



HAL
open science

For an ecological approach to architecture

Grégoire Chelkoff

► **To cite this version:**

Grégoire Chelkoff. For an ecological approach to architecture. First International Workshop on Architectural and Urban Ambient Environment February, Feb 2002, Nantes, France. 1-12 p. halshs-00378393

HAL Id: halshs-00378393

<https://shs.hal.science/halshs-00378393>

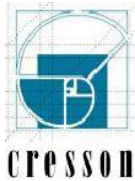
Submitted on 24 Apr 2009

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Pour citer ce document :

CHELKOFF, Grégoire. For an ecological approach to architecture : perception and design. First International Workshop : Architectural and urban Ambient Environment, Nantes, 6-7-8 Février 2002. Nantes: CERMA, Ecole D'architecture de Nantes, 2002, 11p.



Grégoire Chelkoff est architecte, docteur en Urbanisme, professeur à l'école d'architecture de Grenoble et chercheur au Laboratoire Cresson UMR 1563 Ambiances architecturales et urbaines, Ecole Nationale Supérieure d'Architecture de Grenoble / www.cresson.archi.fr

For an ecological approach to architecture : perception and design.

Gregoire CHELKOFF
Laboratoire CRESSON, UMR CNRS 1563
School of Architecture of Grenoble

Theme of the workshop : theory on architectural and urban ambience, reference and referenciation

Key words : ambience, affordances, effects, formers

Several works of research that we have conducted in our laboratory (CRESSON) have aimed at understanding the ambient milieu (among which sonic and optic environment) through one's experience. These works encourage us to consider an "ecological approach to architecture" which takes into account human, sensitive and social experience *in situ*. This approach is useful for a qualitative design of ambient environment in a sensitive and cultural way. It aims at identifying different types of referential situations through potential « formers » that characterise them and find their origin in perceptual ordinary experience. Standing close to what implies an architectural projection of space and built form, it could modify the cognitive attitude in design relatively to ambience. This approach gives importance to potentials of perception and action that an environment can afford to users and questions the criterias on which we can do specific physical measurments on qualitative dimensions. But it also questions the aesthetic criterias that are involved by active uses and the embodiement of « references » that guide architectural thinking.

In a large definition, ecology is a multidisciplinary approach to the study of living systems, their environment, and the reciprocity that has evolved between the two. It leads to distinguish physical reality from a perceptual reality. Our analysis focuses on the active relation we can have when practising the built structures and using its environmental potentials. Walking, sitting, talking, all our practices of architecture awake and use perceived ambient factors like sound, light and heat. Although many works show links between architectural spaces and social uses and teach us some important facts, the role of ambient factors is not clearly taken into account. Many works about environment psychology tend to define criterias based on assessment (*good or bad, pleasant or unpleasant, etc.*) and effects on behaviors. Our approach does not aim at showing the effects of environment on judgments or behaviors (in that respect, it is not behaviorist). Rather we try to show the modalities by which the reciprocity between man and environment is experienced in different architectural forms in order to inflect projectual thinking.

We are interested in following the questions :

Pour citer ce document :

CHELKOFF, Grégoire. For an ecological approach to architecture : perception and design. First International Workshop : Architectural and urban Ambient Environment, Nantes, 6-7-8 Février 2002. Nantes: CERMA, Ecole D'architecture de Nantes, 2002, 11p.

- how is perceived and structured an ambient environment, and how does it involve our action in every day life ?

- how could knowledge on this issue inflect architectural and urban principles of conception and their references ?

Our investigation of current urban or architectural situations (among which public spaces, underground spaces, but also dwelling) consists in describing it with pluridisciplinary tools. Many methods have been conceived to get information about perception but also physical measurements and observations, all these operations *in situ*. This contribution does not consist in discussing these methods. It is to show how we can extract some regularities in the structures of sound or light which are amenable to characterise places for people and to explain some principles which could interest projectual tools and argue references. The central issue is to perfect a problematic and a method that can help us to finely differentiate ambient milieu, while identifying the most determinant elements. In that sense, we are lead to discuss different categories of analysis like *effects*, *affordances*, *formers*. We will briefly explain a few references and their respective importance for this approach ; it will situate concepts that are useful in this kind of study. This approach is indeed inspired and awakened by several works of research in different domains such as that of perception or of sociology and architecture.

Starting from a few examples belonging to the fields of sonic environments and optic structures, we will explain these categories of analysis. The restitution of these exemplary configurations is of course difficult but it is an important issue at stake. Our examples particularly concern transition or change between different contexts and phenomena that help us to orientate in an environment and categorize it. These cases are important in current life and as units of structuration in architectural composition : identifying an ambient milieu and its relations with others is a basic and inevitable issue, it is one of important lever for projectual thinking. The other major question for designing is the question of coherence of an ambience ; it is an adequation between uses (that imply mental state) and material frame.

Rules

A few preliminary remarks must be noted about the description of existing or future situations that tend to use ecological method.

- The architectural division through space and function is less valid if we take into account ordinary experience. When we consider ambient milieu, another division arises that depends on the flows of light or sound structures and on other stimuli. Criteria of composition can therefore be researched and confronted to the spatial one.

- In a great number of cases, the « point of observation » must be closely examined. Sometimes this point of observation is evident, but it is often reversible. This is important in an ecological approach : it shows that an architectural layout has different potentials regarding to the relation between man and environment.

- Spatial scale is defined by a local situation which is significant for human's perception. It is relative to body and direct perception. It is an interesting scale of ordinary experience and also for architectural conception. That's why we particularly examine some sections or sequences that make sense in experience and are

Pour citer ce document :

CHELKOFF, Grégoire. For an ecological approach to architecture : perception and design. First International Workshop : Architectural and urban Ambient Environment, Nantes, 6-7-8 Février 2002. Nantes: CERMA, Ecole D'architecture de Nantes, 2002, 11p.

memorized. These built compounds may become units of analysis and design or may be taken as reference through analysis. An architectural compound is functional and ambiantal ; it can be an aperture, a transition, a place to sit, etc.

- A characteristic of an ecological approach is that the time dimension of experience must be considered. The duration of a transition must be for example noted and events are of course important : they reveal properties of the milieu and changes its appearance in time. Architectural components can be considered through their potential of appearance in time and through the transformations of global structure. This aspect inflects the imagination of forms, introducing time at different scales.

- Our interest for an empirical experience of architecture rather than to its representation and symbolic dimension leads us to consider the relation between perception and action. For numbers of physiologists, the brain transfers its intentions, its predictions, onto the world, and they are linked to action which is itself planned. According to this principle, action is seen as a fundamental resource of our knowledge about the world (Berthoz, 1999). We can then suppose that an ambient array (light, sound, tactile) is precisely arranged (configurée) according to action.

- Although perception is accurate, everything is not necessarily perceived. An approach of perception in situ does not imply describing all things but these ones which are significant to qualify and build up our relation to the environment.

*

Let us start with an example (photo 1). This is an underground gallery of Les Halles in Paris (Chelkoff & Thibaud, 1997). This gallery is not a long one, it links two parts of this underground complex, so it is a transition rather than a real place. Walking at normal speed, passersby cross it in a few minutes (about 3). We could call it a « compressor » because of several properties that are congruent.

1

This apparently anodine example leads us to interrogate the composition of the immediately perceived ambiance. It is not easy to qualify what makes the unity of an ambiance in a lived situation characterised by an architectural space and a context of use. Can we numerate the elements which are efficient ?

This situation can be described through different characteristics that constitute the ambient array in different sensorial registers : sweltering heat, a long reverberation time and a sonic mass that never stops, a gap of the optic array in two ranges of luminescence, the motion of objects (passersby walking) in the low part of the optic array, opposite to the ceiling. It is a rather saturate ambient milieu in most of the sensitive registers ; it strongly requests all the senses because of the important information density and its concentration in time.

We know this brief description is not complete (what could it mean ?). What is most important is that the composition of different sensible phenomena creates an identity of ambiance. In that sense, this configuration can be called *compression* because it is a common rate that characterizes kinesic space, sonic environment, thermal surrounding and optic array. This congruence is due to a combination of events that reinforce the presence of surfaces : heat of the lighting and light itself,

Pour citer ce document :

CHELKOFF, Grégoire. For an ecological approach to architecture : perception and design. First International Workshop : Architectural and urban Ambient Environment, Nantes, 6-7-8 Février 2002. Nantes: CERMA, Ecole D'architecture de Nantes, 2002, 11p.

first sonic reflexions on the walls, motion of objects that you must avoid. These elements are « formers » of the lived ambience and they translate a compressive tendency that is perceived during crossing time.

We must point out that this quality is lived and experienced : in this particular context, passersby's main concern is to go ahead and to find one's direction (underground, this concern with orientation is an important thing). We usually control the floor on which we walk. If we look at the surfaces and more particularly at the ceiling and at the ground on this photograph, we see that the view of the walking surface is masked by other passersby, and that the ceiling is entirely seen, up to the end of the gallery. In this case, the observer can change of referential to walk and anticipate his route. The ceiling then becomes the map of the floor because it is an optic support for walking, it is a guide to follow. This fact is particularly compensatory in a sonic environment which is indistinct, ubiquitous, dense, and also in a restrictive space of self-motion. Here, we understand how walking can shape an ambient array and how the observer can swing to another frame of reference.

More generally, it appears that users' strategies of navigation in such public spaces use the elements of the environment that are adequate to action.

More particularly, this example reminds us the importance of the ceiling and asserts that it must be an object of design.

This example also shows how necessary it is to articulate several levels of analysis in the ecological perspective we defend. It requires to specify links between different sensible phenomena, architectural forms and human behaviors from which we are able to interpret and appreciate an ambience.

2 3

After this sequence in the *compressor*, the passerby crosses a small airlock (photo 2) and reaches in a *regulator* that several characteristics tend to make « relaxing » (photo 3). This passage combines optic and sonic changes. Suddenly, a new frame is given to objects and sounds. This change is characterized by wavering events that make objects and sounds seem slower.

We will not pursue here our description, but we must remark that this abrupt transition brings luminous and sonic formers into play. So it is not only the result of a sensible effect in one register but a combination of several transformations that influence our potential of action (visual affordances, sonic hold, space reserve). That's why we think that « sensible formers » are not only based on the appearance of sensitive events. They involve affordances which are evaluated, regarding to social context and individual intentions. It therefore seems an interesting way to analyse urban and architectural situations : sensitive dimensions and behaviours are linked to our social and cultural knowledge.

Here we must explain how different categories can be used in an approach that gives importance to sensitive experience.

Effects, formers and affordances

Effects

Pour citer ce document :

CHELKOFF, Grégoire. For an ecological approach to architecture : perception and design. First International Workshop : Architectural and urban Ambient Environment, Nantes, 6-7-8 Février 2002. Nantes: CERMA, Ecole D'architecture de Nantes, 2002, 11p.

The notion of *effect* (Augoyard, 1995) refers to a perceptual process that results from circumstances, it is the manifestation of a phenomenon which comes with the existence of an object. It has been defined essentially for sonic environment and some of us have tried to transfer it to other sensitive registers (Chelkoff et Thibaud, 1992, Balez 2000). It is a useful category for qualifying the perception of an environment in each sensitive domain which keeps its own logic. Effect is applied to sensible environment phenomena (sensible effects), it does not necessarily need to be related to built forms because it considers a result, a perceptive quality. Effects qualify perception, that is to say a relation to environment, an aesthetic experience of it. Of course, it is possible to seek examples to show how effects work in urban or architectural environment : for exemple the sonic effect of cut, which is the most evident one, has been illustrated by forms that tend to produce effects of cut. But this effect can also work independantly of a built form (a sound stops suddenly). Other sonic effects are difficult to link to the conception of built forms : for example remanence, sharawadji, crenel, because they essentially depend of perceptual and active processes. These ones allow to explain hearing experience but it is more difficult to use as criteria of design. In consequence, we could say that the first kind is equivalent to « former » and the second kind is not.

Formers

The vocation of the notion of *former* is to establish a direct relation between forms (built, material) and « events » happening in **different** sensitive fields that translate forms. A former links built forms to events, and to a certain extent, it does not distinguish them. So, when we use this notion, it is to define this mutuality relation . What we consider as formers, are those events that reveal objects under a certain sensitive form.

What is important in order to define an ambience, is that, sometimes, some of these events contribute to inform **in the same way** about environment, or structure it in a common configuration.

For example, an aperture can be sensitized by the visual frame on a landscape, in the same way, it can be structured by sound : sound is coming from these patches of light. This also means « aperture » relatively to other sounds in the room. It could be air that is coming into the room, the former is then « air coming into the room from this place», it forms an opening because we know it by experience.

The notion of former invites us to question what it means to *form* a door, a corridor, a passage, a courtyard ? Of course this kind of question deals with all sensitive potentials and not only the eye and the category of space.

This notion should be particularly operative to conceive spaces within ambient environment because it can't be defined without material forms, it requires to consider details of forms to understand how it interacts with energies and action. Thus, it is a notion which is close to the process of space composition because each

Pour citer ce document :

CHELKOFF, Grégoire. For an ecological approach to architecture : perception and design. First International Workshop : Architectural and urban Ambient Environment, Nantes, 6-7-8 Février 2002. Nantes: CERMA, Ecole D'architecture de Nantes, 2002, 11p.

architectural component can be analysed as a sensible former of ambience, as we try to demonstrate it.

Affordances

On this issue, it's impossible to ignore the theory of « affordances » by J. J. Gibson (1979). In this last case, aperture is formed by different sensitive formers and it offers going through (itself), just to see or hear or smell. All these opportunities of action are *affordances* which could be suggested by sensitive information. This notion refers to animal (human) abilities. It is an important notion because it involves taking into account different kinds of actions : motion, speaking, etc, and more accurately, the details of these actions that are socially and culturally significant. For the founder of ecological psychology, medium, substances, surfaces, objects and animals, offer these affordances for an animal. What is afforded are behaviors. In other words, it means that we pay attention to what objects or events allow us to do, that is to say to their affordances. As Stoffregen (2000) emphasizes, affordances exist only in the context of an animal-environment system, whereas events can exist outside of animal-environment systems. As noted by other authors (Waren and Shaw, 1985), what distinguishes affordance from physical properties is that the former is evaluated relatively to an intentional act whereas the latter are not. An affordance cannot be measured as we measure in physics, they have to be measured relative to the animal (J.J. Gibson, 1979, 1986). There have been many empirical studies on this notion, but we can note that spatial characteristics are principally taken into account relatively to human abilities. They are concerned with abilities of action like the passage of an aperture, the interception of an object, stair climbing, etc.

Relations between the senses

This last notion calls on a question : which are the elements in the ambient array that allow us to identify affordances ? This question is an important one for ecological psychology : what kind of invariants, within the different structures of ambient energy, (i-e optics, acoustics, mechanics) give information on affordances ?

A recent hypothesis has been formulated and stipulates that these pieces of information exist in the relations (i-e co-variation) between different sources or forms of energy (Gibson, 1966 ; Stoffregen & Bardy, 2000). One could identify patterns in the energetical structures that specify the relation between an animal and its environment. In other words, information specifying affordances could exist in the configurations and changing the flows that cross different sorts of energy.

This hypothesis is fundamental because it allows us to explain ordinary experience. Considering how the environment is lived, although each sense is not equally important, it seems that relationships between the senses are as important as what each sense conveys separately. In some situations, paradoxes or coherences between different senses can be improved. In the dynamical time of experience, relations between the senses may be modified and we can swing to another sensitive referential in order to get the information which suits our intention and action.

The swing from a sense to another may be induced by events and their

Pour citer ce document :

CHELKOFF, Grégoire. For an ecological approach to architecture : perception and design. First International Workshop : Architectural and urban Ambient Environment, Nantes, 6-7-8 Février 2002. Nantes: CERMA, Ecole D'architecture de Nantes, 2002, 11p.

combinations. We can use different sensible formers to adapt our perception to action.

These ideas lead us to theoretically understand how a plurisensorial environment could be put into a configuration in relation to action and how architectural structure could call or suggest it. This allows us to wonder how architectural forms can awake sensible configurations and, conversely, how ambient environment can inspire built forms.

Ambient formers and architectural forms

- An ambience is not the sum of components, that is to say, of different sensible effects that are equivalent and separated. It is not the sum of signs or sensitive events that compose it. It seems that certain tensors attract and structure the ambient array, give it a form on which it is judged, appreciated, and which confers significance. Among the various sensitive signs that compose the ambient environment, some take on more importance than others and play a role of « clutch » to arrange the perceived environment. But it is not only the most intensive elements that play this role, our attention can confer an importance to what is useful for intention. In that sense, they are potential. An ambience is notably articulated through specific formers that reveal and polarize it, by different sensorial resources that can converge.

- If the origins of formers lies in sound, light and touch or thermal phenomena, we must make clear that they do not correspond to all perceived events and to all stimuli. It is particularly observable in the ambient array : a former is a combination of ambient flows or energies, of built forms and active perception, as we said earlier. It is the result of a linkage between events and built forms which is perceived when adequate for use and when it gives information about the environment.

This is an important point regarding to architectural design which aims at creating specific ambience. In the designing process, we can explore what is designable (forms and material) through what it could become as a sensible former in experience. To see the consequences of ambience on understanding built forms, we need to go to the roots of phenomena.

If an architectural layout appears or is interpreted by different sensitive registers, it is not necessary to describe all of the items that compose it, it is even impossible. There are « lines of force » that characterise an envelope and which are selected according to the experience of this context. An architectural layout is observable and concretely experimented through « sensitive formers » which liven it up when we use a space.

Power of transformation

A former is active, only if it allows to transform the sensitive matrix of the perceived environment. It is extremely important to acknowledge this ability to create, to substitute reality.. It links built form which is represented by visual codes to « sensitive form » which is reactualized in time by events, it is perpetually renewed.

Pour citer ce document :

CHELKOFF, Grégoire. For an ecological approach to architecture : perception and design. First International Workshop : Architectural and urban Ambient Environment, Nantes, 6-7-8 Février 2002. Nantes: CERMA, Ecole D'architecture de Nantes, 2002, 11p.

Architectural form is therefore not only a reacting filter for physical signals since phenomena transform it through different states. To a certain extent, there is no differentiation between the architectural element and its sensible signature. It becomes a former of ambience because its sensible signature suggests a particular configuration.

For example , if we talk in a gallery with an important reverberation time, the effect on voice will be identified as an effect of reverberation, the gallery is sensible through a sonic halo. It is a former just like lateral optic flows signify the proximity of the walls. If light goes off, the contact of the floor under our feet may become a sensible former of this situation and the gallery is then reduced to this former.

So, if one former changes, the whole can change or make us swing to another referential sensitive field. This means that the sensible references from which we structure environment can change because of events that are independent from ourselves, but also by our intention and action. The swing from a « version » to another is as important as each version separately and may depend on the type of action and on other social factors.

Recurrence and stabilization

An architectural layout can interact with events in a similar or relatively invariant way. In this case, ambient process can be stabilized by the recurrence of events. Phenomena are not repeated in the same way but in a narrow range of ways that allow us to categorize them in a class of manifestation. This recurrence creates formers. It is a major fact for predicibility. It is therefore interesting to analyse architectural forms through these reproducible configurations.

For example, a wooden floor which makes steps sound and which feels elastic will react in a small scale. It could specify an ambient sequence for the walker or for one who hears another walk. The recurrence of these manifestations can be an active part of a configuration that is predictable and memorized. In this case, the floor, by its mechanical and sonic qualities, *becomes* an ambient former. « Become » is the right word : it is a potential phenomenon that must be activated to reveal a sort of « sensitive signature » of forms and materials.

Memorization

Sensible formers play an important role in the memory of places and routes. They are kept in memory and perpetuate a generic ambience corresponding to one space and not another. Memory is reduced to those elements which are the most significant or essential during the time of experience. Imagery is not only visual. According to interviews, the elements that are recalled by strollers are not only spatial ones. Thus, we are encouraged to think that a part of what is stored in our memory corresponds to ambient formers.

Pour citer ce document :

CHELKOFF, Grégoire. For an ecological approach to architecture : perception and design. First International Workshop : Architectural and urban Ambient Environment, Nantes, 6-7-8 Février 2002. Nantes: CERMA, Ecole D'architecture de Nantes, 2002, 11p.

Categorization

For each of us, an ambient environment is categorized in a class of situation that concerns space, function, and of course social and individual implication. This classification under some « generic » types seems to be based on several factors. Ordinary experience and design use these categories to specify a milieu where they live, or to create that milieu. Categorization is in part built on sensitive elements and we think that formers are a tool to identify and differentiate classes of ambient environment. Categorization is, of course, the result of a social and cultural encoding of sensible formers and it calls specific studies.

Photography of the gallery
of the library Exeter (L. I. Khan, arch.))

This part of the library is clearly distinct from the central one, because it offers a place appart to read. Users can come from the center to this periphery, from the monumental hall to a domestic like gallery.

One of the emerging aspects of the optic array in this layout is the degree of distinction of the surfaces.

We can distinguish different types of optic array regarding to luminous incidences and architectural layout. This composition in several elements of small geometrical dimension and their different luminescence allows us to identify closed topological surfaces, that is to say separate luminous objects. These surfaces are formers because they tranform the initial linear form of the gallery into a crisscross of surfaces. If they did not exist, it would be a simple tube. In this diffracted optical configuration, the eye can follow each object. Although the light can vary, this diffraction is a constant of the optic array, an invariant. In that sense, we can say that the reaction of this layout tends to reproduce in time a characteristic optic array, linking ambience to built form.

In this picture, « domestication » appears . it is sensible by the fact that space is furnished so as to invite one to stay and read, by opposition to the central emptiness of the monumental hall of the library. But the fact that the walls and surfaces reflect natural light in different directions, reduce the bareness of the place. Without any doubt, the lesser reverberation time produced in this milieu because of this change in scale reinforces this domestication of the ambience.

We can here understand how different sensitive formers collaborate to the qualification of ambience.

Referential situations and project

This sort of work affords us the opportunity to identify what we have called "referential situations" : it is not a cultural reference but an empirical one, we can feel it ourselves or it can be restituted by someone else. Referential situations are indeed circumstantial, but, they closely associate architectural compounds with human perception and action and can become a source of transposition when they are close to similar project situations. Designing processes call several « referential situations », that is to say experimented fragments of ambience which help us predict

Pour citer ce document :

CHELKOFF, Grégoire. For an ecological approach to architecture : perception and design. First International Workshop : Architectural and urban Ambient Environment, Nantes, 6-7-8 Février 2002. Nantes: CERMA, Ecole D'architecture de Nantes, 2002, 11p.

what kind of environment is projected.

One can say that describing an existing situation is not the same thing as designing a project and this is indeed true. But on the other hand, someone who can't describe a situation does not really perceive it and will have difficulties transforming it finely. Identifying by which process an ambient environment can be configured is a tool for qualitative design.

We try to apply these principles to studies meant to establish a qualitative program of transformation for architects. These experiments have allowed us to begin testing methods for diagnosis, negotiation and expression of ambient aspects. The idea is to name a sequence of space and to define formers in different sensitive fields that will be determinant when one will experiment this architectural layout.

Although the knowledge about architecture that we can extract from ordinary experience has generally been minorated, it has consequences on thinking, designing or analysing spaces. It shows how ambience can be a reasoning vector when conceiving architectural and urban projects and how ambient references can be built up and integrated in an architectural culture. It is not without effect on design and educative methods. It gives interesting information and reactualizes our understanding of the relationship between sensible environment and uses. This relationship regards the easthetics of ordinary experience, social interactions and the production of comfort. More observations and analyses are still necessary to build up a corpus of argued references and we must verify each hypothesis. Our goal is now to systematize an ecological analysis of that resource which is available in our current experience or in the corpus of architectural buildings. We also want to test new situations and control ambient factors on full-scale models to verify our hypothesis concerning certain formers.

Bibliography

- AUGOYARD Jean-François, TORGUE Henry : *A l'écoute de l'environnement. Répertoire des effets sonores*. Marseille, Parenthèses, 1995, 174 p
- BERTHOZ Alain (1997) : *Le sens du mouvement*. Paris, pp 1-347
- Physiology de la perception et de l'action*, Résumé des cours et travaux Collège de France, Paris
- CHELKOFF Grégoire : *L'Urbanité des sens. Perceptions et conceptions des espaces publics*. Thèse de doctorat, Université Pierre Mendès-France, Grenoble II, Institut d'Urbanisme de Grenoble, 1996, 393 p.
- CHELKOFF Grégoire avec THIBAUD Jean-Paul. : *Ambiances sous la ville - Une approche écologique de l'espace public souterrain*. Paris : Ministère de l'Équipement ; Grenoble : CRESSON, Septembre 1997. Recherche plan urbain n° 93.31131
- CHELKOFF Grégoire avec THIBAUD Jean-Paul : *Les mises en vue de l'espace public* (avec J.P. Thibaud). Paris, Ministère de l'Équipement - Plan Urbain, CRESSON, 1992, 231 p. Recherche n° 90 31145.
- GIBSON J.J. *The ecological approach to visual perception*, London, LEA, 1986.
- RAUBAL M & WORBOYS M. (1999) "A formal process of wayfinding in built Environments", Int conf Cosit 1999, Stade, Germany, pp 107-109.
- REED Edward S. *J.J. Gibson and the psychology of perception*, Yale University Press, 1988
- STOFFERGEN T. A. (2000) "Affordances and events", *Ecological psychology*, Lawrence Erlbaum Associates,
- STOFFERGEN, T. A. & BARDY, B. (2000) "On specification and the senses", *Behavioral and Brain Sciences* 24 (1).
- THIBAUD UD Jean-Paul (Dir.), GROSJEAN M. (Dir.) : *L'espace urbain en méthodes*. Marseille : Parenthèses, 2001
- WAREN W. H. (1984) "Perceiving affordances : visual guidance of stair climbing". *Journal of experimental psychology : Human perception and performance*, Vol 10, 683-703.

Pour citer ce document :

CHELKOFF, Grégoire. For an ecological approach to architecture : perception and design. First International Workshop : Architectural and urban Ambient Environment, Nantes, 6-7-8 Février 2002. Nantes: CERMA, Ecole D'architecture de Nantes, 2002, 11p.

WARREN W. H. , WHANG S. (1987) "Visual guidance of walking through apertures : body scaled information for affordances", Journal of experimental psychology : Human perception and performance, Vol 13, 371-383.

WARREN, W. H., & SHAW, R. E. (1985). *Persistence and Change*. Hillsdale (N.J.): Lawrence Erlbaum.