all the projects are organized around the management of the water. The principal idea is to realize public waterworks ensuring storm water. Flood plains and basins which remain permanently in water are conceived to offer qualitative public spaces in period of low water. These flood plains and basins are landscaped in order to allow public activities as walking, ball games, cycling, etc.

Each eco-neighborhood is conceived to focus on a water management limiting soil sealing.

The maximum infiltration of rainwater will be sought. The treatment of rainwater to the plot is privileged. An ecological continuity through the landscape is therefore planned.

“Our operations are designed according to an alternative water management. In fact, water is retained up on the plot (housing or collective operation) and we try to find the natural flow of water to access to the brook without realizing a buried network infrastructure. The goal is to retain water to allow the direct watering of the gardens and create a network of channels that depending on the rains will be in charge or infiltrate as in its way. Therefore we do not conceive the city as most of the land that we will sell to developers. We have a more comprehensive reflection of the overall flow of water that ensures that once the water meets public spaces, it must find a use.” said J. A. of the *EPA Sénart*, interviewed in 2012 december (*EPA Sénart*, J.A. 2012)

Consequently, the urban *eco-conception* of *Sénart* is strongly linked with the water management. This way of designing gathers the architects and urbanists of *EPA Sénart* with external landscapers and is conducted around 5 specific architecturological scales: technical scale, functional scale, geographical scale, socio-cultural scale, integrating scale.

The geographical scale of this way of designing concerns the existing watercourse and the relationships to establish between them and the project. The natural flow of water is considered in order to strengthen it. Connections

between the existing watercourses and new basins are imagined in order to associate them to the new water *couloir*, cycle and pedestrian paths.

Then this geographical scale is coupled with a functional scale that consists in giving a social rôle of the water *couloir*: the promenade and public activities. This functional scale concerns also the creation of an ecological corridor allowing fauna and flora to be continuous. This ecological corridor supposes that the watercourse was not broken. So, it implicates a thought on technical system allowing to connect all the elements of the watercourses.

In other words, a technical scale is inevitably implemented in this way of designing (to urban eco-conceive with the water management). The first action of this scale is to find system to infiltrate the rainwater at the plot. Two kinds of basins are then possible: flood plains (hollow green spaces) and basins which remain permanently in water. Following Ph. L, “*water can be treated in a very technical way: it's a hole, put a fence around the water issue and it is set*” (EPA *Sénart*, Ph. L. 2012). Regarding to the biodiversity, it is not satisfying. So, a system of pipe has been imagined in order to connect in the underground, the water elements of the projects.

The creation of flood plains results also from the implementation of a socio-cultural scale. As written above, the global urban eco-conception of *Sénart* is based on a ideal new lifestyle centered on community life, friendliness, calmness, meeting and the promenade. So the flood plains are imagined in order to allow this atmosphere and landscaped for the family promenade.

At last, we can say that the urban eco-conception organized around the management of the water results from the implementation of an integrating scale. *Sénart* is not crossed by the *Seine* river and is not a seaside resort nor a port area. In Brief, water is not naturally extremely present on the site (Fig. 3). However, the New Town of *Sénart* has early been designed around the management of water and the nature including a base of leisure. Basins and lakes had been created and the waterways and their banks highlighted. Nowadays, this work is maintained and served the sustainability.

To complete this architecturological analysis, I would like to return to the involvement of the geographical scale in the eco-design process. We have seen that this scale is predominately used in sustainable design. It consists in establishing important geographical data to take into account to conceive sustainable spaces. In sustainable design these data can be: the biodiversity (of the flora and the fauna), the water, the nature of soils, the sun, the topography and the climate (the rainfall, the temperature, the wind).

All the projects of *Sénart* are prepared with diverse studies including a landscape study. This landscape study aims to establish the geographical data. In the projects, the data relative to the sun and the climate help to work on the orientation of the project at different scales: at the level of the urban design, at the level of the landscape design, at the level of the architectural design and at the level of the interior architecture.

Figure 3. Water on Sénart (<http://www.senart.com/cartographie> 2012 may)



At the level of the landscape design, the wind can be taken into account for the orientation of the basins, the choice of the tree species and the organization of the landscape itself. For example, screens trees can be associated to some public spaces in order to mitigate the effect of the wind. At the level of the architectural design, the data of the sun and of the climate are included in the organization thinking of the islet and of the buildings. The orientation of the buildings is really important concerning energetic performances. To join these energetic performances, the buildings must be protected to the North and more open on the south...

So this example of the geographical scale shows the existing complexity of the design process at different levels of design.

Conclusion and Discussion

The urban conception of *Sénart* is a complex activity within which diverse scales of development are implied: the scale of the *Grand Paris* (connection

with the project Grand Paris at 30km and the creation of a new TGV stations), the scale of the *Grand Pôle* (Connection in between the surrounding municipalities), the scale of *Sénart* (with its 10 municipalities), the scale of the in-between of the municipalities of *Sénart* and the scale of the municipality of each project. The complexity of the urban conception is reinforced by the enactments of regulatory of each scale of action and of the sustainable development.

We have seen that eco-conception at *Sénart* implies different architecturological scales at different levels of design and especially geographical scale, technical scale, socio-cultural scale, functional scale and integrating scale. These scales can be inspired from the models of eco-neighborhood studied before (BedZED, GWL Terrein, Hammarby Sjöstad and Vauban neighborhood) but are specifically implemented within the conception of eco-neighborhoods through the question of water management.

A new architectural scale seems to be at work in eco-conception: a temporal scale that consists in planning the project with time in order to include in design the ways to connect the new neighborhood with the existing and to not perturb the functioning of the town.

Moreover, we have discovered that eco-conception implicates new ways of working based on cooperation on one hand and collaboration on the other hand, including new actors of the projects: inhabitants (auto-eco-construction) and the elected officials.

Regarding now our results relatively to the work of Alexander and his team (Alexander and al. 1977), the case we have analyzed tackles especially four patterns: 25. Access to water, 51. Green streets, 52. Networks of paths and cars, 56. Bike paths and racks.

The realizations treat the question of access water by preserving the water's edge and including public spaces for common uses. But here, the water management is more complex than only to allow the physical access to water. It implies new system to collect rainwater to reuse it (for watering the gardens, for the toilets, etc.) and a thought on the natural infiltration in the soils.

All the eco-conception of *Sénart* is based on the idea to preserve the atmosphere of "the city in the countryside". Green streets are then designed and the roads are landscaped. This conception allows to limit the use of concrete and asphalt that have adverse effects on environment. The integration of green streets raises the question of the different modes of transportation required on the site, their junctions and their atmosphere. It is then also a complex level of design.

Each eco-neighborhood of *Sénart* is designed by considering the relationship to establish between cars, bus, trains, pedestrians and cycles. The networks of paths, rail way and cars are then meshed in order to allow multi modality. The aim is not to separate each mode of transportation but to ensure their cohabitation. Networks between diverse modes of transportation are then a complex object to design.

This problem of networking raises the question of the treatment of each path and road. A specific thought had to be developed on the bike paths and

racks in order to keep every body in secure. On *Sénart*, the bike paths are separated from the road by a green strip but sometimes, it is not enough.

Moreover the question of bike parking is not solve and racks have to be designed and included along the paths and at noodles between different modes of transportation (bus, RER stations). Only one has been created today... Finally, if sustainability is important to the urban design of *Sénart*, it is not alone shaping the city....

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