NR2C New Road Construction Concept

Work Package 1 – Development of new concepts for the road of the future

Deliverable 1.2

Specifications and preliminary concepts for the design of multimodal streets

Modifications follow-up

Ref draft	**date**	**date** of submitting to approval or date of approval	**Comments and/or brief description of the modifications**
First	2007-02-19		
Fr	2007-09-04		Final version in French
En	2007-09-12		Final version in English
En	2008-01-21		Final version in English – with glossary and English improvements

Table of contents

Glossary

For vocabulary is quite an important tool in all disciplines dealing with qualitative rather than quantitative matters, we have decided to introduce this report by a glossary. It will allow us to explicit the precise meaning of the words and concepts that have been elaborated during this research.

* Arrangement: refers to a physical or spatial configuration of the city. Urban "arrangements" are opposed to urban "forms" (which are mental) and to urban "uses" (dealing with functional aspects of the city).

* Conception: refers to the human faculty of forming an image (a vision, a concept, an idea) in the mind; conception is one aspect of design; it is opposed, here, to "realization" (building this image) and to "utilisation" (using this image and its object).

* Conceptual modelling: building a model of some phenomena.

* Configuration: One of the categories of thought of a design model (context – problems – parti – intentions – configurations); configurations are "differences of arrangements", that is to say a relation, a proportion or a ratio between one urban arrangement "A" and another urban arrangement "B".

* Context: One of the categories of thought of a design model (context – problems – parti – intentions – configurations); the context refers to the recurrent characteristics of the situations into which a given design models happens to occur.

* Design model: A design model is an implicit conceptual model useful for design that has been formalized according to the following logical scheme: context – problems – parti – intentions – configurations.

* Design operator: A design operator is a conceptual instrument useful for the creation, transformation and modification of design models.

* Form: In our report, "form" is neither a physical configuration nor a visual appearance; it refers, in contrary, to the mental (cognitive, abstract, mathematical) aspects of cities: the "principles and modes of organisation" of the urban realm.

* Intention: One of the categories of thought of a design model (context – problems – parti – intentions – configurations); intentions are "differences of uses", that is to say a modification of current uses, a relation between that uses and other uses, etc.

* Modelling: cf. conceptual modelling

* Parti: One of the categories of thought of a design model (context – problems – parti – intentions – configurations); partis are "differences of forms", that is to say a relation between two distinct forms or two distinct principles of organisation.

* Problem: One of the categories of thought of a design model (context – problems – parti – intentions – configurations); problems are inherent contradictions between forces and tendencies occurring in the context of a design model.

* Realization: refers to the human faculty of getting an image (a vision, a concept, an idea) from the mind to materials; realisation is one aspect of design; it is opposed, here, to "conception" (imagining this image) and to "utilisation" (using this image and its object).

* Utilisation: refers to the human faculty of using "something" thanks while understanding its image (a vision, a concept, an idea); utilisation is one aspect of design; it is opposed, here, to "conception" (imagining this image) and to "realization" (getting this image to materials).

* Urban field: refers to a local and congruent pattern of {uses – forms – arrangements}.

Summary

A tool to conceive streets, their uses, their forms and their progressive construction

The present report *(D1.2 Specifications for the design of multimodal streets*) is organized in 4 main parts: the first one raises the various stakes of street design; the second one presents a systemic approach to street production and locate the role of current, implicit and unchallenged street models; the third one exposes a set of *design operators* that may help urbanists and researchers to conceive new models of street; the fourth and last part deals with first applications of these tools: the construction of a street forms *classification* and the realization of a street design kinds and design models *cartography*.

A second report (*D1.3 Models for the design of multimodal streets*) will follow that one and will be especially dedicated to the exposition of the models of streets, avenues, boulevards and bus lanes that have been formalized during the research. Some of these models have been applied to the design of one of Wattrelos' city entrances according to a design method that is synthetically described at the end of this report (D1.2) and that will be detailed extensively in next report (D1.3).

-A- The first part of this report (*The street within the problematic of the modern city)* develops some of the most difficult issues that street designers have to face in their daily practice: street network hierarchy, relations between transport and buildings, multimodality of transport, cohabitation of uses and appropriation of public space, functions definition, cooperative design methods, articulation between political deliberations and technical design processes.

-B- The second part of the report (*Street arrangements, forms and uses in a systemic perspective*) locates the "design models" tool into the global system of street production. It considers successively the principle of *street organization* (recursive utilizations, conceptions and realizations), the principle of *street conceptual modelling* (recursive measures of utility, relevance and quality) and the principle of *models of streets formalization* (recursive definitions of intentions, configurations and parti) that lead to *street design models*, the purpose of which is to answer the issues previously described in part A.

-C- The third part (*Some design operators to imagine and conceive new models of street*) proposes a set of tools to build new models of street both during the design process and the research process. These tools are a set of various ways of thinking the design of multimodal streets by apprehending the complexity of urban forms without destroying it. The street form is thus divided into several *urban fields* that may be transformed by design *units*, *dimensions*, *levels*, *relations*, *elements* and *positions*. All these classes of operators are defined in a recursive fashion and then derived according to the 3 viewpoints of *utilization*, *conception* and *realization* so as to form specific instruments able to support the designer in passing from one street idea to another, from one principle of organization to another or even to reformulate a problem in order to consider new possibilities of development.

-D- The fourth part of the report (*Street forms design, composition and specification)* gives the first applications of the tools that have been developed in the previous parts: it describes

the *typical design process* in terms of all these new concepts; its constructs a table of street forms *classification* and finally draw a *cartography of street design kinds* and *design models* that may constitute a good support for designers in their task of exploring the street design solution space.

The reader will find in the appendix some design models that are the first result of this research task and which prefigure the content of next report (D1.3). These models are briefly illustrated in a fictive application case.

Introduction

The street: a certain form of political organization of urban life

The "street" is a millenary urban form of which the integrity is today threatened: neither the modern districts of the 20th century nor the present urban sprawl have decided to follow this model.

When shops, trades and leisure are concentrated in sort of parks which are isolated from the rest of the city, what is left to the street except housing and circulation? Is a street without shops, without bakeries, in which one cannot leave the children alone, in which one cannot walk while sheltered from rain and sunshine, where the simple promenade is unsafe, where it is difficult to find distraction, refreshment or relaxation spots, is this kind of space still a "street"?

All European cities continue to survive on the "residues" of urban organization that old streets represent. For how much time? Faced with the poor value of today's urban extensions that emerge here and there on the national territory, we tend, without noticing it, to freeze what is left by cities' history, well conscious, in fact, that we are experiencing amount of difficulties to produce well organized urban forms of living.

A street ?

A street is not a simple concrete "arrangement". It is first a mode of social and political organization of a city, a certain form of living together, the choice of a certain manner to live in the city, a certain way to constitute the urban society.

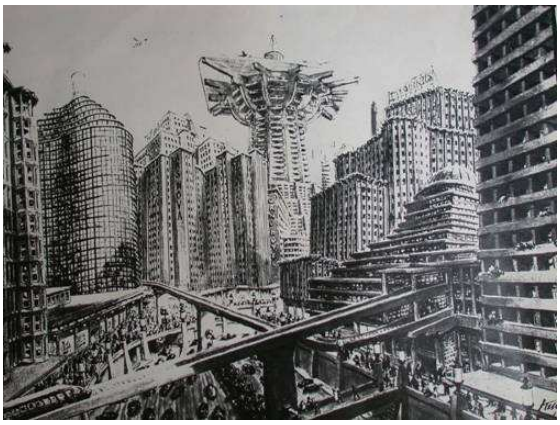
Shops periclitation is not a fatality, nor is the augmentation of car traffic. These phenomena are finally simple resultants of aggregated local choices that lack, obviously, of political coordination at all scales.

Indeed do we really want to live *in* the street, *by* the street and *with* the street? Are we really willing to organize our modes of living in such a way that such a form of urban life may be possible?

The "street" is not the universal model of the city, and the city is not the universal model of the living in society. We may certainly choose other ways to organize the urban life, more

original manners of building our life environment, this despite the numerous failures of modern 20th century urbanism. If society opts for the street model, if we decide to think the evolution of cities *by* and *with* this tool, we must start, however, to organize ourselves in consequence, not solely at the big scales but at all scales, from the front door of every house to the whole city scale projects.

A street



Something else

Design questions only come after. They are secondary in front of the political questions, for the street model lies more in a certain form of organization of urban uses and practices than in the more or less sexy arrangements and configurations that are stick on it for its concrete supports…

This report deals however with those design questions. We'll try to put some light on those problematic which are sufficiently vast and complex to need the prospective and insights of several whole research projects, starting by this one.

How do we proceed, indeed, when we have very little time to spend in the design, when the street forms are mechanically modified in following designers' habits and images on one side, and by applying the proliferation of administrative norms and planning documents on the other side?

Reduction of the width of roadways, distribution of variety bollards, cyclists lanes creations, tree plantations, bus lanes reservations, widening of sidewalks, housing district creations, rebuilding of technical networks, settling of bus stops, of flower stands and public benches, reconstruction of buildings, renovation of their façades, shops conversion…

Many actions that, if more or less well made, may contribute to build a "street", to consolidate this special form or urban life organization or, in the contrary, may contribute to its decline and progressive decomposition…

-A- The question of multimodal streets within the problematic of the modern city

How to approach the street question?

Multiple ways exist to approach the question of street conception as it is presented to urban designers today:

* We may take the street from an anthropological, social and political point of view, and consider, for example, the street as a form of organisation of the society and its way of living. The street is then, a cultural element among others; it reflects the conceptions of the city, of the society and its link to the natural environment. The street is even the material bearing of the city political organisation, of regulations and of social behaviours set by its inhabitants.

* From a technical and morphological point of view, the street system has even known evolutions. The whole devices of a street are more complex than it was on the past. Cleansing, underneath networks, lighting and traffic brought multiple innovations, but also, lot of difficulties in the street production.

* However, urban “disciplines” and “studies” are those which have known the more significant transformations: the road mender having to take care “globally” of a small parcel of public territory has been replaced by plenty of different professional specialities, some supervising the parking policy, others taking care of accessibility, safety, aesthetics, car traffic, road signs, shops, cycling, waste collect, etc.

* Throughout those professions and their tasks partition, it’s finally the street *conceptions* that have been transformed. The way to approach the problem of transformation of a piece of street into a new peace of street is not the same than before. Management, maintenance, and patrimonial protection of streets have changed.

In fact, it’s all the relation between political organisation and urban life, technical and scientific knowledge, and work methods which have known one revolution that influences today the way society products its streets and street networks.

All those phenomena are closely linked: the street, as cultural element or social instrument, is also, inversely, the street as a technical object or device used for certain functions. The street is even, from an other point of view, multiple trades and professional practices which refer, in a particular way, to the various corpus of present knowledge.

It seems difficult to highlight the actual problems related to street design if we do not try to articulate those points of view: to understand how uses, configurations, trades and street knowledge are closely linked together.

We shall start by featuring three sketches of the street design problematic which will mix, in various proportions, all of those three points of view: political organisation of uses, implementation of knowledge and technical realisations.

Then, we will attempt to highlight, through each sketches, some stakes and significant questions that will be used as reference when further, we will have to evaluate the accuracy and relevance of the tools and methods that have been elaborated within this research project.

I. Roads, streets and future development of cities

« At the heart of the question of plurality of transport modes, there would be a considerable issue of urbanity and urban recasting. »[1]

1) Is the street a road passing within the city?

Is it a "road adapted to the urban environment?" Is the street, from the Latin *ruga*, "wrinkle", a special kind of road, *rupta*, "trench", or isn't it rather the opposite: the road which would be a kind of street?

At first glance, what distinguishes the street from the road seems to be the complexity of the former when one discovers the simplicity of the latter. The street bears innumerable uses; it is the place of coexistence of underground and aerial techniques, of public and private domains, of commercial and non-merchants exchanges, of predicted and unpredicted activities; it is sinuous, rough and it used to be muddy and smelly; doesn't it contrast with the rectilinear stones of the Roman roads proceeding straight through the territory? Doesn't it contrast with the elegance of a configuration that is in perfect adequacy with the function which is its mould: circulating?

"A circulated way whose edges are built"; such could be a first definition of the street considered as a kind of road. Friction rather than slip, complexity rather than simplicity, delimited spaces rather than opened ones, uses rather than functions, alive rather than functional, such are the oppositions that one could be tempted to draw up between streets and roads.

But where does this complexity come from? Would it be enough for a road to go and "make a round" (circulate) "downtown" to inherit the urban qualities? The last four decades experiments let us believe that it is not the case, that a road penetrating in the heart-even of a city is not automatically transformed into a street. The observation of the growth of a burg which becomes a village, of a village which becomes a city, of the city which spreads out, could indicate that it goes rather differently: it may be the city which, while extending, would adapt the road (which is often only a "path") and transform it into a street…

The street can be thought as a sample of the city, one of the basic patterns from which it is constituted and which gathers in itself the whole of the urban phenomenon characteristics.

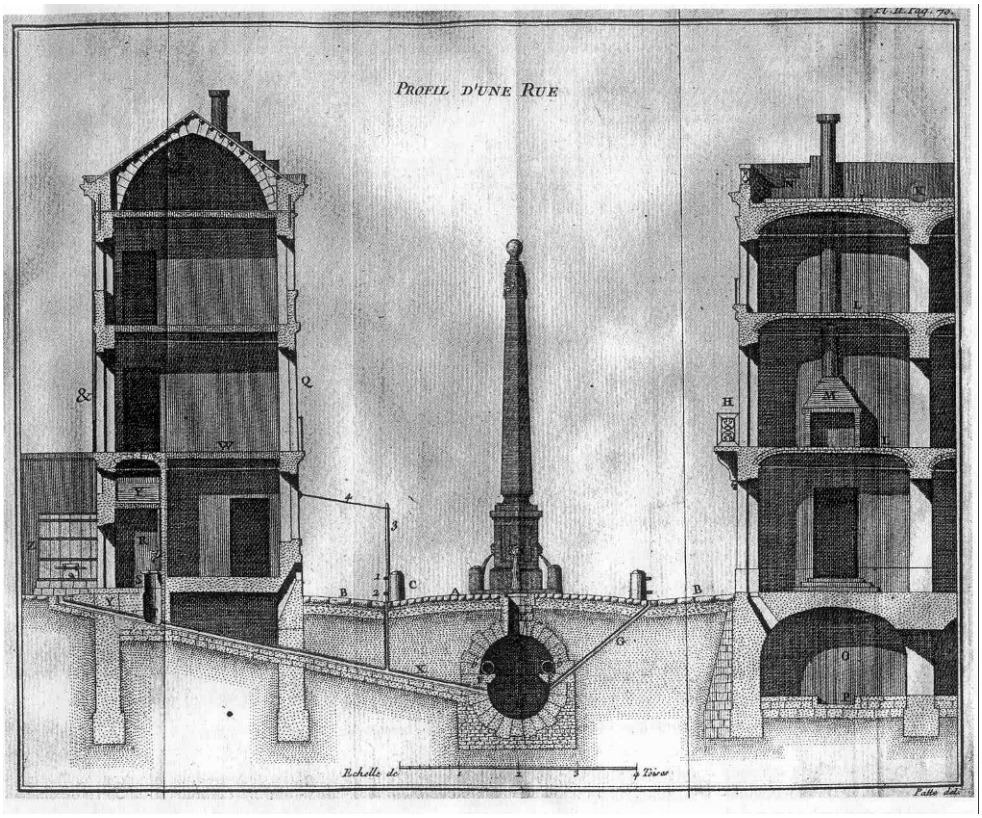
The street is at the same time the support of movement, of trips from a point of the city to another one, from an activity to another one, and the support of dwelling, of building constructions, of stability. It is the place of articulation between public and private spaces. The street, with the system of parcels and building blocks, organizes at the same time the permanence and the renewal of the urban fabric: the layout remains, and thus the available space for networks, plantations, infrastructures. While parcels are joined or cut out, one after the other, while these parcels take value, while the buildings, much more ephemeral, are built and rebuilt, while their uses, their frontage and their occupants change again and again, the street remain the same.

[1] Jean-Loup Gourdon : « Circulation urbaine, guerre ou paix ? »

Thus the street, a kind of void opened to the sky, is the most perennial structure of the urban system, since constantly, below it and on its sides, things change and fluctuate while its *form* remains, supporting the renewal of the city on itself.

2) Little history of streets technical thinking

The urban roadway system, contrary to the buildings, remains unthought until the 18th century, except as a receptacle of the daily urban garbage: the street belongs to the residual and muddy space left over at the foot of the buildings. But the water run-off and the organization of an underground grid connected to the buildings will eventually push the roadway system (*i.e.* the urban ground in all its thickness) in the fields of architectural and technical concerns



Pierre Patte, « Profil d'une rue », 1769.

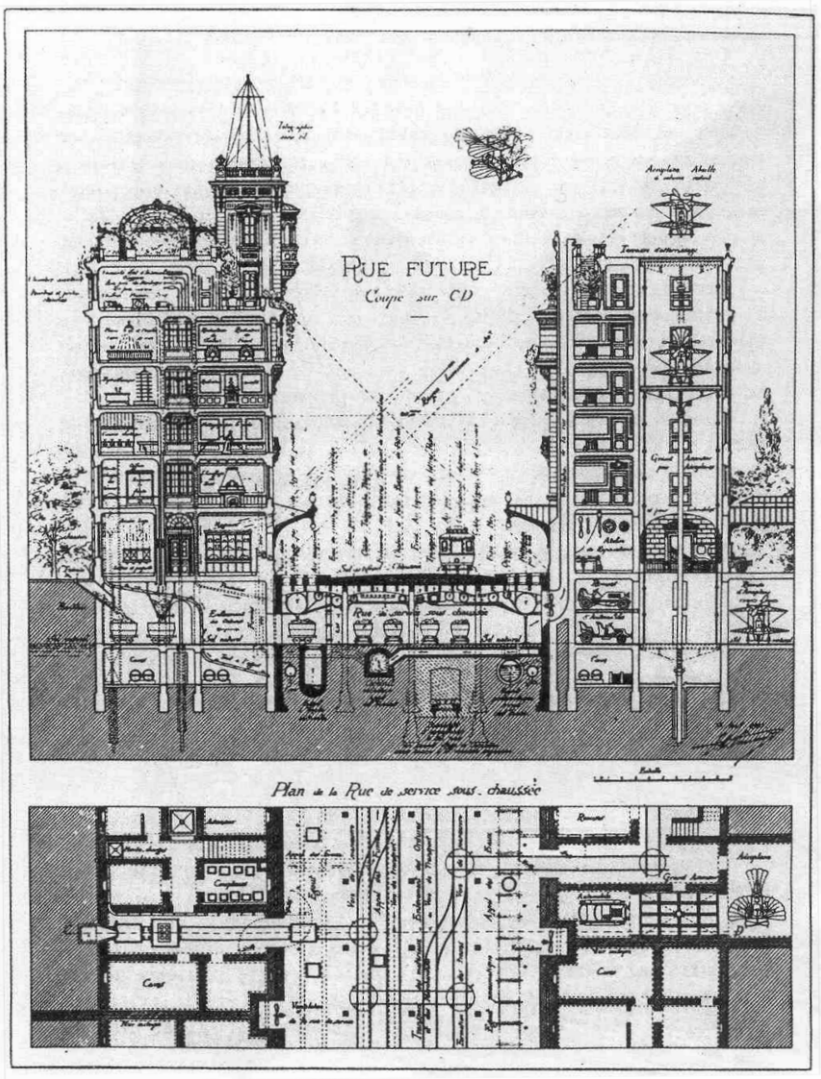
The street is seen as a global system: the drains make the buildings interdependent of the basements (rise and descent of water through the water conveyances) and sky (the conduits of the chimneys which lets escape the smoke).

The appearance of the section drawing makes it possible to think the street as a global technical object, located between earth and sky, integrated in a topographic, geological and climatic context. Longitudinally, the street section allows considering the distribution of flows inside the available transversal space, starting with the surface road service, the distribution of water and cleansing. Transversely, the relationships between these flows appear: their horizontal and vertical coexistence, their frictions and the organization of the exchanges from one edge to another. Curiously, it is at this moment that the street profile undergoes an inversion of shape from the ground surface point of view: one passes from a concave profile with the drainage by a central drain left under free air, to a convex profile which becomes similar to that of the roads of close-cropped countryside.

On the 19th century, this thinking in terms of "flows" continues and rises, leading to the concept of *network*, which will then apply independently to water distribution, to the streets as

to the roads, to channels as to the railroads. Thus, from the end of the 18th century, the profile of the street adopts side pavements and sometimes covered galleries that stimulate the commercial activities. These innovations constitute some of the first urban design models aiming at separating the various flows, here pedestrians and horse-drawn.

In parallel, the technical knowledge related to engineering of roadway structures and coating is improved, which gradually contributes to give a scientific and autonomous character to the field of roadway systems. With the increase of flows of all kinds and thus of the importance of the technical systems in urban organization, the roadways will widen and impose their own constraints of connection to the buildings. Eugene Hénard's section drawing, which presents a "street of the future", illustrates this presentiment very well, of *this change of scale of flows and networks* that would finally happen at the beginning of the 20th century. This drawing shows at the same time the continuing specialization and division of the "available section space", being visualized out of the section drawing and being consequently possibly invaded and saturated by the multiplication of functions and their especially allocated spaces.



Eugène Hénard, « Rue future », 1910.

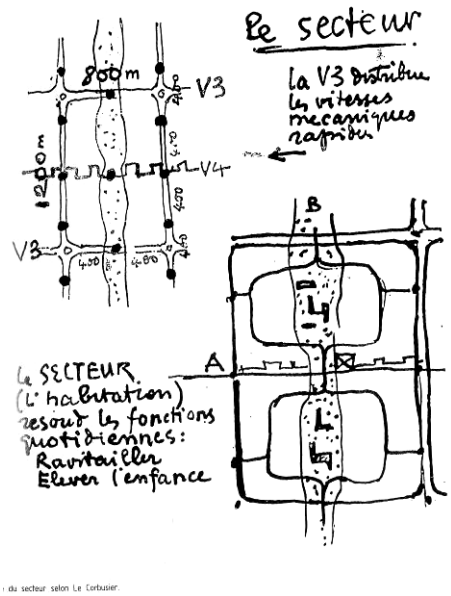
The profile of the street is used here until its last possibilities. But are these limits those of the street, or are they the limits of its graphical representation, of its drawing section?

Would the "circulated way whose edges are built" reach its proper limits under the increasing pressure of the technical infrastructures? It is, consequently, the question of the relationships between architecture and infrastructures that is now raised with acuity.

3) Car rising and scale change of "urban design"

Modern "urban design" was born at the moment of awakening of this jump of scale: not only that of the technical infrastructures, with the appearance of gas and electricity networks and especially that of cars in the city, but also that of the production of architecture which will be thought for the first time in a massive way. In fact, "whole pieces of city" are designed and carried out thanks to the industrial methods of production, and more especially thanks to a "functionalist" way of thinking that reaches its maturation: to mitigate the difficulty of the production of the city on a large scale, the 20th century urban thought is constraint to simplify the arising problems by considering an univocal distribution of spaces according to a limited number of functions. "Functionalism" allots and adapts one space to one function.

The "street", if this word still has a meaning in this case, mostly considered in plan, becomes part of a hierarchical network of service roads and only its longitudinal dimension is fully considered. All the questions of transversal relationships are eliminated: relationships from technical networks between themselves (in the 60's urban plans, which are made of housing bares and towers, the roadway system and the technical networks are independent and do not superimpose themselves, pedestrians paths and car ways are dissociated) or relationships between buildings and infrastructures (the configurations of the roadway system and that of the building arrangement are not interdependent any more). At the same time, the parcel, which traditionally defines the limits of each property, and thus the articulation of public space to private space, disappear, and the building block (*i.e.* a whole of parcels circumscribed by public ways) becomes an isolated sector. Thus the modern "street" becomes almost mono-functional with the advent of the car.

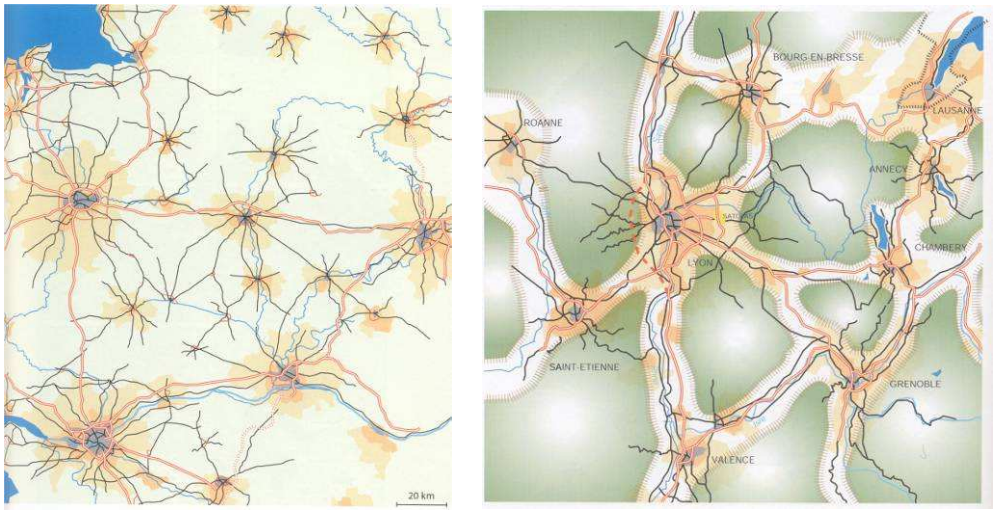


Hierarchy and specialisation of ways according to Colin Buchanan (on the left, 1963) and Le Corbusier (on the right, 1948).

The idea of the street disappears when its concrete arrangements are reconfigured (in particular by eliminating the tramway which was well established in France till the 50's) to deserve one omnipotent function: motor vehicle traffic, a real "trench" (*rupta*, road) shearing

the urban fabric. In France, from the middle of the 70's, 64% of the households are motorized and nearly 20% of them have two vehicles. In twenty-five years, the vehicle ownership thus passed from 250 to more than 400 vehicles for 1000 inhabitants.

In 2002, more than 80% of the households have a car and nearly a third of them are multi-motorized. The construction of the highway network, which enhances the French territory grid and sets network of cities, is started during the 60's to reach nearly 9000 km in the year 2000. The cities, firstly enclosed by fortifications and further of burgs (which were true streets making both the limit and the interface between the urban environment and the countryside) are now crossed and circumvented by huge infrastructures. At the same time, those infrastructures, by reducing the temporal distances, potentially open new spaces of possible urbanisation. Thus the shape of the road infrastructure becomes a major determining factor of the growth of cities, generally leading to star-like and linear configurations.



Concentric configurations in the French Atlantic plain (on the left) and linear configurations worked out by the valleys of the Rhone and the Saone (on the right), extracted from D. Mangin, La ville franchisée, 2004.

4) Toward the disappearance of the idea of a "city"?

Hence, despite the fact that since the 60's the roadway system is thought (by engineers) independently of the buildings (designed by architects), its influence on the construction is far from being negligible: the road infrastructure delimits today tight zones inside which the urban installation is possible, areas that are now available and then attractive, discontinuous portions of the territory that form today what one calls in Europe the "peri-urban" and the "sub-urban", the "emergent city"[2], the "diffuse city"[3] or even the "generic city"[4], the "in-between city"[5], the "spread out city" [6], the "franchised city"[7], the "space of flows"[8], etc.

All these denominations reveal, not a fundamental diversity of situations and new forms of city, but rather a kind of form relatively homogeneous and harsh to qualify, a kind of floating

[2] Cf. Dubois-Taine G., Chalas Y., (eds.), *La ville émergente*, Paris, Editions de l'Aube, 1997.
[3] Selon Bernardo Secchi.
[4] Cf. Boeri S., Koolhaas R., *et al.*, *Mutations*, Actar, Barcelone, 2001.
[5] Cf. Sieverts T., *Entre-ville, une lecture de la Zwischenstadt*, éditions Parenthèses, Marseille, 2001.
[6] Cf. Collectif, *La ville étalée en perspectives*, éditions Champ social, 2003.
[7] Cf. Mangin D., *La ville franchisée*, éditions de La Villette, Paris, 2004.
[8] Cf. Castells M., *La société en réseaux*, 3 tomes, Fayard 1998 et 1999.

which demonstrates our incapacity to recognize a “city” in the actual spatial configurations of the urban phenomenon, not only in Europe but nearly everywhere in the world.

Following the formidable increase of traffic and flows of all kinds, the “street”, or at least the “way”, as well as the whole of the networks, have been seen and thought primarily longitudinally, as one pathway from one point of the network to another, and not transversely, from one type of network to another, or from one side of the street to the other, so that sometimes they become inaccessible to each other.

The points of connection to multiple networks gradually relegate the spatial continuity (the continuity of public space and its routes) with the old boroughs, and promulgated the “nodes” articulating the various networks to the status of new “urban polarities”.

Looking at this “urban transition” that many European cities know today, positions are contradictory but the street seems indeed to be a central issue of the debate.

For some people, these new urban forms are the result of an inescapable evolution: the compact and dense cities that some regret today constitute only one stage among others in the evolution of city forms; however this stage would not be compatible any more with the technological discoveries, the way of life evolution and the quantities of flow of any kind which the modern society is currently experiencing.

For other people, compactness and density are elements that are at the core of the idea of a city. They are essential characteristics of any “good city form” that is concerned with the future; to consider a sustainable development can only be done if politically, decisions are taken to reduce trip-makings and flows that require energy. And as it is observed, those trip-makings find their origin in the dispersion of residence, leisure and work places, a phenomenon that has reached a degree exceeding all what the past compact cities have ever known.

In all cases, and whatever the positions about the future of European cities, the *relation between buildings and streets*, between motions and stops, installations and transports, or even between displacements and «non-displacement», this relation is today, central in the designers preoccupations, from the street scale to that of the whole city.

5) The street, articulation of motion to installation, as a city prototype?

Yet, if there is an urban form which contains in its constitutive genesis, this double dimension of the city, this primary opposition of motion and establishment, it is, of course, the form of the street, which was transmitted to its « descendant »: avenues, parkways, boulevards, courts and lanes…

To question the future of the street is thus to approach that of the city from a *microscopic* point of view: the street as the basic pattern of the urban fabric, likely to be repeated and transformed without ever being exactly the same, and carrying in itself all urban features of the territory.

Inversely, to consider the road and its future is to consider the future of the city from a *macroscopic* point of view: the road as the basic pattern of the "territorial fabric", the "city-landscape" or the "diffuse city", whose condition seems to spread, already strongly on a European scale.

Thus roads and streets are complementary when one considers the problems of the contemporary city in a global way. So if yesterday roads used to penetrate the urban environment, sometimes brutally, often by successive transformations of existing streets, perhaps tomorrow the roads and other infrastructures that are today at the city gates (*i.e.* at the end of our current streets) will be transformed into streets.

What could resemble, not a “street taken from the path” but a “street taken from a road”?

And how shall we be able to imagine and to conceive such transitions?

Will the section drawing and the network plan be accurate and sufficient tools to design the street of the future?

Do we have to create a new tool, able to communicate the multiple concurrent, antagonist and complementary relations between urban motion and establishment, the built and the roadway systems, displacements and “non-displacements”, buildings and infrastructures, this in a *coordinated manner and according to every macroscopic and microscopic scales* which characterise the development of actual cities?

II. Cohabitation of uses within constituted cities

"The functional specialisation influences every day more the formation of the urban space, and inspires an increasingly stronger contemporary demand for assigned spaces (speedways, bicycle paths, pedestrian ways, "reserved lanes" for public transports, etc.) materially separated at the price of complex interventions, large consumers of space…"[9]

1) Stay uses and transport uses

There is actually a certain paradox of transport uses. Firstly, the society and its ways of life evolve, the city dwellers are moving more and more, and increasingly faster, the connections between the various parts of the city, once disturbed by modern town planning, are gradually remade. On the other side, this extent of transport uses generates among the city dwellers a growing need of fixed spaces, more welcoming, more convivial, and more "human"…

Everything occurs as if contemporary urban planning was pulled between those two general tendencies: workplaces are increasingly farther from rest and recreation places, themselves farther and farther from dwellings… transportation develop consequently… and several hours per day, everyone is in transit, from one point of the city to another, in car or in public transports. This overload of annoying activities contribute, indirectly and in a more or less marked proportion, to the creation of new needs for recreation uses, to which we respond, notably, by urban green spaces, landscaping and touristy installations, events and week-end activities of all kinds, expected to counteract, among other things, for all the time spent in uncomfortable and relatively monotonous daily transportation…

Those leisure urban structures become increasingly new attraction places and consequently, new sources of transport and move, so that we may mull over: aren't "animation", "landscape" and "leisure" not running after transport uses rather than trying to transform them? Are they not generating new trips rather than optimizing the quantity of existing trip-makings?

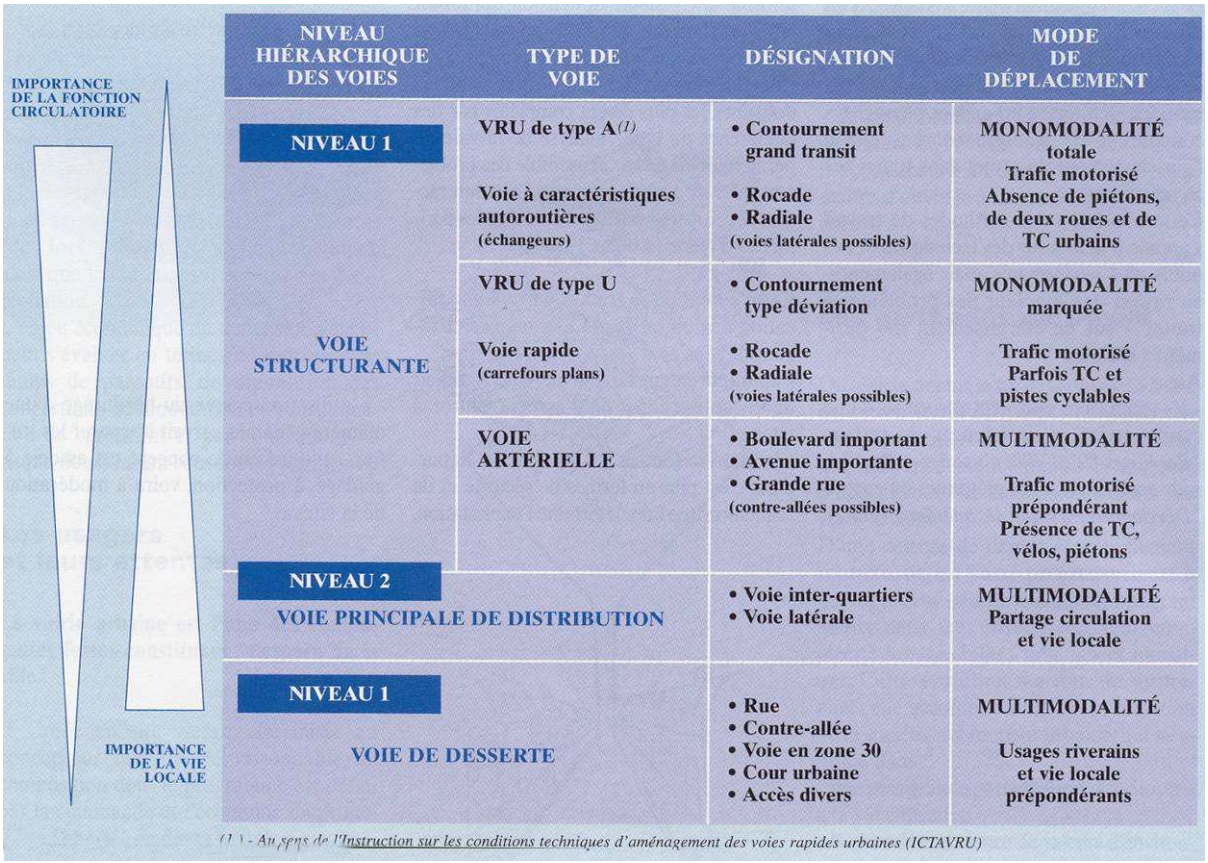
If there is an astonishing disproportion between traffic and stop spaces, it is because streets, which represent an overwhelming majority of urban public spaces, are mainly designed like traffic spaces: it is necessary to be able to move, transit, and have access to…

Antverp, Belgium: Are the stay uses and transport uses inevitably antagonist?

[9] Jean-Loup Gourdon : « Urban circulation, war or peace ? »

Are the "stay uses" and "transport uses" inevitably antagonists? Are they incompatible at the point of requiring a place for circulation (the street) and another one to take rest and to recreate (the park, the piazza)? Isn't it possible to consider inside the street, the cohabitation of stops and circulation, of rest and movement, of stay and transport?

It's such a conceptual impossibility that is implied by the current streets classification presently used in France. This classification distinguishes, through it's hierarchy of urban ways, those ones which provide a more important role to traffic (arterial ways) from those which provide a more important role to local life (service and access ways), as if these components of the human activity were inversely proportional, as if the rise of the one of them would automatically mean a diminution of the other.



NIVEAU HIÉRARCHIQUE DES VOIES	TYPE DE VOIE	DÉSIGNATION	MODE DE DÉPLACEMENT
NIVEAU 1 — VOIE STRUCTURANTE	VRU de type A(1) Voie à caractéristiques autoroutières (échangeurs)	• Contournement grand transit • Rocade • Radiale (voies latérales possibles)	MONOMODALITÉ totale Trafic motorisé Absence de piétons, de deux roues et de TC urbains
	VRU de type U Voie rapide (carrefours plans)	• Contournement type déviation • Rocade • Radiale (voies latérales possibles)	MONOMODALITÉ marquée Trafic motorisé Parfois TC et pistes cyclables
	VOIE ARTÉRIELLE	• Boulevard important • Avenue importante • Grande rue (contre-allées possibles)	MULTIMODALITÉ Trafic motorisé prépondérant Présence de TC, vélos, piétons
NIVEAU 2 — VOIE PRINCIPALE DE DISTRIBUTION		• Voie inter-quartiers • Voie latérale	MULTIMODALITÉ Partage circulation et vie locale
NIVEAU 1 — VOIE DE DESSERTE		• Rue • Contre-allée • Voie en zone 30 • Cour urbaine • Accès divers	MULTIMODALITÉ Usages riverains et vie locale prépondérants

(1) - Au sens de l'Instruction sur les conditions techniques d'aménagement des voies rapides urbaines (ICTAVRU)

Excerpt from the "Guide de la Voirie Urbaine": is « local life » really inversely proportional to the «circulatory function »?

However, if we take a close look at this question, it's not hard to realize that transport uses and stay uses are closely interrelated, sometimes antagonists, but often complementary: most of the time, stops occur along the flows edges, as on a riverbank, because these flows constitute, when hold off at a comfortable distance, a constant source of attraction and of steady movements, of liveliness that makes rest and stay more interesting and amusing. Shops and traders know that where people pass, some of them are strongly likely to stop…and in this regard, street corners, at the intersections of many ways, naturally become favored locations for shop signs and various activities settlements…

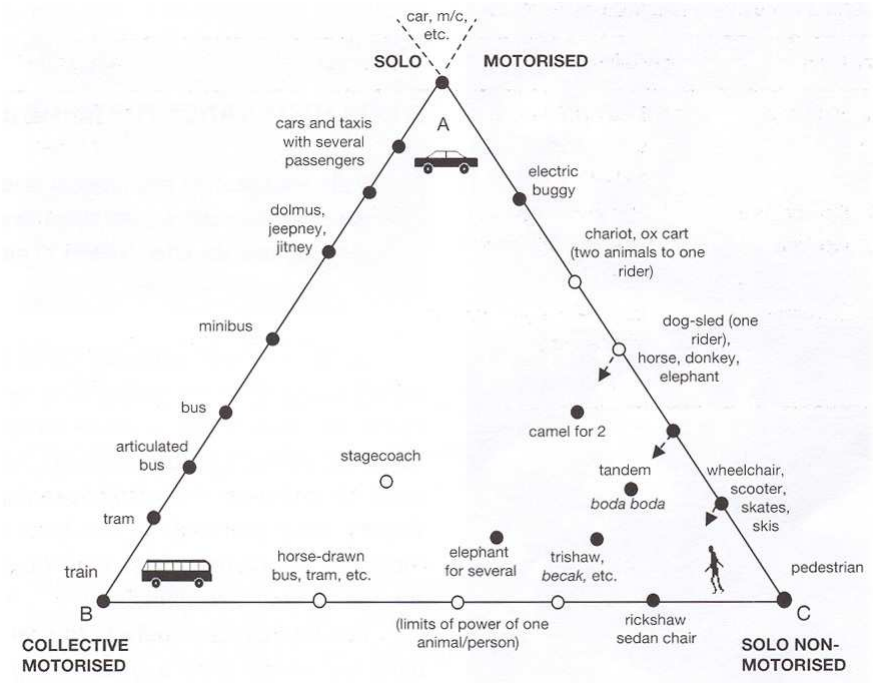
If at first sight it is easy to consider stay uses and the various activities that can edge a way as rather conflicting with a good effectiveness and fluidity of transport, it is not hard indeed to reexamine this judgment: trip paths are not chosen according to the shortest way, but also, when it's possible, according to that way which is the more pleasant, which may be the most interesting and economical in itself.

Indeed there is no way of going from one point to another that is more "economical" than the one which makes it possible to satisfy all urban life requirements in an only time, in an only one round of city block… purchasing, leisure, friends visiting, health, wandering and roaming, resting, running… Thus an increase in flows doesn't necessarily imply a reduction of the local life but, this is even the contrary which may be true sometimes, when we observe, for example, how much our housing estate "streets" are unused...

Today street design main issue consists in stepping out of this simplistic mental scheme in order to imagine other patterns. Avenues and boulevards from past centuries, still functioning today, are good examples which demonstrate how local life, stops, rest, activities and installations are far to be in opposition with high traffic levels, as long as they remain in corresponding proportions. We may simply and possibly have a lack, today, of a political organization to would make achievable such projects of social life, and even a lack of benchmarked urban design models enabling us to imagine, to think and to organize such possibilities of cities development in current contexts.

2) Cohabitation of various types of transport

If there is an issue about the association of "stay uses" to "transport uses", it mustn't leave down the heterogeneous character of movements: because they are carried out according to various vehicles (by walk, bicycle, car, tramway, etc.) and because they pursue distinct purposes (to go to work, to wander, etc.) at every hour of day and night, transports are far from being simple flows of fluids.



Classification of different modes of transport according to their characters:
- *Motorised / non-motorised*
- *individual / collective*

Stephen Marshall, Streets and Patterns, p.199, 2005.

When the various modes are associated within the same way, some modes become, according to their mass and speed, an implied threat for the others: bicycles are dangerous for pedestrians, cars, bus and tramways are dangerous for cyclists, etc. Most often, the feeling of danger becoming too important, it is to the "threatened" modes to give way to the others. In other cases, some modes of transport like cars constitute, not by their dimensions or speed but by their significant quantity, an evident obstruction that affects all the others modes, in particular the public transports whose vehicle dimensions make them very sensitive to space availability…

To overcome those dysfunctions and insure a fair division of city spaces, several solutions are considered; these go from a simple road sign (bicycle paths of different colors, separated by rough bands, etc.) to large installations (pedestrian ways, arrangements of "soft banks" for pedestrians and cyclists, public transports in reserved lanes, etc.), passing through more punctual touches (bike shelters, widen sidewalks, etc.).

But often, it may be forgotten that, for example, a cyclist doesn't ride "naturally" in a narrow lane of 1m50 width, and that a large sidewalk is often more pleasing to ride a bike than a two wheels vehicles specially dimensioned track.

It's then useful to come back to fundamental considerations, keeping in mind that *each mode of transport is a specific motion (*speed, rhythm, trajectory…) requiring its own conditions for passing. Thus, the walk follows a subtle march process that many urban planners and designers of the 20th century seem to have ignored; it can be succinctly described in the following way:[10]

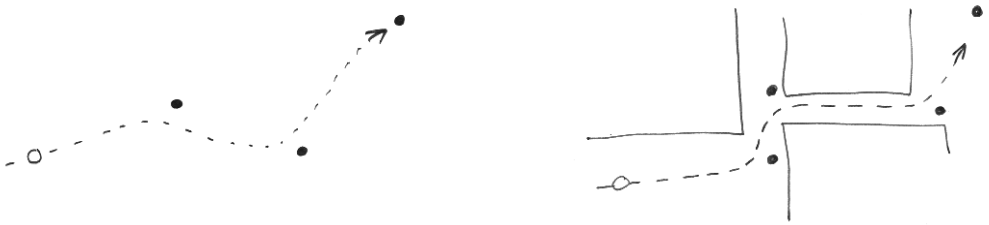
- Walking, we look at our surroundings in search of intermediate goals towards which going, and we *roughly* walk in straight line between those various points. Thus we naturally cut angles and follow the diagonals that directly lead us to where we want to go.

- The intermediate destinations change as we move on and perceive new horizons, new objects that come off it, so that if we constantly head towards those new directions that progressively appear to our sight, our trajectory will end absolutely curved, in the manner of a missile constantly readjusting its trajectory according to its continuously moving target.

- However, we generally try to avoid changing direction at every moment for obviously, such a practice appears rather tiring in the long run; we thus manage to set few intermediate goals, clearly visible and that we try to reach before changing direction again. In the meantime, this allows thinking to something else, sniffing the flowers, *i.e.* walking freely.

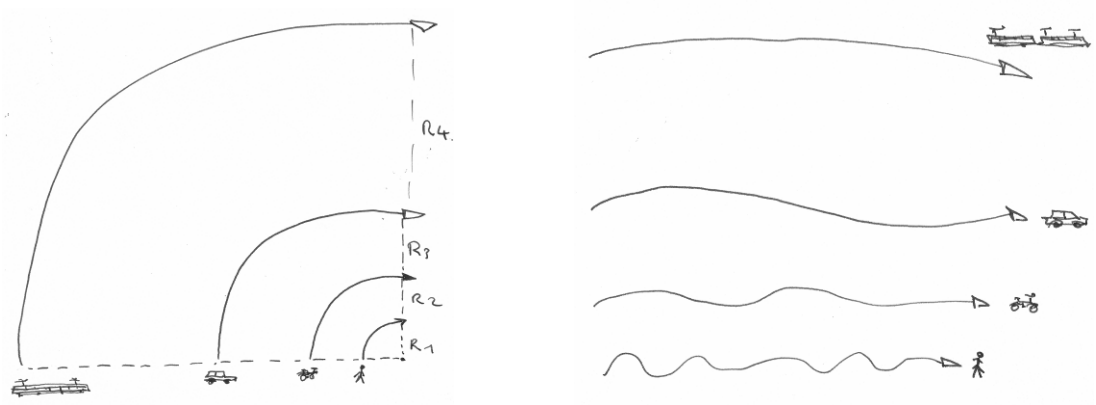
- Let's add to this, the necessity of feeling protected and safe, *i.e* of evolving into spaces with relatively reduced dimensions, of being able to stop at the edge of the road or simply to stay on the doorstep, of talking and resting, and by this walking process we thus obtain kind of the narrow streets and bent little squares that are so typical of European medieval city centers.

[10] See Alexander Ch. *et al.*, *A Pattern Language*, Oxford University Press, New York, 1977.



Streets used to be formed by the walking process through intermediary goals and by buildings location.

The arrival of horses and cars, bicycles and tramways, sewers and other networks, completely disrupted this way of giving form to the streets, mainly based on the pedestrian course and on the aggregated installation of buildings. Today, the street configuration and indirectly building arrangements are dictated by the heaviest mean of transport, that is to say the car and when they are present, public transports.



Radius of curvature of various modes of transport and types of "natural" trajectories

Take a 4 lanes ways, ideal for car driving, and widen it with two broad sidewalks planted with service lanes: you may obtain a today "urban boulevard". Lay out a path for tramway on the roadway and, right away, the minimum radius of curvature increases consequently…

We thus tend to proportion and configure the streets according to the most geometrically constraining means of transport, thinking that where a bus can pass, a cyclist or a pedestrian may go through easily…

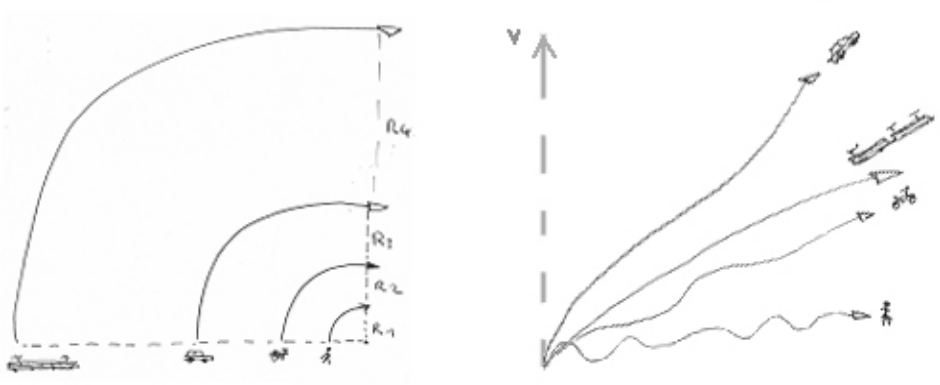
However, as everyone has already experienced it, it is not very comfortable to walk in a lane dimensioned and curved for a car, to continuously follow a path which is not your own path, but one whose form was dedicated to another user's motion: fatigue and humdrum will not wait to come.

According to a "static" point of view, it is the *collective* character of transport that is source of constraint. In general, collective transportation modes might be defined, indeed, by the fact that whole of the users follow a similar pathway into the street space: this is foremost for bus and tramways users themselves, as they evolve in the same vehicle. However, this even tends to be the case for those who use parallel lanes, where pathways trajectories are constrained and formed by heavier transport lanes.

According to a "dynamic" point of view, the *speed difference* between modes of transport is the one characteristic that is going to raise safety problems and mutual discomforts: if the street concrete configurations depend on the pathway and radius of curvature of each mode of transport, the street functions and uses organisation in time-space are more structured by the various modes' speeds and rhythms.

Thereby tramways, whose radiuses of curvature are larger, condition the pathway configurations while their uses (slow speed and relatively low frequency) don't make them too constraining for other modes of transport, unless they are protected and evolve inside a reserved space… Inversely, motorists dominate the uses they meet not by the form of their specific pathways, but rather by par their large quantity and high speeds.

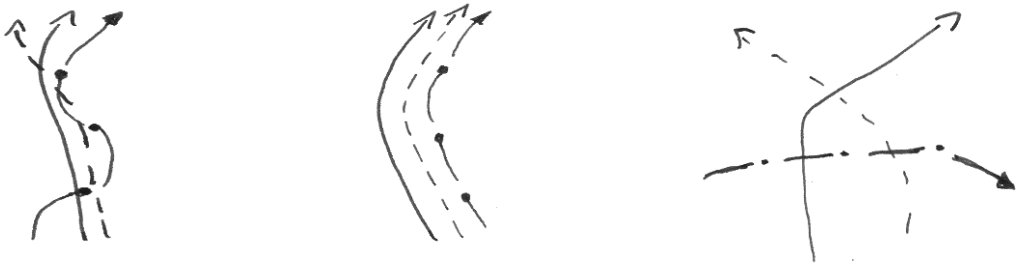
From the Roman ways up to our current streets, the central part of a roadway has been mostly dedicated to high traffic and reserved to faster vehicles, while lateral parts have been serving slower moves, as on present sidewalks. Traffics are often distributed according to a speed gradient, from centre (higher speeds) toward edges (lower speed and stops), hence minimizing the constraints resulting from speed differences.



Radius of curvature and potential speeds of different modes of transport

Once admitted that differences between transport modes comes from their *quantity*, either from their *speed* or from their *collective* character, once agreed that those differences generate some mutual constraints between the various modes (constraints of *size*, of *speed*, of *rhythm*, of *pathway* forms), it becomes obvious that several conceivable *forms and principles of organisation* exist, which link and articulate in *different manners* all the transport modes together.

Here are three schematic examples:



GROUPING? *JUXTAPOSING?* *SEPARATING?*

- **GROUPING**: All flows are contained in a same "urban channel", a same space, a same street, flows of all sorts and of all scales coexist, joined together in the same places. *Speed differences must be reduced but trajectories are free.*
- **JUXTAPOSING**: Flows are places side by side, to make them follow the same trajectory without mixing them. Speed and pace of each mode of transport are unconstrained, but path forms are imposed.
- **SEPARATING**: Flows are moved apart from each other, to get them independent: the paths, paces and speeds are not constrained, except at the connection points where different modes of transport meet.

GROUPING:

Lisbon tramway encroaches upon a part of the sidewalk to enable its left turn...

This example contrasts with usual contemporary tramway networks that usually impose their path constraints to other users in a permanent and rigid fashion.

3) Urban life and the appropriable character of urban space

If at a large scale, at the street network or city scale, the "functionalist" lay out (which consists in "separating" and "juxtaposing" the urban functions, by attributing proper and distinct spaces to housing, workplace, leisure place, etc.) has been largely disapproved during the last decades, there is a more delicate issue at a smaller scale, requiring to go further into detail.

Nowadays in France, plenty of interventions and transformation related to transport development seek for a higher legibility, users' safety, a respectful sharing of spaces and transport efficiency. All these intentions have often contributed to apply the "functionalist" ways of thinking to a smaller scale of action: creation of reserved lanes and tracks for bicycles, reserved lane and tracks for public transports, physically delimitated spaces, etc.

If the profession agrees that it is not relevant to create specific and separated transport networks for each mode, opinions are most divided about how to organize the mutual existence of all modes within the same street.

The debate exists between traffic efficiency defenders on one side, and those who, on the other side, laud for uses diversity, for a regard of context variations and especially for an integration of the political and intelligent capacity of citizens at the core of street uses

organisation. Indeed, aren't citizens able to mind out, to be courteous, to choose a pathway adapted to circumstances and to behave with keenness?

Thus the "traffic efficiency and reserved tracks" defenders meet some loud opponents who prefer "shared spaces and patterns": where physical delimitations and signage are almost absent in order to prompt each user to take his citizen responsibilities, to oversee his own way and respect others pathways.

However the "shared spaces" parti obviously meets some difficulties: what happens when a group of users is in position to impose is presence to the others, when the whole of users being left to their own, some succeed to overrun the spaces supposed to be public?

This problematic appears quite clearly in transport uses. Tramways, bus and cycling dedicated lanes are not only laid out for a functional clarity issue. It is even the car traffic pressure, which is so high, that eventually other transport modes tend to be excluded from the shared roadway, unless they have a reserved space for their own.

But motorists are not the only users who spread over parts or whole of the public space. Some groups of users make an extensive utilisation of the public space, tending to exclude other peoples from it. Bystanders and itinerant people for example, nearby the train stations or downtown, but also some gangs of tourists, elder people and troops of hurried workers going to their offices…

More, space appropriation is not a phenomenon we always try to avoid as in the case of cars and itinerant people. For places that are perceived as the more "living" or "alive" in a city are, very often, those that are welcoming the most demonstrative collective uses: a continuous human agitation made of bustle, laugh, passionate and loud discussion, of music and songs, and other practices that all have as a same common characteristic to be played by people "feeling at ease". It is obvious that those usages that contribute to the life of a place and to its abounding atmosphere would not be possible without a sort of feeling and thinking of belonging to a place: people need to feel "at home", to find enough self-confidence if they are to express their deepest gladness and sadness in the middle of the street.

From that positive perception of uses "agitation" to a radically different perception that may rather see in these waves some "perturbations" and "noises", *i.e.* an "exclusion" of one group by another, there is only a small jump, easily jumpable, easily jumped: "urban life" is a kind of fragile state of equilibrium between space appropriation by groups of individuals and the permanence of the public character of that urban space which is meant to avoid any form of exclusion.

This fragile equilibrium between appropriation and respect of the public character of urban space is foremost a political and social matter, a question of collective and individual liberties: peoples and groups of peoples have to deal by themselves their relationships with others groups of people, evolving in an urban space that belongs to everyone and which is regulated by rules applicable to everyone.

However, the street concrete arrangements may sometimes indorse or support social and legal settings of the urban life, by facilitating or, in the contrary, by discouraging some conducts, practices and behaviours that society wants to promote or to prevent.

That is where we might approach the question of "functionalism": in which situations a spatial arrangement may be useful in the "separating" of two distinct uses?

Houses walls are solid edges, concrete frontiers that distinguish the private and intimates spaces from the open and public spaces of the city. The separation gets involved here, by well-distinct realms: the private realm, which is the « inside » of houses, a highly appropriated space, and the public realm, which represents the « outside » of houses, the city most accessible space.

But if we look at a series of arcades bordering a piazza, there is obviously, in this architectural device, an inverse intention of making easy and comfortable the contact between the inside and outside of buildings, of promoting and favouring trade that might happen there, of blurring the limits that usually distinguish the private and public realms.

How do we decide, then, whether to open or to enclose the spaces located on the dwelling edges? It might be that the uses supported by those architectural forms (walls and arcades) are not the same ones: House "life" evolves around the dining room, among friends, at home, in family. The houses walls then, serve as much to *gather* under the same roof these groups of persons than to *isolate* them from the rest of the world. The arcades themselves serve as much to *get together* clients and merchants in a nice and well-behaved atmosphere than to protect and *take them away* of the faster flows of sidewalks roadway…

The question is maybe not that one:

- Should city users be separated or mixed?

And neither that one:

- In which cases city functions and uses must be separated and in which other cases is it more relevant to mix them?

But rather:

- How, according to situations, to separate some uses in a way that this "separation" be also at the same time a useful "grouping" of other uses?

Otherwise:

- How to define the "units of use" dedicated to be isolated from each other, that is to say what are the "functions" on which, with which and by which we think about the street design?

- According to which reasons is it necessary to consider them as different "functions" susceptible to be gathered or separated?

The "functionalist" approach that prevailed during the 20th century and that continues, today, to constitute a motive of critics of the road technicians' work, cannot be properly defined by only arguing that it tends to "separate" the spaces and their functions rather to "gather" or to "mix" them.

For anyway, no matter its degree of separation from other "functions", the notion of "function" itself is already a kind of "grouping" uses and users.

"Functionalism" specificity may rather come from *the way* those separations and groupings are *thought* and *operated*.

Not:

- *"Separating or gathering"?*

But instead:

- *"Who to gather and who to separate?" (political question)*

And:

"How to separate and how to gather?" (technical question)

It is also difficult, for the same reasons, to criticize the "specialisation" of spaces towards a function so as to promote, instead, their "polyvalence"[11] or their "open" and "passing"[12] characters.

Ask rather the following question: "how to accurately specialize these spaces if they are to be specialized?" Is the so criticized "functionalism" not a singular (bad?) *manner* to specialize the city? Is it not a special *manner* to open and close the habitable spaces?

The general confusion reigning in the actual urban disciplines make more or less vain the urban "debates". As long as the question of "functions" is going to stay without real reflection, as long as we won't try to understand that the *manner* to conceive them, our *way* to define and to decompose the "units of use", influences our *manners* to use and to know the city, how we try to transform it, both technically (or artistically) and politically, we may be forced to remain vaguely "for or against":

- Shared spaces / separated spaces,
- Specialization / polyvalence,
- The passing city / the blocking city,
- The open city / the enclosed city,
- Appropriation of urban space / public nature of city spaces,
- Animation / calm,
- etc.

Why do not postulate that, *from a technical point of view*, a city may be both specialised and polyvalent, free and constraint, passing and blocking, open and closed... in a way to be able to decide, *politically*, to close or open the city, here and not there, according to the way that we wish to organise ourselves into an urban society.

[11] Gourdon J-L, *La rue, essai sur l'économie de la forme urbaine*, éditions de l'Aube, 2001.
[12] Mangin D., *La ville franchisée*, éditions de La Villette, Paris, 2004.

4) Urbanistic scales and the persistence of the "functionalist" doctrine

A simple manner to ask adequately this kind of question consists to start from the notion of scale: the interlocking of several different levels of knowledge and action on the city, starting from the small sidewalk border, microscopic realm of urbanism, to the urban area created by the settled agglomeration and its natural site, that might be considered as the macroscopic scale of urban planner preoccupations.

The questions in debate can thereby be expressed in this way:

How to provide, at every urban scales, "closure" and "opening", "polyvalence" and "specialisation", "sharing" and "separation" of spaces ?

Take this example that may touch everyone as its concern is the very home space. A debate exists today, among architects and urban planners, that is related to the emergence of a singular kind of housing estate, commonly called « gated communities ». Those housing estates, which are lots isolated from the surrounding city by a wall and a gatekeeper controlled entrance, are consequently made of private streets. Defenders of the "passing city" and "open city" find in that kind of development a sort of modern unease, of "social withdrawing, of " in between"[13] for the citizens of those estates indeed, get together peoples of same social classes or of equal social level, this in urban forms that are introverted on themselves, without free physical communications with the nearby city…

Thus peoples are "for" this enclosure (when they live inside, or when they sale this product) or "against" it (as urban planners who act sometimes as kind of preachers) that is materialised into that fence and its guardian. Multiple urban planners feel indeed invested by a kind of social mission. They are to convince representatives and inhabitants of the lack of "urbanity" produced by that kind of urban forms. For them, this organisation mode and its social withdraw are less "urban" than the "opening" of spaces, poorer than what could generate a certain "social diversity".

However do we ask to urban planners, landscape designers and architects to express a *moral* judgement on the manner that some peoples decide to live, on the "virtue" of the opening that we should oppose to the "sin" of enclosing? Are they not asked, rather, to help those persons and their political representatives to better-laid the satisfaction of their desires and aspirations? Are they not asked, rather, to properly accomplish their role of master builder in order that the work commander may organise himself so as to intelligently fulfil its role?

Here is a manner to reformulate this question, starting from the technical rule that a city is necessarily both open and close, out of moral judgment *a priori*:

How are distributed, at all city scales, the different "openings" and "closures" of a family life space?

Is your room's door closed or opened? Who might enter this space? Is your house's door closed or opened? And what about the door of your estate? Of your borough? Of your city? Your country?

[13] Cf. Mangin D. et la thèse qu'il soutient dans *La ville franchisée*.

Are “gated communities”, which are so criticized by urban planners of the “passing city”, not urban plans that, if they “enclose” the city at the estate scale, allow in return to “open” it to other scales, for example to the neighbourhood scale ? To the opposite, is the demolition of our city fortifications during the last centuries really a sign of a greater opening of our cities?

Aren’t those two extreme cases simple moves of some “openings” and “closures” from one scale to another, according to the project life of inhabitants and to the various modes of organisation of the urban society? Is it really to the urban doctrine to determine here, on the moves which, among these ones, would be more or less desirable for the benefit of inhabitants?

How do not behold that the spaces’ opening is not “good” in itself and the closure not “bad” in itself? How do not conceive however that, according to the *political* objectives established by inhabitants, and according to contexts, one can find some ways more accurate than others (some techniques, artifices, the art of urban planners and designers) to distribute opening and closure among the many urban scales that range from the marriage bed up to the edges of the city ?

In this way can be taken the whole of the urban problematic: not as a phenomenon of a certain scale, but as distributions of spatial organisation principles that respond to certain inhabitants and society purposes, this at every city scales of its environment.

This notion of *urban scale* provide a good criteria (among some others) allowing to characterize the “functionalist” approach according to the *way* this one both join together *and* separate city uses.

Indeed, functionalism does not link only “a space to a function”. It is to an entire *place*, to a whole of spaces of different scales interlocked together by inhabitant’s presence and activities, that this thought attribute a singular function, in other words, to a whole of homogeneous uses.

Functionalism is not distinct of other urban design approaches only by it supposed aim to gather uses according to their speed, cost, gender or even other criterion. It is rather that this unique distinction, no matter its nature, should be applied to all scales in a continuous way: the functionalism urban design is not really concerned by the notions of residential district or commercial district, but rather by the fact that a residential district be conceived of homogeneous parts (dwellings), being themselves constituted of homogeneous parts (bedrooms), being themselves constituted of homogeneous parts (beds)…

That is how a “passing”, ”open”, “shared” or “nomad” city, is not less functionalist than a “blocking”, “closed”, “specialised” or “static” city…

Functionalism is rather following this maxim: “Think global, act local”, that is to say: when the whole (political and technical) univocally impose its constraints to its parts (political and technical), when the macroscopic scale dominates every thoughts at microscopic scale, or even when every urban scales are considered as a whole of relations of a same system rather than constituting a superposition of distinct and relatively independent systems.

However, this distribution principle of elements in the organisation of a city, according to several interlocked urban scales, is inherent to the question of the street network hierarchy. Hence its greater results might be related to this question.

5) The notion of the street network "multi-polar hierarchy"

The concept of *hierarchy of the street network*, such as formulated by transportation engineers and architects of the 20th century, is only a simplified and quantified version of a more general idea, this idea being a succession of urban interlocking scales with specific forms that respond to the many social scales of cities' acitivities organisation

In fact, it is possible to set up different categories of urban ways according to their size, their flow, their commercial impacts or even their symbolic roles[14]… Street typology and their classification within a hierarchy depend of the taken viewpoint: that of the landscape architect, the transportation engineer, the acoustical engineer, the network maintenance staff, the anthropologist, the resident, the tourist…

Each typology of the urban ways is not, *a priori*, more "functionalist" than another one: there is an aesthetic or landscaping functionalism as well as a symbolic functionalism, a functionalism of management, of comfort, or even a traffic safety functionalism…

For example, to reduce roads accidents, several diagnostic and care can be taken *at every urban scales*, from the improvement of adherence qualities of a road pavement (microscopic scale) up to the street layout regularization of a road pathway (macroscopic scale), or even by reducing the width of the roadway to conduce peoples to slow down, or also by an homogenisation of road signs, to the intermediate scales.

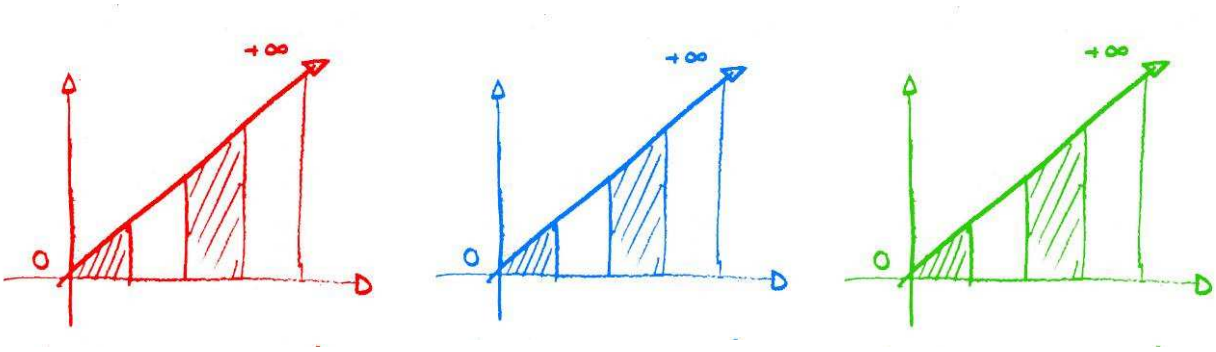
This functionalism, strongly supported nowadays, competes with another functionalism which more difficult to detect: the environmental functionalism. This one, with several labels[15], social marketing, advertising of all kinds, tend to reconfigure the production (or at least the superficial appearance of the production) of streets and networks. From the road pavement concrete conceived with titanium dioxide to absorb greenhouse gases, or from the control of car pollutants emissions at the sources, there is no transition toward the reducing of home/workplace transports, to the creation of urban parks, to the plantation of trees alignments or more, to the modification of spaces reserved for public transports in green ways: every urban intervention scales are mobilized, in a more or less coordinated fashion, to promote and build the "green" city.

Thereby, it would not be difficult today, to establish a sorting of the actual "green way" according to their aptitude to contribute to the environmental purposes of sustainable development, or even a sorting of the actual "fluid ways" according to their flow and speed,

[14] Pour un recensement assez complet des typologies de voies qu'à connu l'urbanisme du 20e siècle, cf. Marshall S., *Streets and Patterns,* Spon Press, London, 2005.

[15] The label HQE (Haute Qualité Environnementale) such as practised in the building industry, tending to inspire analogues approaches in urban and road disciplines, is an example of an actual functionnalist approach : are identified, 14 targets of environmental quality conceived as autonomous and among which the contractor is going to have to mahe a choice between those seeming to be a priority…

another sorting of the "safer roads", according to their dangerous character and another of the "profitable roads", according to their commercial impact etc.



Different hierarchies of ways according to the engineer viewpoint, to the traffic control, to the ecologist, etc. In each graphic are represented, on abscissas axe, considered urban scales (sidewalk, street, district, city…) and on the ordinate axe, the gradation of performances realised by each considered way: flows for road engineer, car crashes quantity for traffic control specialist, pollution and public nuisance for the ecologist... According to those quantitative viewpoints, le degree of performance is directly to the size of the way or the considered element.

Then, each disciplinary *viewpoint* design its action according to several scales, from territory planning to technical details, while keeping at every scales the *same criterion* to define its units of knowledge, action and result. Those units tend to create, in a "functionalist approach", homogeneous and often quantifiable hierarchies in which the "whole" sets its constraints to the "parts": is it possible to be against the traffic fluidity, against safety, against commercial profitability, or against ecological life of the planet?

Following those rather *moral* than *political* and *technical* arguments, it is almost impossible to expose a hierarchy of the street of Paris for example. In fact, the most important urban element will be different, depending on the various sensibilities of people addressed: ecology, economy, road safety etc. Thus, if eventually is chosen a kind balanced average of those viewpoints, as in the multi-criterion evaluation approaches, it become obvious that such a method only move the problem elsewhere: the weights given to each criterion become more or less arbitrary.

Though intuitively, it is easy to consider some ways and elements of the city as more important than some others, without any particular point of view (flows, trade, accidents…), neglecting also that bigger urban elements are inevitably those with the higher performances.

The Eiffel Tower is easily taken as the core of Paris network, being also the core of the whole city of Paris, and not only the middle of its own road network.

Taking the Eiffel Tower as the core, as the high spot of the network, as the site with the higher hierarchic position within the city of Paris, which path may we choose to find the opposite part of the road network hierarchy?

To answer this question, the Eiffel Tower may be considered as a kind of "exit" of the network, among some other exits that may be discovered: *the central point of the network is both part of the network and living independently of this network.*

In fact, it is possible to "step out" of the Parisian network:

- by entering into someone's house,
- by using the "Boulevard Périphérique" and then a trunk road toward another city, for example.

What do you find between the Eiffel Tower and a Parisian's bed?

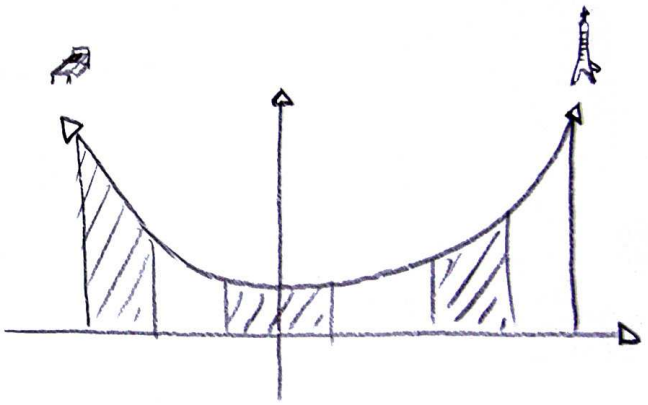
The whole of the street network. The entire city, the whole system of built spaces which compose successively his room, his house, his street, his district, his district edges, his city…

What do you find between the Eiffel Tower and the Boulevard Périphérique? The whole road network, the entire city, the whole system of built spaces …

Which element will be placed, finally, at the top of the hierarchy? The bed? The Eiffel Tower? The Boulevard Périphérique?

According to the road hierarchy nowadays in use, which refers to the admissible traffic of vehicles, it is the Boulevard Périphérique and all the urban speedways take place on the top of the hierarchy.

But, for the Parisian who works in a suburb for example, this boulevard is just a *median* element among all the ways linking his home to his workplace, or from his workplace to the Eiffel Tower.

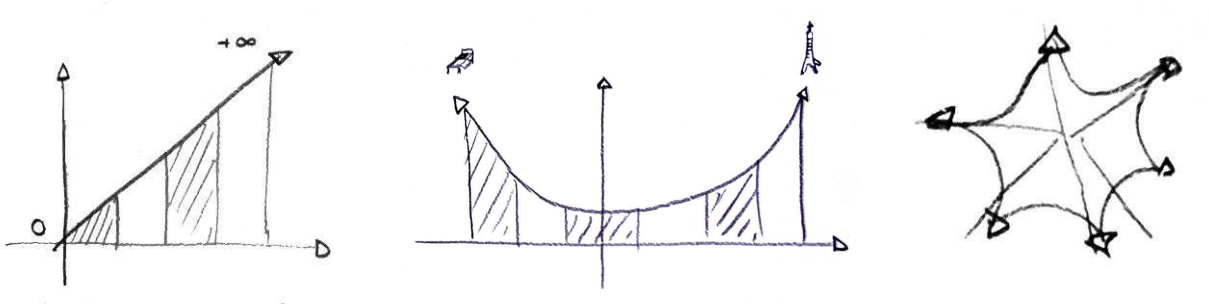


The bed of a Parisian and the Eiffel Tower: two centres of the street network, or two ways to step out of it. Between those two extremities, the whole street network of the city is expending itself.

In the same way, taking as top of the hierarchy the marriage bed rather than the Eiffel Tower or the Boulevard Périphérique, you may always find someone (your wife's lover for example) who is going to consider this place not as the first or final destination but as a place of intermediary importance in his daily use of the urban environment.

To these emblematic, central and culminating places of the city, let us add the workplaces, the leisure and trade places, etc. Then, it's neither a multitude of different and incommensurable hierarchies (one for the traffic engineer, one for tourists, one for the landscaper, one for the suburban residents etc.), nor even a kind of *average hierarchy* which would be the balance of all those common viewpoints that we may obtain. Rather, we may reach a single "multi-polar" hierarchy, within which each element and place of a city is itself a kind of "centre"

more or less influential on its surrounding and on the other "centres" of the network which are, in other words, kinds of exits of the network, of connexions toward the exterior world which lies beyond the street network.



Single, bipolar and multi-polar hierarchies: from the functionalist thought to the systemic thought.

We come back, once again, to the question the "units of uses" definition, of "city components". What does *multi-polar hierarchy* means in this regard? This kind of hierarchy is made of urban entities, of city *elementary fields* that are considered to have a relative central position, as poles having an influence on their surrounding…

Each element of the street network, each street is both a *way* to serve a place, a way toward an "exit" of the network, and a *place* in itself which is an "exit" or a "pole" of the network, having an existence out of it and toward which some elements of the network are directed.

The status of the element (or the way) within this kind of hierarchy is not determined by its size. Then, an important way which is "at the top" of the multi-polar hierarchy of a city is not necessarily a multiway used by high flows of vehicles. It is only that this way is composed of "important elements" that can be of diverse natures: certainly a large roadway in some cases, but often a gorgeous view on the shore, or even sometime all the shops of the city gathering on a small piazza…

Is important a place constituted of important places… This recursive mode of definition of the status of way of the multi-polar hierarchy is only useful if we make abstraction of the specific criterion of the "whole" each time when a transition from the "whole" to the "parts" is done: this in order to consider the "parts" with in new and "global" perspective, that must be accurate an adapted before everything else.

That is how the "Champs de Mars", which is *a priori* difficult to place at the top of the Parisian network according to the criterion of vehicular flows, can even have a certain importance, as we know that it leads to the Eiffel Tower or, in other words, that the Eiffel Tower belongs to it in a certain way..

Lets us try to summarize the previous considerations by the following logical and "non-functionalist" elements:

Concerning the composition, *i.e.* the setting of relations linking "parts" to "wholes" by the designers, it can be affirmed that the "whole" is more than its "parts", and the "parts" are more than their "whole":

- The street are “parts” dedicated to traffic that compose some specific “wholes” which may be of a different nature, as some residential districts for example, in which traffic function is not fundamental.
- The streets are “wholes” of the street network composed of “parts”: those “parts” do not have, all of them, a traffic role, as for the buildings and the café terraces which participate in giving to the street its inherent nature.

Concerning the street utilisation, *i.e.* the setting of relations linking the uses of a street to the other users of the city, it can be postulated that a street can welcome certain uses and their contraries, that a street can be used in a certain way *and* in an opposite way.

- The streets “are” the street network: they are ways leading from a certain place to another place of the city, the system that “serves” the city “places”.
- The streets “are something else” than the street network: they are also some “places”, some “centres” or some “exits” of the network, some urban elements which have a relative independent existence out of it[16].

The notion of *multi-polar hierarchy* and its inherent elements of systemic logics may be useful not to definitively fix a unique form of hierarchy more than another, but rather as a “non-functionalist” hypothesis (that does not reflect the same criterion of definition from the city scale to the gutter scale, from scales to scales) that allows to understand how all aspects of the city (inhabitants, environment, flows, symbolism...) have interlocked connections that contribute to form *what is intuitively appearing to everyone's experience*: not several and more or less abstract mono-dimensional hierarchies, corresponding to those analysed by the different urban disciplines, but rather one and a same hierarchy of the city. But this hierarchy, if it is potentially shareable by all its inhabitants and specialists *while in a design project*, will always remain eventually impossible to define quantitatively.

If until now, we have used the notion of *scale* to characterize the functionalist thought, we will address now, more directly, the subject of the definition of the “units of use”, “units of design” and their related knowledge.

[16] Cf. Chapter 5 “Remarks on a City’s composition” of Salingaros N. A., *Principles of Urban Structure*, Techne Press, Amesterdam, 2005.

III. Three "modern" ways of conceiving streets and street networks

1) A question of units and viewpoints

The existing approaches to examining a city define it as either a superimposition of an economic system, a social system, a collective transport system, a street network system, an environmental system, a sanitation system, etc. This kind of system is one-dimensional and composed of homogeneous elements interacting with one another. An in-depth investigation of a unidimensional system leads to ways of thinking and of acting in networked cooperation: it leads one to represent and understand the considered urban phenomenon as examined through a certain viewpoint, through sets of nodes and arcs that can be drawn on a same cartography, on a same layer. The layer is the tool of the designer who considers a separate study of several unidimensional systems, in order to possibly confront one another at the moment of action.

In a schematic way, we can say:

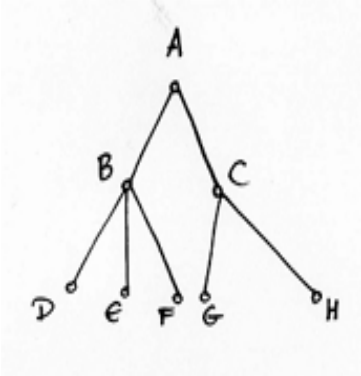
- That functionalist urbanism chose not to superimpose those tracings by allotting a well defined function to each part of the space in order to avoid any questions concerning their overlapping.
- That the sectorial urbanism has extended beyond and thus overlapped those unidimensional systems, while analysing and practicing them separately.
- That integrated approaches gave more consistency to those systems, not only because they are considered as separate entities, but also because they entertain relationships with heterogeneous tracings, thus giving birth to an "urbanism of networks".
- That today another possibility is open, which would take as its unit of knowledge and of action, the phenomena of organisation of the urban space and their urbanistic models. Indeed, they already articulate by nature and in a specific way, a certain number of unidimensional systems.

2) Functionalist urbanism

Antwerp, Belgium.

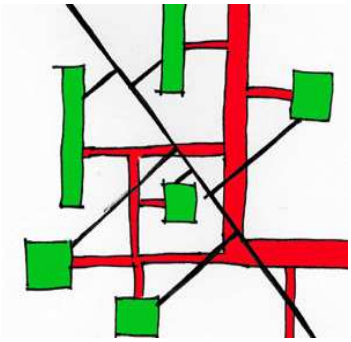
The layouts of functionalist urbanisms are composed of zones designated to unique functions (accommodations, work offices, park, administrations, etc.), juxtaposed with each other and linked with each other through several networks. There are only a few examples of "modern districts" in the history of cities where there is no direct correspondences between the technical networks and the street network, where pedestrian walkways rarely encounter the ways allotted to the heaviest ways of transport and where the built and the roadway systems (we can no longer talk about streets) aren't linked.

The following figures duplicate a "housing estate" layout and a "modern district" layout that we can find all over France and Europe, at the periphery of big cities. The housing estate layout is considered to be a succession of simple problems: the network configuration has to minimize the length of the roadway system to be built, which is also the length of the associated technical networks, which is almost proportional to the assembling costs of those networks; therefore, this length mustn't overtake a certain limit, which depends on the number of houses planned for the operation, itself depending on the lot surface and price dedicated to the housing estate. The simplistic computation is quite conscious; it logically leads to choose the tree configuration or one of its variants in the case of housing estates: the racket.



A tree: to go from D to E, it is necessary to pass by B; to go from D to G, it is necessary to pass by A.

Housing estate lay out: technical and road networks follow the same plotting in tree



Layout of a modern district: technical networks, tree shaped, are independent from the public road.

With regard to modern districts, the absence of parcels, and thus of proper streets, led the constructors of certain operations to adopt a tree configuration for the technical networks, going to the shortest way independently from the public road that, in this kind of city planning, were paradoxically not built in the cheapest way.

These kinds of layouts have extremely important effects that are often not anticipated by the people responsible for their design. The relations offered by networks are generally insufficient in practice and allow for very few possibilities of evolution. Difficulties come up when more and more short-term economic variables are add up to other variables like the uses, the safety or the possibility for the network to evolve…

In general, criticism concerning the functionalist urbanism focuses on the following points:

- The *segregation* of the functions and the spaces which they are associated with, in particular giving space to deserted portions of city during the day (dormitory town), and to others lifeless during the night (workplaces, campus, etc.);
- The *omission* of many criteria in the city conception; in particular those linked to informal uses that hardly fit with the categories of Athena's Charter (lodging, transport, work and recreation);
- The *standardization* of the architecture and of the city spaces, coming from confusions between the notions of model and of standard;
- The *falseness* of certain presumptions and results announced as scientifically proved, presented in conjunction with an extreme simplification of the problems encountered;
- A thought too preoccupied by *objects*, which thus forget the relationship they entertain between themselves.

Antwerp, Belgium

But the more fundamental criticism that one may oppose to this kind of thinking and designing is without doubt linked to the fact that this mode of designing has completely eliminated the political aspects of urbanism.

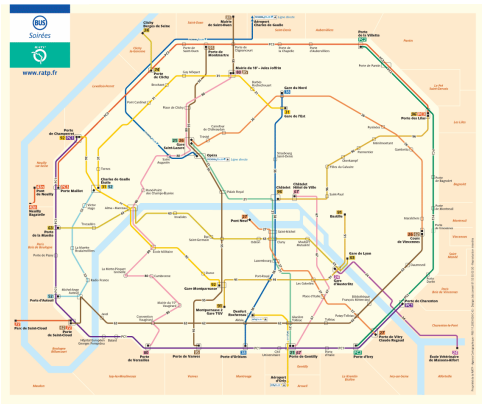
Indeed, if we can define the *functionalist urbanism* as the application of one two-variable function, one being that of cities' functions and uses and the other being that of its spatial and concrete configurations, the urban planner or urban designer would be meant, according to this approach, to master these two types of variables! The definition of functions is considered as a full part of the technical doctrine, it may be "optimised" as may be the city concrete arrangements: the architect or engineer has a complete liberty to organize the life of the city as he may wish, or a least as the modern doctrine conceives it… *Political*, *moral* and *technical thought* are confused into a kind of a total and directly applicable doctrine.

3) Urbanism of networks

In order to answer to the difficulties raised by the failures of the functionalist urbanism, many fields start scientific studies of some urban phenomena considered under particular aspects. Space psychology, sociology, anthropology, ethnology, urban geography and economy for social studies; transport, road safety, pavement' constructions and coating, hydrology, illuminating engineering, acoustic and others among the engineering sciences cast the first stones of an urbanism of networks.

Today, approaches that study and transform cities by applying unidimensional logic are called "sectorial approaches." Examples include adding road signs in order to decrease the number of road accidents, reducing the automobile traffic in order to limit the emission of polluting gas and inserting bollards in the sidewalks to prevent cars from parking there.

Analyses, diagnostics and programs of action are done within each system. They cover the entire city, agglomeration or even national territory. Therefore, the management of the public transport system is thus optimized so as to meet the transport needs of all of the towns and districts considered. Characteristically, a local action upon a part of a network will have an impact (not always predictable) on its over-all mechanism.



The network of Parisian buses: a complex meshing but within a same system.

The main asset of those approaches is the fact that they may rely on strong knowledge. Therefore, the link between knowledge and action is above all one of "application". While a scientific discipline defines itself by its object of study and especially by the point of view adopted regarding it (the point of view of the discipline establishes the object of study by selecting among the empirical object, the aspects that seem the most determining to proceed with the development of its theory), a trade defines itself first of all by the nature of the objects it produces, or of the actions it takes. When a scientific discipline is applied, like within the framework of the sectorial approaches, it is the single point of view that has been elaborated that takes precedent over the object to produce or the action to be taken.

The main difficulty for those approaches is the fact that they are conceived independently from one another. The effects of actions taken inside a system or inside a particular network aren't realized outside of it, while it is clear that acting on a road signs is also acting for example, on its aesthetic, its legibility and the atmosphere radiated. Thus, we can notice that the cooperation between those unidimensional systems can be done only in a passive way (the town successively undergoes each intervention done independently from each other, like the numerous trenches done one after the other as concessionaires of technical networks need to

preserve or make evolve theirs networks), or at the last moment (the various representatives try to come to an agreement on the choices that respect as much as possible all points of view), which often result in subordination relationships (according to the negotiations course, one "logic" or "criteria" is favoured in comparison with the others).

In order to overcome sectorial approaches defaults, "integrated" approaches continue to be implemented according to a specific logic, proper to a fix unidimensional system, while taking into account:

- Impacts on other systems: for example, what are the environmental, economic and aesthetic effects that the accomplishment of such a road infrastructure will set on its context?
- Effects induced by other systems on the considered system: for example, what are the climatic effects, the economic and sociologic effects that will modify the use of this infrastructure?

What are the environmental, economic and aesthetic effects that the accomplishment of such a road infrastructure will set on its context?

Each mode of intervention strives to "take into account" external elements that will interfere with its own functioning. Thus, multi-criteria assessments are generally processed to ensure an integration that gives an operational legitimacy and efficiency to the urbanism of networks.

The relationship between knowledge and actions has been slightly modified: the discipline point of view has made a little more place to the nature of the objects and of the processes considered. In the area of technical networks, when the economic criterion is considered, added to the flow that has to be provided, tips and other wires are no longer proportioned "custom-tailored" (with only the flow to ensure as measure), but they are chosen among pre-defined diameters. We move from a one-dimensional continuous space of solutions, to a multi-dimensional discontinuous space of solutions. The kinds of tips and wires available on the market are a function of their production requirements in the factories (height of the machines, etc.), but also of the conditions of transports and of implementation in the construction sites etc.

Unidimensional systems, for they are composed of relatively homogeneous entities, allow to link in a direct manner the "whole" to its "parts": one can measure the impact of a local variable (the pollution of an automobile, the economic exchanges of a restaurant…) on the global variable of the considered system (the vehicle pollution of a city, the commercial exchanges of a city…). This is how, when some global variables come near to *moral values,* to positions in front of which it is difficult to be "against" (how may one be opposite to the economic growth of a city, or to the reduction of traffic pollution?), the *technical possibilities and options* are finally replaced by a whole set of *moral duties*: air *quality* and water *quality,* acoustical comfort and thermal comfort, reduction of visual nuisances, traffic fluidity, availability of parking lots, accessibility to reduced-mobility people… all became as many purposes that are taken independently to guide a myriad of local actions.

The logic of "think global, act local" reduces, without saying it, the technical action and the political action to a sort of moral action which exhibits some inherent limits:

- The logic of "taking into account" numerous external criteria remains limited in a practice which by nature, remains concentrated on the main network or system which is carried out.
- This brings to proceed to an organization into a hierarchy of the criteria, of which it is difficult to identify the true issues; it thus stays more or less arbitrary varying on the case.
- Many urban phenomena slip out of those approaches, in particular those who manifestly participate in the quality of the proposed spaces. The following example, extracted from the article of Christopher Alexander "A City is not a Tree"[17], is a good illustration of it: the relationship system that is shown here is neither sectorial nor integrated. It's not a network but rather an interweaving of networks into an urban phenomenon of an "organized complexity":

"For example, in Berkeley at the corner of Hearst and Euclid, there is a drugstore, and outside the drugstore a traffic light. In the entrance to the drugstore there is a news rack where the day's papers are displayed. When the light is red, people who are waiting to cross the street stand idly by the light; and since they have nothing to do, they look at the papers displayed on the news rack which they can see from where they stand. Some of them just read the headlines; others actually buy a paper while they wait. This effect makes the news rack and the traffic light interactive; the news rack, the newspapers on it, the money going from people's pockets to the dime slot, the people who stop at the light and read papers, the traffic light, the electric impulses which make the lights change, and the sidewalk which the people stand on form a system - they all work together. From the designer's point of view, the physically unchanging part of this system is of special interest. The news rack, the traffic light and the sidewalk between them, related as they are, form the fixed part of the system. It is the unchanging receptacle in which the changing parts of the system - people, newspapers, money and electrical impulses - can work together. I define this fixed part as a unit of the city."

One may find the same kind of urban phenomena in any street corner: in a same space meet various objects, proper spaces and devices that belong to one or many urban systems: water drainage, leisure, information, road network, pedestrian paths, commerce, transports… All these elements contribute, *together*, to give *one* form to the daily living spaces of a city. What one experiments everyday, as an inhabitant, is the whole of these mutual *patterns* of

[17] Alexander Ch., "A city is not a tree", 1965.

imbrications: the “street corner”, the “parking row”, the “pedestrian street”, the “central piazza”, the “public bench”, the “roadway”, the “building block”, etc.

We shall see how these *forms of organisation*, and their *models*, may constitute powerful supports for the *technical conception* and its articulation to *political deliberation*.

The building block is one form of organisation among others that belong to many urban systems and networks and that are therefore impossible to understand and design if these systems are taken separately.

4) Model-oriented urbanism

Most often, it is architects and urban planners who work on the mutual interweaving of systems, but there also exist multidisciplinary teams and collaborations between diverse services. Those people work by project on global approaches that must take into account all systems (in the sense of networks, that is to say unidimensional systems) in particular contexts, in order to consider the transformation of a portion of the city space.

However, those people don’t have an appropriate knowledge as specialists do. Thus, the cooperation between the various networks of knowledge is done on a case by case basis, and project by project despite the complexity of the task.

However, there exist *implicit models* used and re-used all over Europe and the world. Thus for example, the model of the pedestrian street is identical in Madrid, London, in Stockholm and in many other cities; you’ll find for the most parts, the same signs and shops, the same special configuration, the same uses and the same behaviours. It is a model among others, which regularly feed the projects headed here and there. Likewise: public transport ways in reserved tracks, double tree alignments, archways, multiplex cinemas or raised sidewalks which are as many *tools* that urban space planners implicitly apply in their projects of pieces of city.

Actually, despite their implicit and thus unproved character, the nature of these models is that they each articulate several urban networks. The pedestrian street is a set of spatial configurations supporting a very strong social activity; as such, it operates into a network of places, in which the different aspects of the public life organize themselves, compete with and complement each other. The pedestrian streets also support a strong economic activity, of commercial type; here are located the major international brands, the only ones able to pay for a location so well-situated, and playing a particular role in the global urban network of trade activities. Generally, the pedestrian street connects two important places of the city and is also

a link in the global traffic network. The shapes of the actual pedestrian streets are also subject a number of critiques; in fact, the specialization of the way limits its possibilities as public space; during the evening and the night in particular, those spaces are often deserted. However that may be the quality of this model and of the spaces it produces, we are facing a complex object, applied in urban projects and which articulates by itself a certain number of heterogeneous networks.

There exist three main difficulties going against a work on those models as they are presented actually, that is to say under their implicit form:

- Today, the dissemination, the content and the shape of those implicit models rely mainly on fashion and picturing phenomena, more than on the real advantages they would offer to users and to the city; flimsy implicit models, foremost guided by the global network of images;
- While sectorial actions have explicit scientific knowledge, project architects don't have such a legitimacy and experience difficulties in supporting the validity of some urban models against arguments endorsed by science or for the sake of economy;
- There exist a strong ideological opposition from designers themselves to explicit the models they use. The functionalist standard-models' rejection is still very present in minds, and in the same way, an under-evaluation of the complexity of the tasks to be done remain in the field.

Thus, there must be a reflection on such models' status[18, 19, 20]. Conferring to them the status of urbanistic knowledge seems necessary and would allow overcoming the three kinds of difficulties raised: to build a knowledge shared by a certain community of professionals remains one of the best ways to keep control over the dissemination of information concerning its sphere of thought and actions. Constituting an urbanistic knowledge is also, for the community of practitioners, a way to acquire more legitimacy and more respectability. Finally and above all, knowledge is the only way at the disposal of professionals, to share the results of their experiences, to ripen their tools, to acquire more relevance and finally being involved into an art that overtakes the limits inherent to all individualities.

Networks and models approaches are complementary. The first ones are developed horizontally and in an homogeneous way, on the whole space of the city, the other ones being rooted in specific types of contexts, crossing some systems of which they form a particular spatial and temporal articulation.

The *design models* that can be considered in this perspective, that is to say in their explicit form, are closely linked to their context; in fact, they can only be applied by a sort of clutch in the real world that results in their transformation and in the transformation of the contexts in the same time. However, it doesn't prevent them from keeping a value of knowledge, *i.e.* to offer a set of organized information, sharable and of general reach. In this way, they are based on epistemological foundations of systemic models[21].

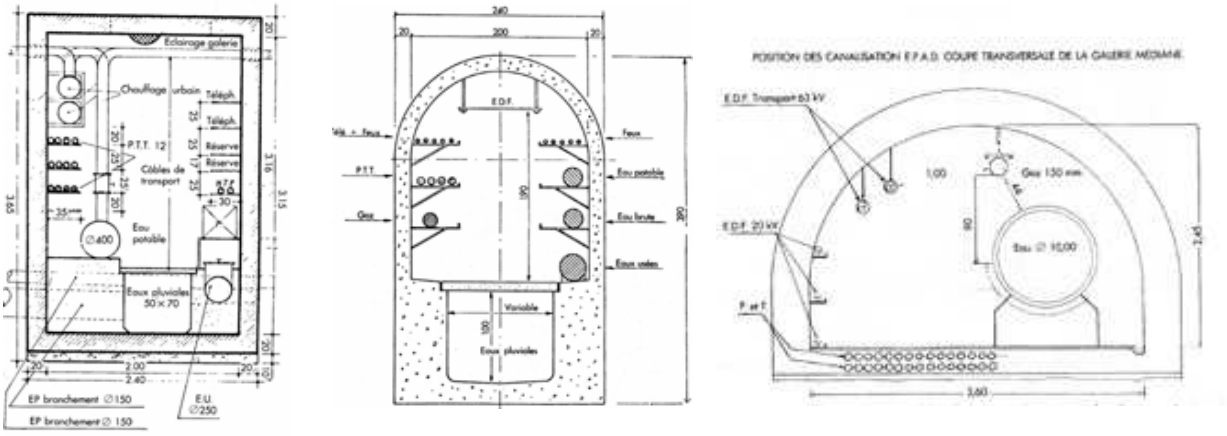
---

[18] Jacobs J. « The kind of problem a city is », in *The Death and Life of Great Amercian Cities*, Vintage, 1992.
[19] Alexander Ch., *A Pattern Language, Oxford University Press, 1977* ; et *Une expérience d'urbanisme démocratique*, Seuil, 1976.
[20] Lynch K., *Good City Form*, MIT Press, 1981.
[21] Le Moigne J.-L., *La modélisation des systèmes complexes*, Dunod, 1999, and *Les épistémologies constructivistes*, du même auteur, PUF, 1995.

5) Technical networks and urbanistic models

The concept of technical gallery which plans to put together and places in the same gallery, opened to visits, all underground networks, is a good illustration of this kind of approach. The difficulties in applying this model are technical (doubts about rules proper to each kind of network…), financial (the economic advantages of this model are better measured on the long run than on short term logics,…), juridical (question of property, of responsibility and of management…) and finally organizational (convince all concessionaires and partners of the utility of such an effort of changing habits and sectorial processes is doubtlessly the hardest) that can explain the slowness for applying this model since its invention.

The model of the technical gallery is clearly linked to a precise context of action with which it interacts: for example, it corresponds to problems of possible hold for networks; it can also be part of a bigger project of urbanization of sub soils, and thus interacts with other *design models*. However this last point is the less developed, and could clearly benefit from an expansion of the models, not only of technical models, but also of urbanistic design models[22].



The technical gallery: a model of coordination of technical urban networks

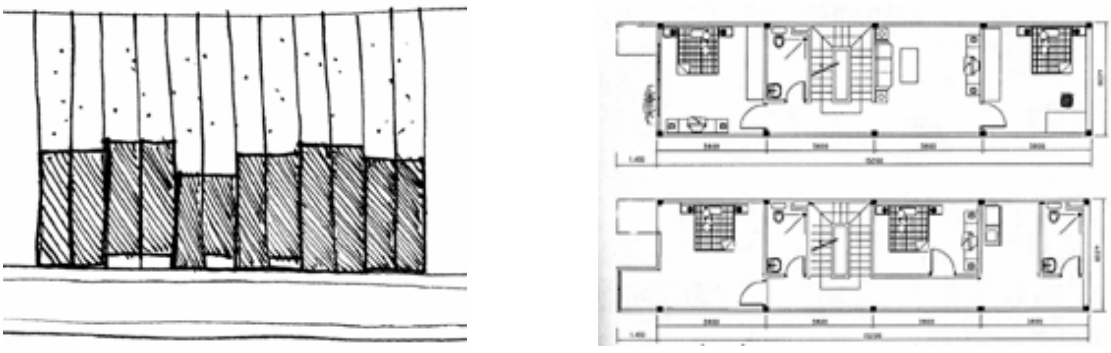
Let's take this type of example, the one of town houses or "houses in row". In the frame of such an urbanistic model, the networks and the road still determine dwellings' layouts for economic reasons. In particular in some developing countries, in which networks are barely developed and the access to the way that centralizes the whole is very expensive. As a result, pieces of land are very narrow, with a width of only 4 m. Thus, constructions are, placed side by side when the regulation allows it, distant of some centimetres when forbidden.

This has direct consequences on the bright quality of houses' indoors, on the way that rooms will be organized, and thus on inhabitants' way of life. The only possible openings are located at the front or at the back of houses, *i.e.* on the shortest walls; while the core' house is sorely enlightened by the light of the day. Spaces inside the house are strung one after the others, thus insuring a progression from public spaces to more intimate spaces, which can be interesting in case of accommodations in strong density. However, neighbourhood relations may not be particularly favoured at a main street' surroundings…

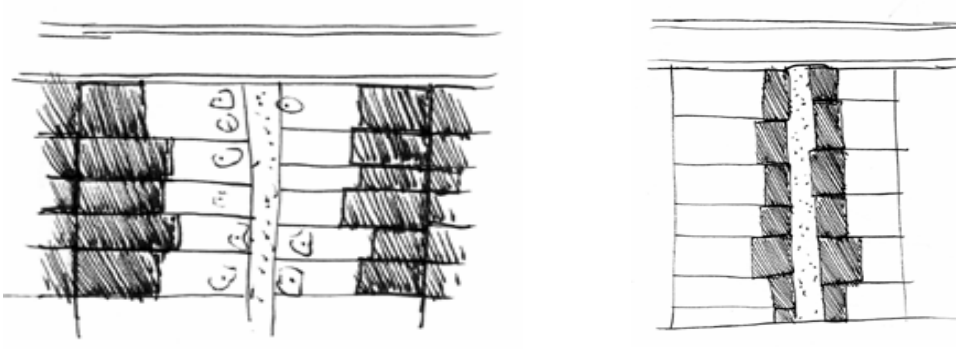
[22] Source of illustrations : *La coordination technique*, recommandations pour la coordination des VRD dans les opérations d'aménagement, Editions du STU, 1987.

Hanoi, Vietnam.

Other schemes have been imagined and realized, more expansive from networks' point of view, ending in different configurations of street, separating part of pedestrian and automobile' flows, but giving room to shared spaces between the several residents. It would be interesting to further study those configurations as well as the previous one, from a social or from the atmosphere point of view for example. This would enable to ripen those configurations, the kind of context in which they are relevant, the way they are transformed by it and transform it, and the processes of their conception and production.



A configuration in economic plan from the point of view of technical networks with its consequences on the internal' organization of houses.



Other configurations less competitive from networks' point of view but entailing other consequences in the organization of houses.

The question of technical' networks is here imbricate into many other issues that put at stake social organisation, bright quality and the distribution of houses' rooms, just to give a couple of examples.

Studies on such urbanistic models, *i.e.* on such configurations and on their conception and implementation' processes would usefully bring together and articulate, researches made into sectorial areas a *priori* disjointed: technical networks, neighbourhood relations, the bright and acoustic quality of houses, rooms' distribution, etc.

The first thing to do, is to observe and evaluate such configurations and processes when they exist, according to the relevant' points of view for each model. Then it consists in proceeding in an inductive manner, in order to grasp those pieces of *organized complexity*, relatively autonomous but functioning in relation with each other. Certain sectorial logics will quickly block the transformation' possibilities of the existing configurations and processes; but the fact of presenting them as subjects of theoretical researches themselves, enable to imagine solutions where *a priori*, some actual parameters prevent from spending too much time to search through during the design phase of particular projects.

This bring us to ask the following questions: does the concept of technical gallery, which centralizes all networks, gives in this way too much weight to underground networks during the establishment of the configurations of the parcels? Do all networks maintain the same relationship with the frame and general configuration of streets and street patterns? To what extents the meshing of the street' networks and the one of underground and aerial technical' networks can correspond?

Those questions don't find answers by themselves, outside of any context. It is very hard to evaluate in a global way the relationship maintained by two systems distinctly different from one another. However, those kinds of relationships can be considered inside the frame of some *urbanistic models*, involving a larger number of systems while restraining the study into considering only one kind of given context. Hence the utility to lead researches on these phenomena of *organized complexity* that can be conceptualized and made accessible to several fields. Indeed, it consists of conceptual issues, depending on several specialists' competences, that require reflection on different time scale than that short one which is needed for the design of urban projects.

Some issues in the development of a new tool for street design

Three overviews of the street have been sketched within the first part, each one mixing several problematic that street designers must try to resolve.

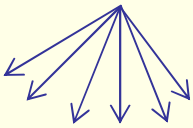
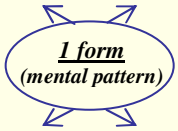
The two first sketches have permitted to extract 4 key questions:

- The *microscopic / macroscopic* relation: the role of the street in the process of constitution of the city.
- The *"transport uses" / "stay uses"* relations and, more globally, the relation between the streets and the "things that are not the street", notably parcels and buildings.
- The question of *multi-modality*, or the relations shared between the various modes of transport within the street space.
- The *street network hierarchy*, in other words, the relations shared by the streets between them.

On its side, the third sketch has allowed to extract three different approaches of the urban action:

- "Functionalist urbanism"
- "Networking urbanism"
- "Modelling urbanism"

The following table shows how those typical approaches, previously identified, embrace all these issues in a specific manner. It thus defines, in its third column, the purposes targeted in the development of the urbanistic "models of conception and deliberation" that are going to be the subsequent subject of next parts of this report.

Approaches	Functionalist	Networking	Modelling
Unit *of knowledge*	***1 function*** = one group of similar uses: "circulate", "sleep", "recreate"…, might be satisfied separately.	***1 viewpoint*** = a group of special relations: the acoustical, sociological or lighting phenomena… and their separated spatial system.	***1 form*** = one common principle of organisation of both {one pattern of uses} and {one pattern of spaces}.
Principe *of causal relations*	***1 function*** *(F)*  *(O)* *1 spatial object*	***1 viewpoint*** *(P)*  *{S1, S2, S3, …, Sn}* *1 spatial system*	*1 pattern of uses* *{U1, U2, U3}*  *{E1, E2, E3, E4}* *1 pattern of spaces*
Relation *knowledge / action*	***Application*** of standard models and simple rules coming to a *mono-criteria choice, among some existing solutions,* of a configuration that space must follow according to its attributed function.	Successive and independent ***applications*** or even associated applications of some different and sectorial models leading to a *multi-criteria choice, among existing solutions*, of a configuration that space must follow.	***Conception*** i.e. *imagination, on the basis of explicit and well-proven models*, of forms of spatial organisation which might be combined and transformed according to the context and the intentions of the contractors.
Relation *technique / politics*	***Elimination*** of the notions of "technical good" and "political good" by the modern notions of "problem" and "solution".	***Confusion*** of the notions of "political good", "technical good" and "moral good" into the notions of "criteria" and "values" thus manipulated as dogmas.	***Articulation*** of the "technical good" to the "political good" by the notion of "form", *i.e.* of a principle of organisation common to urban spaces and urban uses.
Microscopic / Macroscopic	The streets exclusively respond to a sub-group of the city functions: those related to traffic. A street will be more efficient if bears only one function.	The transports in a city are supported by a set of streets organised into a network. This system has some impacts on some others systems of the city as on the "local life" or the social environment.	There is several models of street and principles of organisation responding, each one, to different city situations. It might thus be possible to say that almost the entire city "is" in the street.
Transport uses / Stay uses	Flows and stops are some different functions more suitable and well supported if put in spaces adapted to their nature and thus different from each other.	The flows have some resulting impacts on the stay uses and inversely, the stay uses have effect on flows. Then, those uses can coexist together within a certain limit.	The flows and stops may be antagonist, concurrent or complementary, according to the situations they are taken in and to the considered street models.
Multi-modality / mono-modality	Each mode of transport is different "by nature": pedestrians are separated from cyclists, themselves separated from cars. Each space is meant to be mono modal.	According to the adopted point of view (speed, size, pathway, use rules…), modes of transport are more or less different. Then, this point of view leads to gather or to separate them.	While some models are mono-modal, some others are multi-modal: there are plenty of different principles of organisation that respond to different types of purposes and situations.
Notion of hierarchy	The city spatial hierarchy follows the hierarchy of functions: more or less importance and consequently more or les space may be given be given to each transport mode and its allocated space.	A proper hierarchy exists for each point of view: hierarchy of green spaces, of flows, of site symbolism, of commercial activities, etc. Those hierarchies are conceived as independent.	The importance of a site depends as much of the intensity of some functions as on the successful interactions of some of them. A hierarchy of urbanistic design models is thus necessarily "multi-polar".

-B- Streets Arrangements, Forms and Uses in a Systemic Perspective

Definition of a conceptual modelling of street design

We present, in this second part, a theoretical model of the production and functioning of streets: a "conceptual modelling" which shall have to satisfy to the conditions and purposes presented in the previous part.

We will proceed, for that, by "switching" from "things" to "ideas", from the concrete streets to their design tools: once the organisation of the street well understood, (*see I. Organising*), and after having demonstrated the role that a whole set of implicit models plays in this production (see *II. Modelling),* we shall able to define and locate the urbanistic "conception and deliberation models" and to explain, finally, how this tool might help designers to conceive and realise the streets. (*see III. Formalizing*).

I. Street simple and complex organization

1) Recursive acceptation of the notion of form

What is a street? At first sight, it is a concrete arrangement, a real thing in the city, composed of a whole set of heterogeneous elements all made, configured and placed by man: these are the *multiple arrangements of the street*.

Thus, we see, at a second level, that this arrangement reflects and serves a certain repartition of city roles, responsibilities and functions, and a certain political organization of the urban life: *these are the multiple uses of the street*.

To understand the adequacy or inadequacy of those multiples arrangements (the means) to the multiple uses of the street (the purposes), one is lead to consider the *reasoning and ideas* that designers, users and stakeholders have produced in their mind during the design process: these are *the multiple (mental) forms of the street*, in other words, the several manner to conceive it, the several possible ways to consider its transformation and to set its organization.

It is that missing link of the "cognitive form" that has been hidden or misunderstood by modern and post modern theories of city production until today. The *form* as "principle of organization" (mental pattern of formal features and properties) has been largely mixed up and confused with the real and measurable *configuration* of the design, notably in the famous functionalist formula: "Form follows function" [23] which should be rather formulated, if we are to express its author real idea, by this other sentence: "Configuration follows function".

Even when this superficial notion of the "concrete form" (which is in fact a configuration) has been completed by the more ambitious one of "internal structure" (supposed to contain and express synthetically the essence of the analyzed objects), or by the complementary one of "process" (supposed to express the dynamic character of structures), peoples have continued to see in those couple of notions something rather simple and rough[24].

What is always difficult to describe is the *recursive* character of the notion of *form* which, when well understood, makes it finally impossible to mix up the notions of "form" with that of "concrete shape". Some properties that are *mentally attributed* to things are formal or "forming" relatively to some others properties which are, from this point of view, in-formed or "formed". But those however, can exhibit "forming" properties from another point of view and in relation to other elements that might be, in their turn, informed or formed...

---

[23] From the cognitive and mental point of view (form as a principle of organisation) the modern "functionalists" as their "formalists" rivals are, in fact, only two complementary branches of a same "materialism" far from the "rational" and "formal" characters that society has too generously attributed to these schools. For it is the work of conception that they have well hidden during the whole of the 20th century: their weakness is not due to an excess of "reason" or neither to an excess of "form", but rather, inversely, to a reduction of the mental part of the design in *every* acts of urban transformation.

[24] We take the notion of "forme" as Aristote and Platon were taking it: the "formal cause" is the mental pattern formed in the mind before any *artefact* is realized. Today te theories of systemic modelling and deign sciences have come the clcosest to these notions of *form* is we shall use it here, notably when these theories have developped the concept "gestalt", "pattern" (Christopher Alexander, Hebert Simon, Norwood Hanson et Gregory Bateson) and "auto-organisation" (Edgar Morin, Jean-Louis LeMoigne, Stuart Kauffman).

In others words, it is absolutely possible to take the (mental) *form* of the sidewalk as the organization principle or as the transformation principle of the roadway (by conceiving the roadway as the border of a wider way for example). And oppositely, it is even possible to take the *form* of the roadway as the principle of organization of the sidewalk (in defining for example, two distinct ways of traffic on the sidewalk).

The street *form* and the sidewalk *form* are as "real" as the street configurations and uses: they have some influences, not only on themselves, in the world of ideas and concepts, but also determinately on the existence of the material street arrangements and on street purposes[25].

When one considers the production of streets, the recognition of the role of *forms* in the global process imply to conceive the intervention of a work of *imagination*, of a mental activity which is going to reason and to form some organizing principles that shall be useful when it's time to pass from the desired purposes, to the concrete arrangements.

This intermediary step is determinant from three points of view:

- *Technically* (or artistically), that is to say from the viewpoint of the master builder: the passage from problem to a solution is not made by some rules automatic application: it involves a real work of conception of a form of space and matter organization.
- *Politically* (or morally), that is to say from the viewpoint of contractors and users: the definition of intentions not only some simple choices among pre-existing goals and solutions: they suppose a real work of *deliberation* of a form of social organization.
- From the point of view of the relationships between contractor and users on one side, and the master builder and building companies on the other side, agreement or disagreement are not only related to concrete details of street arrangement nor to the simple definition of purposes, but even about an set of recursive forms (formed and forming, informed and informing, transformed and transforming…) supposed to organize both the concrete arrangements of the street and its attributed uses.

We shall thus describe the street organization in 3 steps:

- What are the *arrangements* of a street? What is its material constitution? What are the "things" composing a street?
- What are the purposes of a street? Why did they build it like this? According to which *uses*? *A*ccording to which modes of functioning*?*
- What are the *forms* of a street? Which principles of organization have been thought to generate this organization that is both human and spatial?

[25] The notion of form and its recursive proprieties do not provide new elements to the concept of « form » (as « specie », « proper beauty ») » and of « formal cause » (opposed to the « final » causes, « efficient » and « material ») as developed by Aristote and after by the scholastic philosophy .

2) The multiple arrangements of a street: polyvalence and parsimony of means

Multiples objects, spaces and devices of all kind are built and placed together to form what we will finally call a "street". At first sight, the following list can be made, naturally not exhaustive, of all the *arrangements* of a street:

Table 1 : The multiple arrangements of a street

OBJECTS	SPACES	DEVICES
○ Buildings ○ Trees alignments ○ Public benches ○ Waste bins ○ Bus shelters ○ Shop arrays ○ Cars ○ Road signs ○ Bollards ○ Parking meter ○ Advertising hoardings ○ …	○ Parcels ○ Sidewalks ○ Forecourts ○ Gardens ○ Parking ○ Bicycle tracks ○ Arcades ○ Roadways ○ Café terraces ○ Building halls ○ Pedestrian crossings ○ …	○ Street lamps ○ Roadway structures, ○ Paving ○ Technical networks ○ Manholes ○ Telephone booths ○ Roadside gutters ○ Sidewalks ○ Traffic lights ○ Radar traps ○ …

It appears that each arrangement can play the role of a space, of a material objects and / or of a technical device. For example, a parcel taken for a space, a piece of land where its owners want to build, might also be an object for the neighbours: the piece of land is made by its delimitations, by its edges and walls. A parcel is even for the parish council, a juridical device of attribution of lands. It is also for the inhabitants, a social device allowing controlling accesses of peoples to their territory.

This is exactly the same for a sidewalk. This space dedicated to circulations is even a protection device for the building and its dwellers against an accidental car diversion, or even a paved object, a support for the gutter, etc... A street lamp fulfils a function of technical device: to produce certain lighting in a certain direction and at a certain moment of the day. The street lamp is also an object that can stand in the way, an obstacle on the public way. And more, it is also a space: a pedestrian might come and lean on, a cyclist can use it to chain its bicycle and a café terrace table might stand behind it.

In regard to that heterogeneity and indefinite multitude of arrangements composing a street, each street possesses a unique configuration resulting from their mutual relations in a certain context, in a specific environment.

Though, despite the quantity and the complexity of all these parts, despite its singularity and uniqueness, a street expresses a certain form, a certain organisation and a certain general

scheme of functioning, characterising its unity and giving its common "parental" bond with the other streets.

A street is thus a heterogeneous and complex system of devices, spaces and objects implanted ones *next to* the others, ones *on* the others, ones *in function* of the others. But this heterogeneous system is composed in such way to allow everyone's recognition of the form of that specific *place* which we call a street, this in order that everyone knows how to behave, what is the organization and how to understand and construe the global functioning of the street.

Principle 1: Polyvalence and parsimony of means

** A street is the organisation and the disposition of whole set of arrangements. If each of these arrangements can take part into the constitutive relations of the site as object, as space and as device, then all those arrangements are polyvalent and closely interdependent.*

** It is only needed then, to act on some of those arrangements, taken as spaces, as objects or as devices, to modify the global functioning of a street, its organisation.*

** This conducts to act with parsimony and polyvalence: small, simple and well-understood arrangements may generate great effects.*

Example 1: Installing a bollard alignment, widening a sidewalk

To install an alignment of bollards and prevent chaotic parking (device), is also to shrink the available space of the sidewalk for pedestrians (space), multiply obstacles for blind peoples (object), and to protect pedestrians from an accidental left of road. (device)

Widen a sidewalk to provide more space to pedestrians (space), it's even to reduce the speed of the cars (device), increase distance between pedestrians (space), make car's passing impossible in case of temporary stops (object), allow shops to appropriate a pert of the sidewalk (space) etc.

Example 1': Stone arcades and glass curtains

Which importance could have the facade of a building regarding the uses organisation of a street? Two inverse examples will demonstrate the kind of effects that can produce some simple modifications to the "edges" of the street.

An arcade's bordered street is entirely related to the building and its contained activities: trades, exhibitions etc. Pedestrians find their way toward the buildings offering protection against bad weather: there is something to look at along the arcades and the pathway is protected against wind and rain, away from the roadway and its traffic. Sudden stops are easy and shops get huge benefits from this. A glass-fronted building produce the opposite effect: it is impossible to lean on, neither to stand in front, without to feel observed from the inside. The polished aspect, clean and fragile, incites to get away. Leaning on a glass curtain is not a nice place to wait somebody, neither a place chosen by peoples to eat their lunch meals. More, it is not along that facade, barely touching it, that pedestrian will prefer to walk along. That is how, while placing some building along an axis and even before to have laid the sidewalk configurations, that a certain fundamental aspect of street uses organisation is already determined. The stone arcade is not better or worst than the glass curtain: theses are simply two different localized ways to act on the global functioning of a street.

3) The multiple uses of a street: relations of politeness and politics

Before to be an arrangement, a street is a political organisation between permanent or temporary owners, users that utilise the place for their own needs, following their wishes, their intentions, according to the rules and the organisation set by themselves. The street serves the society. As the society, the street has a multiplicity of actors with different interests, habits and behaviours that create at the street level, the multiple *uses* that a street may welcome.

Table 1: The multiple uses of a street

USERS	PRACTICES	FUNCTIONS
○ Passer-by ○ Residents ○ Sole-traders ○ Maintenance staffs ○ Local police ○ Handicapped ○ Cyclists ○ Motorists ○ Tourists ○ Deliverers ○ Drivers ○ Traders ○ Passengers ○ Skaters ○ …	○ To go out ○ To cross the street ○ To make shopping ○ To relax ○ To roam ○ To go home ○ To wait the bus ○ To stare peoples ○ To wait someone ○ To bask in the sun ○ To breathe fresh air ○ To deliver something ○ To clean up the roadway ○ To sale books ○ …	○ Orientation ○ Circulation ○ Leisure ○ Information ○ Protection ○ Transport ○ Distribution ○ Access ○ Shelter ○ Trade ○ Parking ○ Street lighting ○ Play ○ Water drainage ○ …

Every uses of a street can be seen according to these three points of view: they have “actors” (users), with some behaviour (practices) who follow certain ability of the street arrangements to welcome them, to allow the accomplishment of certain aims (functions).

The residents for example, practice several *uses*: they go out, walk on the street, can also relax on the street, wait someone in front of their home etc. They even call upon to several *functions* of the street design: accesses, shelters, street lighting etc. A *practice* might be even, related to several different *users*: the ramble is not reserved for tourists neither to walkers; tourism is not reserved for tourists…

To relax is a *practice* common to residents, cyclists, tourists, etc. Likewise, a same *function* refers to several *practices* and also to multiple *users*: to circulate, it is possibly to roam, to walk, to bask in the sun, to make shopping etc.

By a sort of agreement, both explicit and implicit, every user appropriates a part of the spaces and objects provided: each follows his own motivations, his own pathway, within these spaces shared with other peoples. The street organisation is produced by users themselves, by their living together.

This tacit agreement is possible only because each citizen has, at a certain moment, to play each one of those roles: each citizen is then able to understand how other peoples may use the street, is able to understand the general functioning of the social life of a street and then to participate intelligently into the street' rules.

Principle 2: relations of politeness and politics

**If each use of a street is likely to be done by several users, to generate several practices and to solicit several functions of the street arrangements, then everybody might potentially understand every uses of the street.*

**It is then possible to affirm that into the street, the collective use of space is first a political interaction, in other words, that everyone can and must know how to make use of this public good and how to share it with other users.*

**The first solutions to uses conflicts may then be done at the level of individuals and their relations, at the level of rules and their respect, that is to say between intelligent persons. The concrete arrangements only come only after, supporting the modes of uses which have been politically decided.*

Example 2: Installing a bollard alignment, reducing the width of a roadway.

To install bollards and prevent chaotic parking is not the first mode of action to which designers may think. It should rather be an ultimate mode of action that should be used when the political and legal ways of action have shown inefficient.

Likewise, reducing the width of the roadway for speed and safety reasons is not necessarily the first action to consider. The reducing of speed is, first, an act of politeness and respect of rules.

Example 2': The car parking policy in Italy

« According to Gilbert Lieutier, a "intrinsic rusticity" characterises the means carried out for cars parking in Italy, where the heart of cities is reserved to peoples having a reason to be there, peoples named accurately by the Italians as "operative" : security services, public transports, hotels' clients, foreigners, deliveries, etc. and of course the residents. "This simple rule for traffic solves at the same time part of the parking problems… In Italy, no bollard, no centralized management of real-time information … Simply: clearly shown rules, and staff. "

"Recognized primacy to individual... Control officers are in fact possible interlocutors for the comprehension of city's instructions, for the negotiation of a dispensation"...

They are "communication officers, mediator between rules and penalty, between users and city's responders".

This system allows an increase of a well-understanding of the reality. On top of that, it creates jobs; police officers and assistants being often recruited among senior citizens. »[26]

[26] Gilbert Lieutier (CETE Aix en Provence) « Déplacements urbains. Les solutions mises en œuvre dans les villes italiennes », in *Transports urbains N°94* (janvier - mars 1997), cité dans Jean-Loup Gourdon, « Circulation urbaine : guerre ou paix ».

4) The multiple forms of a street: plurality and polymorphism of urban models

If the street has an awesome number of *arrangements* and *uses*, the street has also an imposing number of designers, developers, constructors, specialists, professionals, managers, a multiplicity of consultants and non-professionals devoting a part of their time the *continuous production* of the streets, their study, maintenance and design.

Each of those occupations give to the street some *forms* (*i.e.* principles of spatial organisation) that are characteristic to it and corresponding especially to its own finalities: insure traffic fluidity, resistance and durability of structures, acoustic and lighting comforts, provide pleasant atmospheres and intimate spaces, insure cleanness in front of shops etc... Many qualities and performances that are wanted of street the arrangements and taken in charge by different trades and often implying different *models* from one special discipline to another.

Some people *know* that a minimal distance is needed between two bollards to prevent car's access. Some others *know* that certain intervals produce perception effects (sensation of acceleration for example). Some others *know* that those intervals work better if reduced according to the building's proportions, etc. The knowledge of each one holds the imagination of different *forms* or ideas that are later applied to produce the street configurations in order to realise the expected targets.

Those ill-matched *knowledges*, ideas and forms is manifested by distinctive vocabularies and technical jargon that sparsely communicate together and which characterize the several specific approaches of the public roads system. *Designers* get involved within *fields* that can be similar or different, in juxtaposition or superposition, articulated or simply confused.

Table 3 : The multiple forms of a street

DESIGNERS	FIELDS OF ACTION	KNOWLEDGES
○ Roadway engineers ○ Traffic engineers ○ Architects ○ Landscapers ○ Urban planners ○ Lighting specialists ○ Furniture designers ○ Surveyors ○ Road menders ○ Masons ○ Gardeners ○ Traders ○ …	○ Traffic ○ Cleansing ○ Technical networks ○ Accessibility ○ Rubbish collection ○ Cleanness ○ Parking ○ Green space ○ Road safety ○ Urban security ○ Dwelling ○ Comfort ○ …	○ Acoustics ○ Material physics ○ Hydrology ○ Sociology ○ Anthropology ○ Botanic ○ Economy ○ Lighting ○ Flows modelling ○ Network sciences ○ Business ○ Psychology ○ …

Some situations occur wherein a special kind of designer must hark back on the work of another previous designer, either in the drawing of a project, or in the construction of the street itself, or in its temporary arrangement.

This is how a bollard alignment might be installed for safety reasons and later removed for accessibility reasons… This is how a pavement might be widened for commercial reasons and later reduced to install a cycling track… Each time, it is the street *form* which is modified: its principle of organisation, its idea, the reasoning which determinate its real configuration.

The road safety *reasoning* does not necessarily provide the same *forms* to the street than the reasoning about accessibility or even than of the anthropological reasoning. The "logic" of circulation has some different forms from the "logic" of stops. Forms having interesting properties for the acoustician are not the same than those that may be wanted from an aesthetic point of view.

However, each *designer* finally has to intervene, directly or not, on each site of the city and thus to interact with every urban *fields of action.* Each trade is then confronted, sooner or later, to every urban disciplines and *knowledges*. Except if it is accepted that some could undo the work from precedent designers, it is needed to admit that the resulting forms of those multiple knowledges are not necessarily incompatible. Certain models more "polymorphic" than other models might be able to admit and join a certain quantity of distinct reasoning, several relevant *forms* that may not undo their respective effects.

Principle 3: Plurality and polymorphism of urban models

** It is a significant number of designers which have to transform the configuration of a street, each one identifying the purposes and the performances related to his field of action, each one involving knowledges, ideas and models that are adapted to his own point of view.*

** Admitting that sooner or later, each of these trades may have to act and interact more or mess directly on and with every urban fields, each designer might come to confront his proper models to all other urban knowledges.*

** From that moment, it is possible to imagine some polymorphic models (of which the properties are interesting for several consultants) that may support the conception of some street forms according to various points of view and which may be taken successively by several designers without necessarily being distorted.*

Example 3: Polymorphisms of the tree model

The topological model of the hierarchic tree is extremely polymorphic : street networks are made following this model, such as technical networks, flat's distributions and house's distributions...This concept of structuring and distribution of a space is more general than what each urban disciplines can conceive on their side : hydrology, sociology and transportation engineering have some specific tree forms that would not be impossible to link together within a same urban polymorphic model, model that could be derived according to certain points of view according to the needs..

The tree that is planted in the middle of a place is also likely to be involved in a polymorphic modelling: it is clear that its symbolic significations are not independent of its biological properties, neither of its aesthetic qualities, among other things.

5) Three organizing principles

Street is one and multiple to many regards: in term of constitutive elements (its *arrangements*), of welcomed practices and supported functions (its *uses*) and in term of professionals and knowledge (its *forms*) that are involved in its erection.

Those multiplicity and inherent complexity of urban fields lead to adopt some organing principles summarized by the following few basic rules:

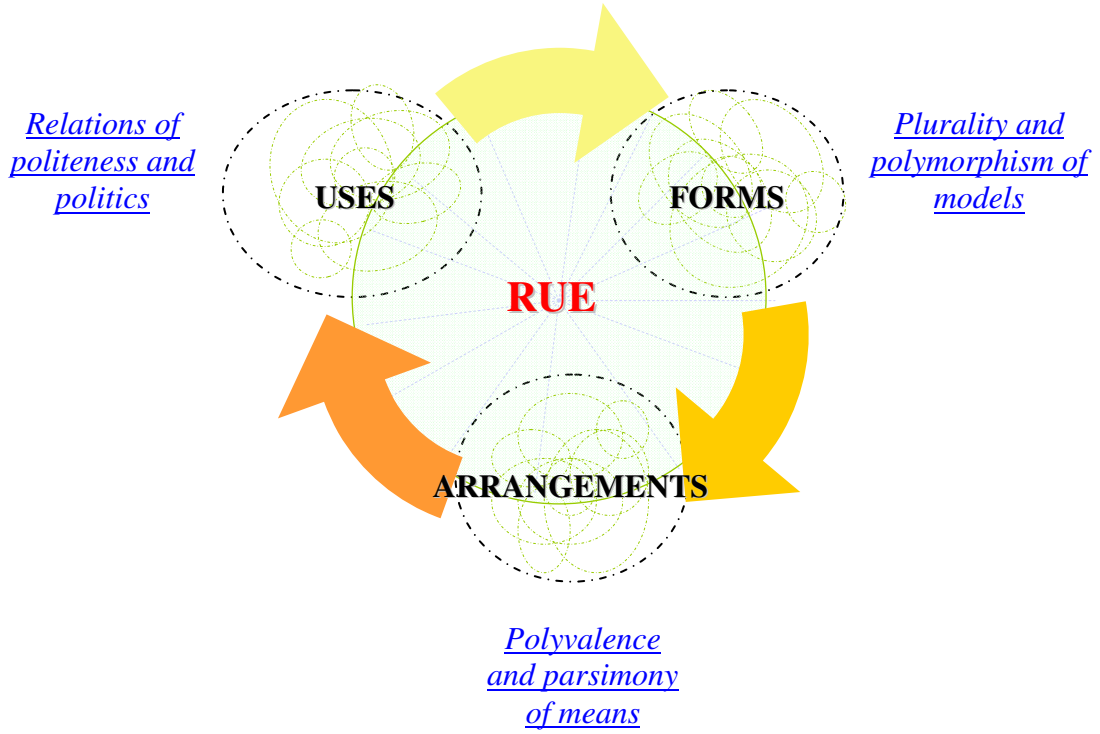
Three organizing principles:

***1. Polyvalence and parsimony of means**: It is sufficient to act on part of the street to modify all its organisation, all its functioning.*

***2. Relations of politeness and politics**: Problems' resolving is a question of politeness and politics before to be a question of concrete and spatial arrangements needing a specific design..*

***3. Plurality and polymorphism of models**: Certain models of street organisation have properties and forms that are interesting from several points of view.*

Diagram 1: The both simple and complex street organization



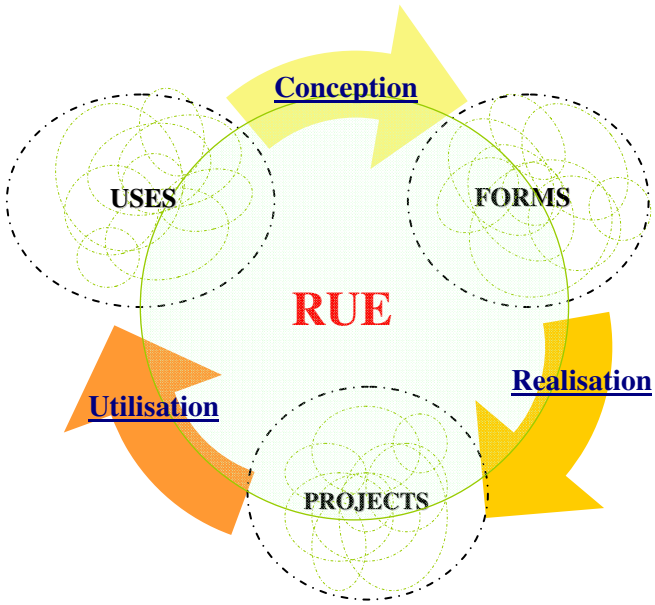
This scheme linking the street arrangements (viz. its physical existence) to its supported uses, passing throughout its forms conceived by designers, will be now generalised: street's arrangements are, their sidewalks, their cycling tracks, but even their representations in perspective, the plans drawn by the architect, the blueprints locating the networks... that is to say every intermediary documents representing the street and serving directly the process of its production.

II. The production of streets and its implicit conceptual modelling

1) Recursive acceptations of the notions of conception, realisation and utilisation

The production of a new street or the simple transformation of an existing street involves a set of intermediary steps, each ones also involving considerable and recognizable products: sketches, programs, preliminary plans, construction plans, etc.

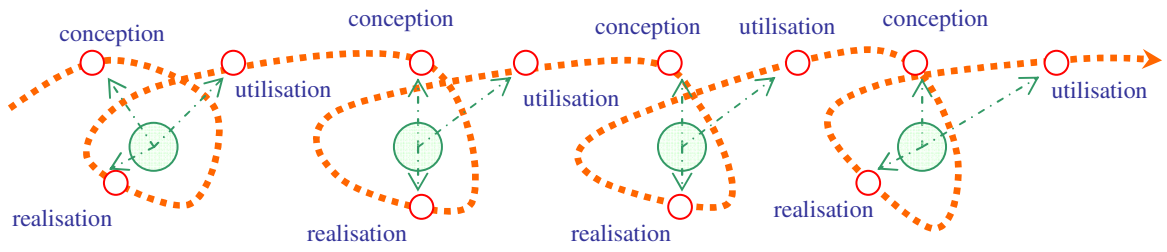
All these productions are achieved according to some similar and generic steps: *conception*, *realisation* and *utilisation* involving, each time, a *relative* contractor which is going to make a *use* of the realised *artefact* and a *relative* master builder which is going to conceive the *form* of that *artefact* and proceed to its realisation, this for the pavement itself, its plan, its sketch or even its specifications.



All those steps involve *implicit* models of street design: certain images, schemes and ways of thinking. Without this underlying conceptual modelling, which is implicit and inherent to the production itself, the conception, the realisation and also the utilisation of streets would be simply impossible.

Diagram 2: Recursive phases and cycles of the production of streets

→ PROGRAM → SKETCH 1 → SKETCH 2 → FIRST PLANS → ...



2) Utilisation and the measure of utility

The qualities of a street are appreciable by differences: a street is felt as pleasant and living only in comparison with another one which is seen as more still and quiet, such as pavement is only considered as safe when it is compared with one of its previous state thought as unsafe.

There is no public space in the street without private realms, no tranquillity without animation and hurry, neither opening without closure. Every qualities and possibilities of uses that a street can handle are some consequences of the perception of differences. Those differences are measurable either by its contrasting relations with another street, or by the contrast of its actual state in comparison with some of its previous status.

For humans, those differences are always measurable in reference to certain mental conceptions: the perceived idea of a street is “compared” or at least linked to the idea of this same street such as it was previously, or to the idea of another street seen elsewhere.

A street or the drawing of a street might be calm / animated, wide / narrow, safe / dangerous, fast / slow, solid / fragile, bright / dark, fresh / overheated, intimate / exposed... in comparison to another street or to what this street should be in referring to its model.

Qualities and performances of a street are thus structured by a group of binary oppositions which are kinds of “dimensions” allowing to size up the *intentions* given by each people: some want darks and crowded streets, some others prefer rather calm and bright streets.

Those couples of binary intentions are many ways of assessing the satisfying or unsatisfying character of a configuration, and even of a certain arrangement, a certain version of a design, of a sketch, that is to say, its utility: such street will be too slipping, too fast, not enough animated etc.

The difference of uses (*intentions*) and the differences of arrangements (*configurations*) are progressively perceived congruent and repeating. They are located and organised in the mind and start to form ideas.

Ideas about streets are linked and compared together and, consequently, street models are formed and models of their possible functioning, models of their possible arrangements. Those implicit models, which associate certain specific *configurations* to certain particular *intentions* will, from now, structure the current appreciations of streets or street projects, not only that of users, but even that of the designers and all trades and specialists that may be actors of design process.

Those models of utilisation or appreciation of streets are often very different according to disciplines, to cultural groups, and also from cities to cities. They work as more or less shared frameworks of interpretations of the differences that might be perceived between one street and another, between one idea of street and another.

Those frameworks change according to job, position and personal background. They allow each one to make good use of the street arrangements or of the street documents, that is to say, to understand the uses possibilities arising from the *configurations* proposed by a certain

street: two benches, face-to-face and separated by a few meters will be *interpreted* by some peoples as a suitable space to get together, to socialize, whereas some other persons may find that same configuration as too intimate…

The appreciation of a street or of planned street is then consequential to each one's experience, to momentary aims and motivations, but also and mostly of to cultural and personal models which are kinds of natural interpretation frameworks of the urban experience.

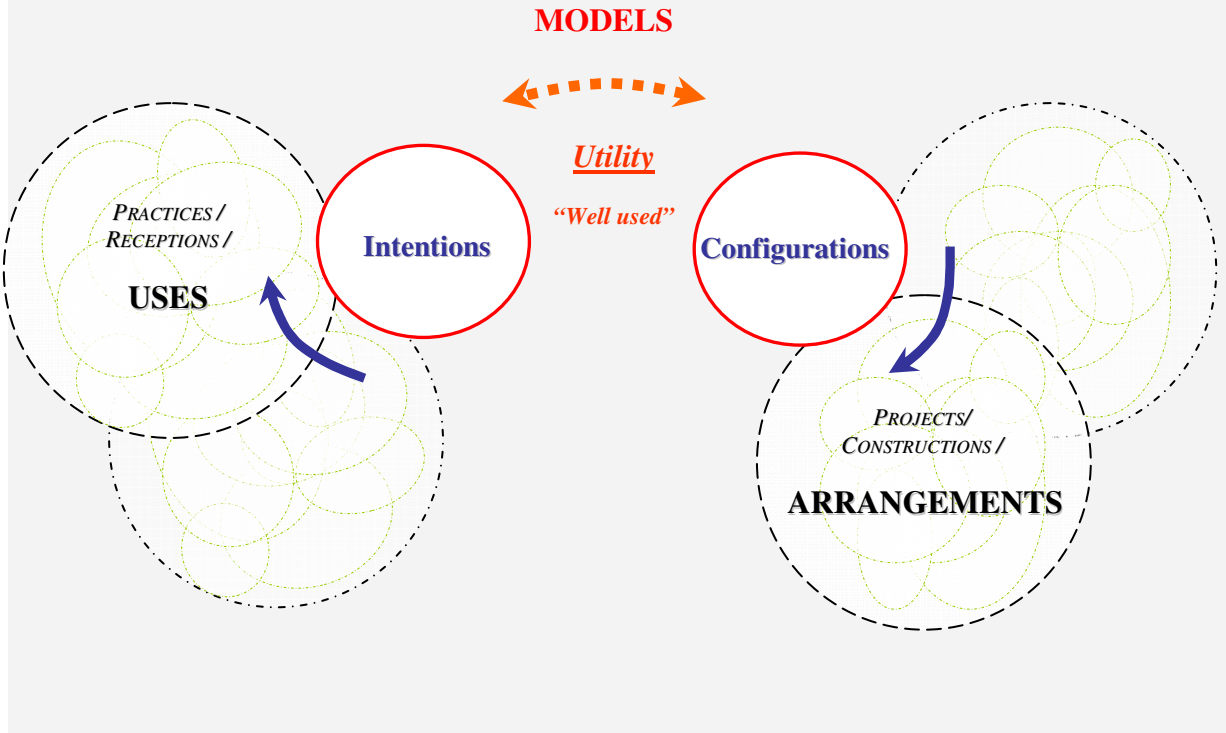
It is possible to define the utility of a street as the relative adequacy of its *uses* to its *arrangements*.

In design process circumstances, when the aim is to transform an existing street or piece of land, utility might be modelled as the link between:

- certain *intentions* (differences between existing uses and aimed uses) and
- certain *configurations* (differences between existing arrangements and aimed arrangements),

this while referring to certain models (differences between ideas or existing conceptions of a street and the future conceptions of that street once transformed).

Diagram 3: Utility is measured in reference to some models



Principe 4: Utility of a design is measured in reference to some models

** One appreciates a street's utility by differences: differences related to previous situations or in comparison to some others streets manifesting similar or opposite qualities.*

** Those differences are appreciated in reference to some contrasting ideas, some implicit models which tie in a reliable fashion certain configurations and certain intentions.*

** Then, when the street configurations are considered to misfit the realisation of some intentions, when the street or the planned street is considered "useless" referring to a certain model, two options are available:*

- It might be decided to improve the existing configurations in order to make they conform to their model, keeping in mind the evolution of circumstances, uses and context.

- It might be decided to change the street model of reference, choosing for a different mode of organisation which will better respond to the expressed intentions and to the context's constraints.

Example 4: Does a street always need a sidewalk?

The sidewalk of an estate road is not apprehended in the same way as the sidewalk of a wide avenue might be, for the implicit models that guide the interpretation of experience differ according to each of these two cases. In a housing estate, the low flow of cars exempts the design of a separation between pedestrians and motorists. This is totally different in an avenue where the sidewalk is one of the essential elements of this model. That is how similar configurations of a sidewalk (5m width and 20cm height for example) located into different streets won't have the same effects: the role of the sidewalk changes according to the considered models of reference.

Example 4': Does a cycling track need a continuous width along its path?

Width of a cycle track won't be felt in the same way on a peripheral boulevard than on a narrow street of city centre. The reason is that the model of street setting the appreciation of this track is not the same in those two cases. Someone bears easily to ride into a poorly dimensioned space while in a dense street of the city centre, but less easily less on a peripheral boulevard…. Here are two distinct models of street which propose different criterion of appreciation.

3) Conception and the measure of relevance

Each action of transformation of a street or of a street design involves a producer and a user, a master builder and a contractor or owner. The two parts plead for a bilateral agreement:

- To one side, approval of owners / users' intentions by the master builders / producers who accepts to follow them in the development of his design.
- On the other hand, approval, by the owners / users of the forms and modalities of organisation conceived by the master builders / producers so as to fulfil those intentions.

The design intentions are both *political* and *moral* and first belong to the owners / users of the work. Often, those intentions are only imperfectly conceived at the beginning of the project; they are multiple, heterogeneous and sometime contradictory, resulting from the street complexity of practices, uses and interests.

It is precisely because of their multiplicity and complexity that a design work (conception of a new form) is finally required. In each design work, *intentions need to be elaborated*

progressively and it belongs to the master builder, not to convince the users and owners to make use of such forms or such other forms or to aim such purposes rather than others, but to imagine some *forms* able to elicit the development and refinement of those intentions in the owners / users' mind. It's only in a second time that the designer will seek to respond adequately to those intentions with a well-adapted organisation: the street *parti.*

The form of organisation of a street must be relevant regarding to the intentions of the owners and users, *i.e.* with the uses modifications they desire.

However, the street's form cannot be simply “deduced” from those intentions or from those uses. It is not sufficient to know that we want to be able “to eat”, “to play” and “to gather” somewhere to generate the idea of a “round table”. The form (that is to say the principle of a round table: a rounded flat surface laid on four feet) is necessarily both *more* and *less* than an answer to those intentions: it has several properties and qualities (aesthetic, symbolic, functional, etc.) of which only certain will serve the satisfaction of the expressed intentions. Then, how to recognise if a form is going to be able to satisfy an intention, to bear a certain mode of functioning?

In fact, each form is imagined in reference to a street model or to an idea of what the street ought to be. In referring to a model in order to imagine this new form the designer is, in a way, believing that this one will respond in a certain manner to the desired intentions, in other words, according to a certain mode which is specific to this model and which has proven its efficiency.

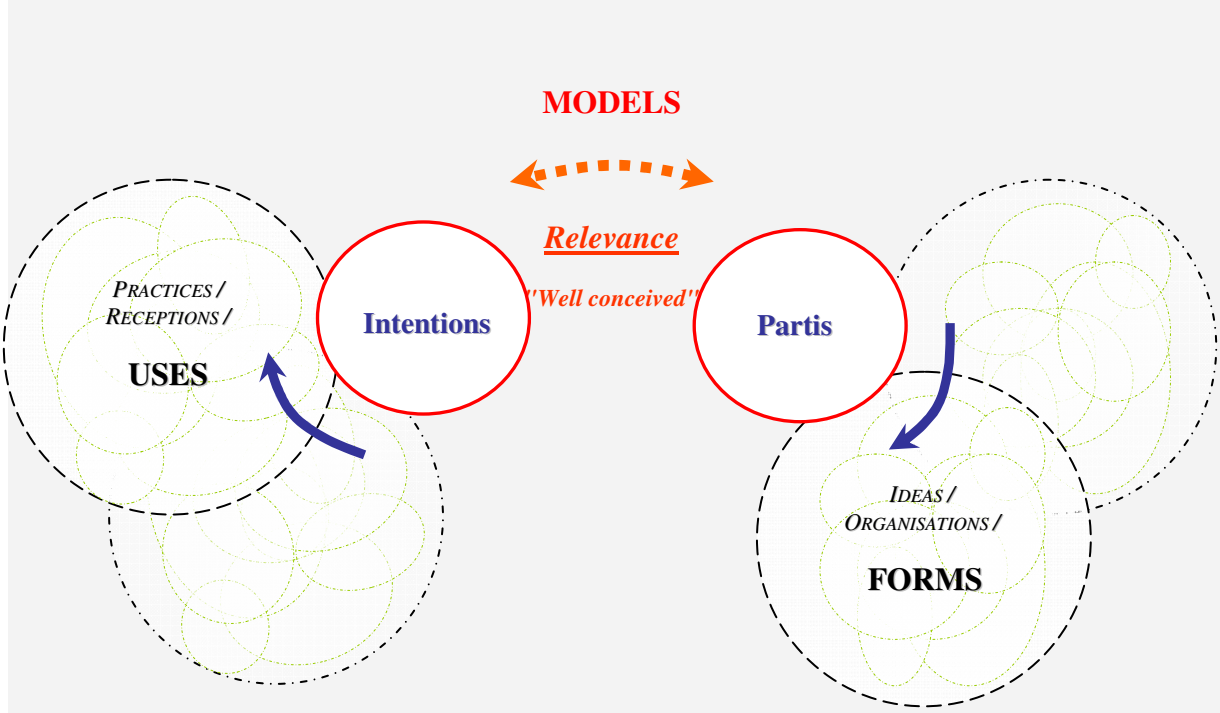
In order to allow pedestrians to circulate on a large avenue and to provide them an access to parcels and adjoining buildings, it is possible for example, to fit up two lateral sidewalks of 12m wide, or to construct three sidewalks of 8m wide (one being a central promenade). Here are two different *parti* of street arrangement responding almost to the same general intentions, but being different by their *principle of organisation,* in other words, by a group of formal properties which are peculiar to two different models: the “simple avenue” and the “rambla avenue” for example.

In those two cases, an important space is dedicated to pedestrians. They will be able to circulate freely and in large number. However, subtle differences known with experience or related to some proven reasoning will head the choice toward one specific model. One can *think* that to fit up three smaller sidewalks may be accurate to make denser the pedestrians' spaces and provide a better feeling of liveliness to the avenue. Referring to another implicit model, one can also think that to fit up two wide sidewalks on both sides of the avenue, each one will be broader and will allow a better appropriation of the public space by traders or café terraces for example.

Those two *partis* refer to two modes of organisation that correspond to two different models of street. These models feature an *endlessness of differences.* Nothing makes one of those two models better than the other, as a crossroads is not better in itself than a gyratory. These are only some different ways to lay out the street, two *partis* referring to some models of street that are irreducible one to another.

Those partis provide in fact a range of “archetypes” and more or less proven “concepts” that are sources of inspiration to imagine *specific forms for each particular design.*

Diagram 4: Relevance is measured in reference to some models



Principle 5: Relevance of a design is measured in reference to some models

** Owners and users' intentions being heterogeneous and numerous, it is impossible to "deduce" from them an optimal solution for the street arrangement: several design paths or "parties" are then possible.*

** The parti of a street design is a choice of a certain way to answer these intentions, a way which is different from other possible ways, the choice of a certain principle of organisation. But the definition of the street form is not yet its configuration...*

** The elaboration of a street parti responding to certain intentions and the measure of the relevance of that parti in relation to those intentions is made in reference to some models of street. Those models may bring the available observations, experience's comebacks and current argumentations.*

Example 5: Sharing or separating users' proper spaces?

When trying to determine whether a street needs a "reserved" space for public transports or cyclists for instance designers are definitely raising questions closely related to specific street models of organisation. Separating the different uses by physical limits is a method allowing the various uses to coexist within a same global space; this method is different from another method consisting to mix users within a same global space, the rules being set by the users themselves. "Separating" and "sharing" urban public space are two complex models of street organisation.

Separation's issue is to provide a larger fluidity to traffic and to let users away from disturbances within their allotted spaces, bringing both safety and availability. The full share, inversely, is defined by the politeness and the mutual attention given by users getting around into the same space. Here are two social life's organisation modes, which consist of two models of street arrangements.

When in any particular circumstance, it is needed to think about the street's uses organisation, one or another of those models will serve as reference: people will refer, not only to the specific configurations of each model but also to the whole of the reasoning that underlie their principles.

4) Realisation and the measure of quality

Each transformation of the urban realm leads first to the conception of a shared and endorsed *form* that is named, discussed, debated, until it is finally built: needs are debated and *formed* in the mind before to write the program; ideas contained into the program are debated and *formed* in the mind before to draw the first sketches; ideas and forms expressed by the sketches are *formed* in the mind before to draw the preliminary plans… the information communicated by the construction plans are discussed and *formed* in the mind before the construction of the pavement starts, etc.

At all steps and at all levels, the passage from the *mental form* to the *concrete arrangements* is done thanks to a certain technical skill. The work keeps going till the obtained *configurations* (program sentences, plans, pavements…) do satisfy the *forms* on which the agreement was built. Technical skills (to know how to build a pavement, how to write a street program, how to draw a street sketch, etc.) directly refer to some street models that might be "well made", "well built", "well drawn", "well-programmed", etc.

The question here is not to know if this is relevant or not to conceive an avenue in a certain situation and responding to certain intentions. It is rather to know, now, if the avenue is a "proper avenue", if this avenue has been well programmed and well drawn, if it has been well constructed.

A certain realisation may only be assessed in comparison with realisations of *the same kind*: a realisation that follows the same model. An arcade can be of better or worst quality only compared to another arcades, a roadway can only be of good quality or bad quality in comparison to other roadways…

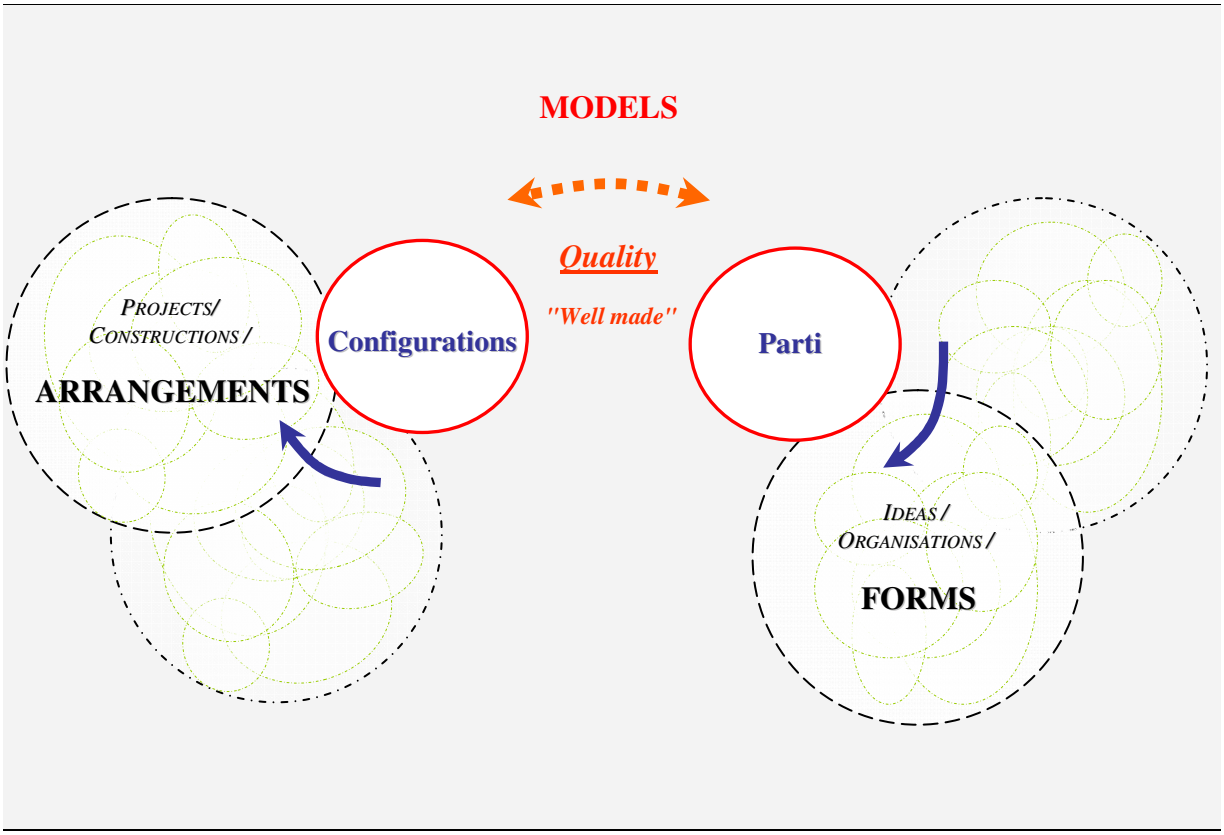
The good realisation of all those elements requires a good *knowledge of the ways to pass from some formal partis to evolve toward some concrete, material, spatial and technical configurations*: a good knowledge of some *design models*. One needs some knowledge so as to "properly place a bench between two trees".

This knowledge can be used directly, by placing yourself the bench between the two trees as it is conceived and proposed in the "public alcove" model, for example. But this knowledge can also be used indirectly by drawing the bench right positions on sheet of paper. In both cases, a reference will be made to a certain model of bench lay out if one is to assess whether the bench has been "well placed", "well drawn" and "well-programmed" or not.

Some ideas about benches, their purposes and their spatial dispositions are inherent to certain design models and not necessarily to certain limited steps of the streets production process: they do not belong especially to "designers" or to "builders" and it is finally possible to keep them in mind when comes the time to write their program (the programmer), to draw their position (the architect) or to place them between the two real trees (the gardener).

It is moreover the existence of such *transmissible models* that allows the more or less intelligible progression of the successive steps within the design and project processes, and thus the measures of the *quality* of the various *kinds of works* (programs, sketches, concrete arrangements…) that have been realized as a *conclusion* of each of these steps.

Diagram 5: Quality is measured in reference to some models



Principe 6: Quality of a design is measured in reference to some models

** After having imagined a form or a parti responding to the owners or users' intentions, the master builder takes this imagined form as a starting point for realization: a starting point from which he evolves his work toward the concrete configurations: street arrangements, drawings, writings, sketches…*

**He uses artistic and technical know-how consisting in some patterns of "ways of doing things" that is to say, way to evolve from some formal parti to concrete configurations.*

** This knowledge is organised by model of arrangement, which are used as references to measure the quality of each realisation taken "into its kind"*

Example 6: Widening a sidewalk to let a place for café terraces

If one decides to widen a sidewalk because the foreseen space for the café terraces is too small to welcome a row of table with chairs while keeping sufficient space for pedestrians passage, this is because the sidewalk has been "wrongly made": wrongly programmed, and / or "wrongly drawn", and / or "wrongly realized": the sidewalk is not conformed to what it should be, not conform to the parti of its implicit model.

However, if we decide to widen one sidewalk because some café wants to enlarge and to occupy more exterior space, this is the previous parti of the sidewalk that is not relevant in this new situation. A new design parti following a broader model of sidewalk will replace it.

The "fault" of relevance (inadequacy of the parti to the intentions, or of forms to uses) is not of the same nature than the "fault" of quality (inadequacy of the configurations to the parti, or of the arrangements to the forms)

Example 6': Diversion of a cycling track, a bus shelter or a bench

Sometime a space is such "well made", "well planned" and "well built" that a certain quantity of unplanned functions, purposes and users finally want to use it. A cycling track planted of trees could, if very well done, be an ideal path for some pedestrians: the quality of a realisation makes peoples eager to use it…

A "well made" and "well realized" convivial bus shelter could become an ideal place for gathering, for peoples who get together in the street. It could be even a nice place for a break after a long walk. A "nice stop", which is a "nice shelter" at the same time, is much more than a simple stop point for public transports where peoples wait the bus, and there is no need to foresee all those possible unplanned uses… The diversion happens for two main reasons: because someone needs a space visibly available. But also because a space is "well made" and because it makes peoples want to use it, as a bench conduces to sit down, but also to recline, and as the stairs of a theatre incite to walk down, but even to sit down.

The "quality" (adequacy of configuration to the parti) and the "utility" (adequacy of intentions to configurations) are then two very different notions: a bench may be "well-made" while absolutely not receiving the purposes that were dedicated to it.

5) Three principles of streets conceptual modelling

The production of a street and of all the needed documents necessary to its construction is supported by several design models that implicitly organise each step of the process, from utilisation and conception to the very realisation.

Three principles of streets conceptual modelling:

* **Utilisation and utility:** *The utility of a street design is the adequacy of uses to the concrete arrangements supporting them, in other words, the adequacy of the intentions to the configurations. Utility is measured in reference to some models: specific ways to appreciate and to use a street.*

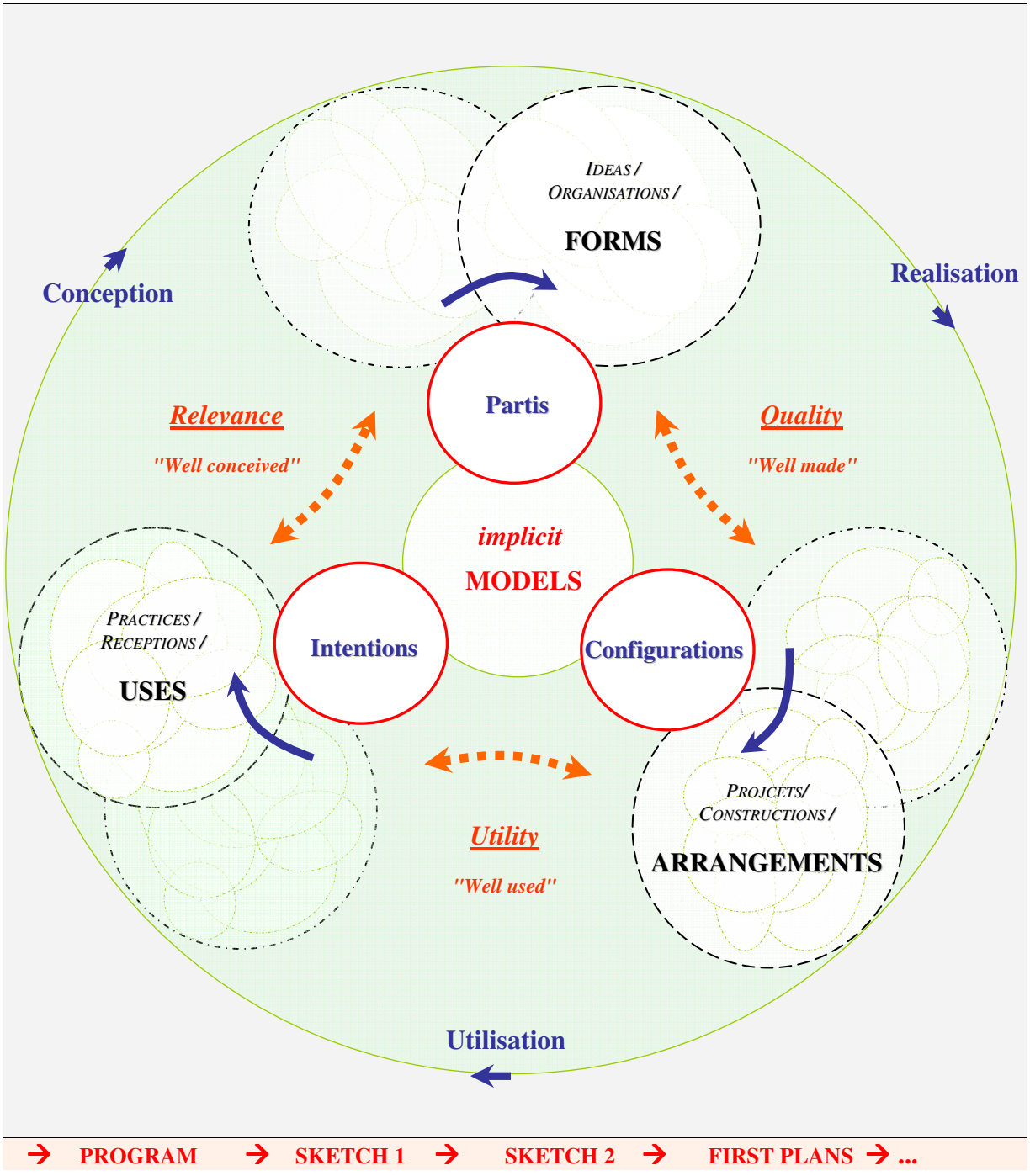
* **Conception and relevance:** *The relevance of a street design is the adequacy of its forms to the greeted uses, in other words, the adequacy of the parti to the intentions. Relevance is measured in reference to some models: specific ways to imagine, to conceive and to understand a street.*

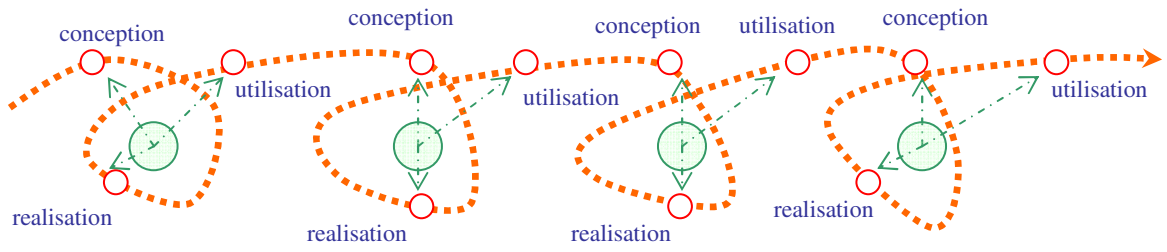
* **Realisation and quality:** *The quality of a street design is the adequacy of the arrangements to the forms, in other words, the adequacy of the configurations to the parti. Quality is measured in reference to some models: specific ways to express, to represent, to produce and to realize the street.*

Cycles of utilisation, conception and realisation are repeated as many times as necessary, from the production of the program to the execution of plans, from the creation of a street until its last modifications, several centuries later…

Each street constantly renews its *configurations*, its *forms* of organisation and its inherent and underlying *intentions*, according to cities evolution, following the transformations of urban society and proceeding from the many changes in urban knowledge and urban design models.

Diagram 6: Cycles of street production and measures of design utility, relevance and quality





III. The formalisation of design models

1) Purposes of the formalization of design models of streets

The first part of this report has exposed the *multiplicity* of *arrangements* composing a street, the multiplicity of *forms* guiding its transformations and the multiplicity of *uses* that are inherent and supported by it. The second part of this report has described the *implicit modelling* along the different phases of streets production: *utilisation*, *conception* and *realisation* being repeated and repeated continuously and measured by such notions as *utility*, *relevance* and *quality*.

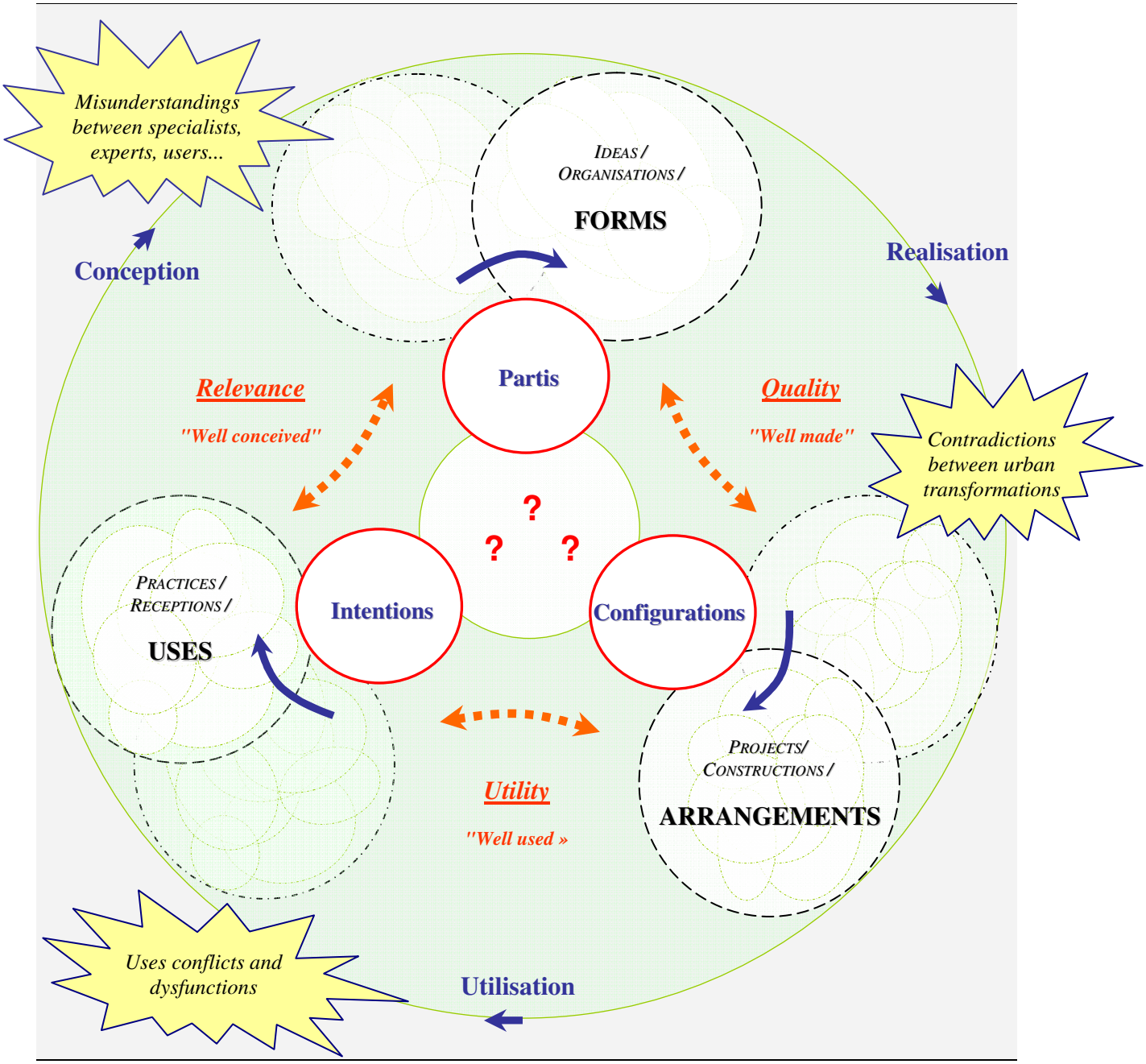
In this third part, we shall now evoke some traps and difficulties that arise from these two facts (*multiplicity* of street organisation and *implicit* character of its modelling process) in order to define the purposes of the explicit and formalized modelling that we shall now try to elaborate. In brief, it can be said that the human mind possesses some *limited capacities*: we cannot think about everything and from every viewpoints simultaneously.

It is thus from the *multiple* character of streets organisation that come the *sources* of misunderstanding, contradiction, mistake and conflict arising first at the concrete configuration level, then at the functional level between users themselves and finally at the design level between professionals and designers, specialists and inhabitants: between the various *forms* and ideas each actor wants to give to one and a same specific street. Furthermore, it is from the *implicit* character of the urbanistic modelling that come all the *possibilities* of misunderstanding, contradiction, mistake, and conflict. Those possibilities present a risk of failure of the street functioning, the street conception and even the street realisation: when each actor does not know that he is handling with him some implicit and proper models, any kind of clever coordination is obviously harder to achieve…

There are thus some conflicts, contradictions and misunderstandings:

- *Between users practices* (pedestrians cyclists, ramblers, purchasers, motorists, residents ...), who do not use, perceive and conceive the street spaces with the same regard, in reference to the same models. This could bring clashes, conflicts of use, malfunctions all the more possible that the quantity and variety of practices may increase and that some of these may be informal, unclear but quite living.
- *Between designers* (experts in parking, road safety, park and green spaces, networks, lighting, aesthetics...), who conceive the same street spaces according to partial viewpoints and heterogeneous models. Some may sometimes undo the work of their predecessors, refusing or being simply unable to understand their logics and reasoning. At a material, spatial and technical level (café terraces, phone booth, car park, cycling tracks, bollards, plantations …), certain devices may dysfunction with some others, by a lack of space or by technical incompatibility. Those difficulties will be more likely to happen to the extent that the quantity and variety of its components remain high and their conditions of well-functioning blurred for almost everyone not directly concerned.
- *Between users and designers*, for whom the difficulties in cooperation are all the more possible and likely to happen that designers may appeal to multiple knowledge which are hard to communicate to the people concerned with the elaboration of the streets forms in which and by which they are going to live.

Diagram 7: How to resolve conflicts, misunderstandings and contradictions in the production of streets?



Beyond the solving of those three *cooperation difficulties* into street's production and transformation activities, we request the modelling to satisfy *3 conditions* related to the status of urbanistic knowledge that we wish to constitute:

- That the modelling formalization adopted be able to articulate and to get understandable and operating the both simple and complex organisation of a street (utilisation, conception, realisation).
- That the modelling process be enough explicit and clear to be easily attainable and useful to nearly everyone likely to be involved in the utilisation, conception, and realisation of streets or street projects.
- That the formal reasoning of an urbanistic model be likely to be both testable by empiric observation and provable by reference to some constituted theories.

2) The explicit repository of urbanistic models as a sharable language

A large majority of the disagreements about street appreciation come from the fact that everyone has his own reflections following implicit and partial models that are proper to each one and thus different if one is resident, taxi driver, architect, engineer, etc.

The first task thus consists in formalizing the existing models, those which are frequently used today by developers, designers and technicians, starting with those models that exhibit the more clearly a "global" character: those drawn and involved into urbanism and landscaping projects.

By naming and delimiting those models, by explaining their principles, edges, and basis of reasoning, we may progressively form *a repertory of the recurrent and general notions* that play the role of *urban design technical concepts* while using the common language in order to remain understandable by most people.

The "levelled street", the "available street", the "multifunctional street", the "vaulted bus lane", the "public alcove"... are concepts that we shall have to recognize, to get explicit and to formalize in order to allow them to become some of the elements of a common language in design process discussions.

It is tricky to imagine at first, what could be a "curtained street". However, once the first elements of knowledge related to this model have been apprehended, each one will be able to get an idea of that concept and keep it in mind as a particular way to design and arrange a main street[27].

A certain number of words from the informal vocabulary exist in fact that suggest quite explicitly some urban concepts appealing to city and street design: the street, the avenue, the boulevard, the court, the arcade, the sidewalk, the roadway, the stairs, the bench, the parking lots, the bus lane, the alley... each of these concepts suggests a global thinking of one specific design. The "sidewalk" current name both calls for a bitumen-covered area, for a surface fifteen centimetres higher than the roadway and for all the things happening there: pedestrians moving and staying, accesses, etc. Equally, isn't it that the arcade suggests both a system of pilasters and arches opening the lower part of a building and at the same time every uses that one may imagine for such a place?

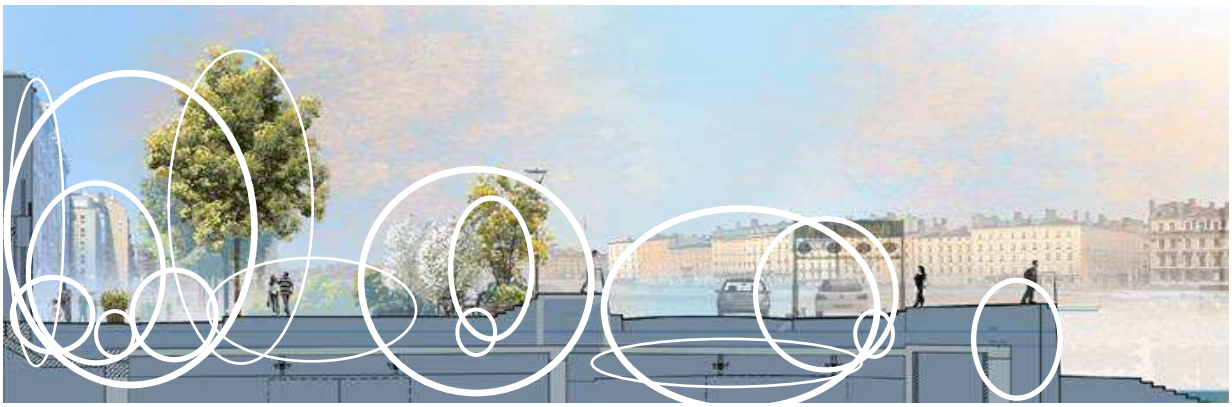
Those concepts such as that of the avenue, the boulevard and the arcade possess this double ability to be both understood by most people and to identify street design models which are not restricted to a single viewpoint but, inversely, significant enough to concern the engineer as much as the architect, the motorist as much as the pedestrian, etc.

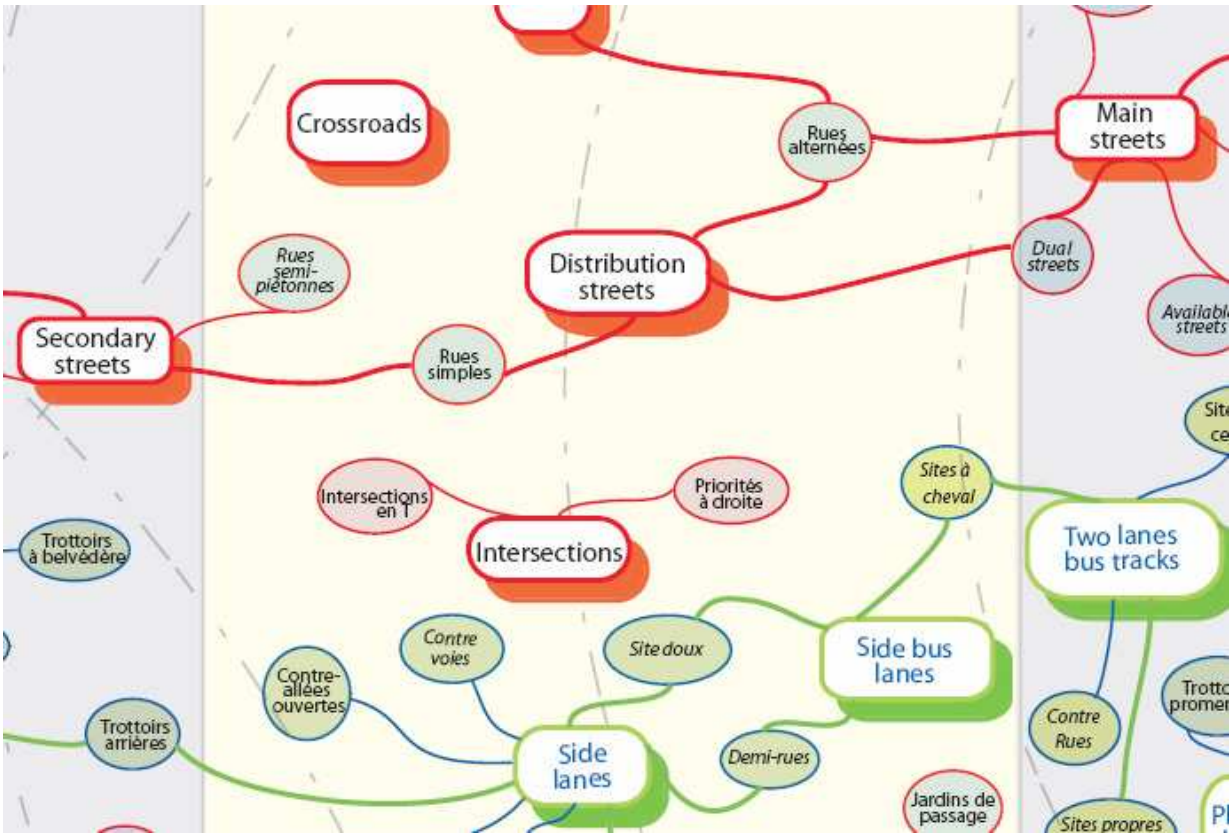
However, those concepts extracted from the informal common language are not yet sufficiently specific to describe with enough accuracy what designers and developers imagine and realise in their daily project, be they architects or engineers. For these people do not have in mind a single model of street, of avenue, or even of sidewalk, but rather several of them, more or less informal and adapted according to context and program.

[27] This model and some others are presented in the appendix of this report.

From the general model of the “street” that is recognisable everywhere and by everyone, it is possible to form the more specific models of the “levelled street”, the “curtained street”, the “multifunctional street”, etc. that are several wittier understanding of some specific manners to set the street functions and uses. This is how the general models of the street, the avenue, the sidewalk, the cycling track, the arcades, etc. can be differentiated in multiple more accurate, stronger and refined models.

We may thus formulate a principle of articulation between the *informal common language*, used by everyone and the *urbanism common language*, which will be usable with some efforts by of those who may be closely concerned by the production of streets: starting from shared concepts (*design kinds*) to specify shareable concepts (*design models*).





Design kinds and design models currently and implicitly employed by urban designers.

Could each word of the French or English language which is more or less linked to street problematic be correctly appropriated and specified into a *design kind* or a *design model*? Of course, the difficulty is not to choice this specific word rather than this one, for such questions of vocabulary remain specific to context and people who may use the common language.

On the other hand, it is the manner by which these terms are taken and approached that is very important. An "American kitchen" might be taken as a spatial configuration: a room split by a counter. It might be seen as a lifestyle: be able to cook and talk to your guest. It can even be taken from a formal viewpoint: the kitchen is a sub-space of the living room, a kind of alcove. The important thing, in naming and defining the urbanistic models, is to comprehend and to articulate those three viewpoints in the description of each *urban elementary field* exhibiting the following features:

{arrangements, uses, forms}

Or again

{utilisation, conception, realisation}

When a concept is formulated according to those three articulated dimensions, it might be said that this one may very well constitute the starting point for the elaboration of an urbanistic *design kind* or *design model*.

Principle 7: Starting from the *shared* common language to specify a *shareable* urbanistic language

** In the current vocabulary, there are already some global design concepts that are shared by everyone: the street, the avenue, the sidewalk, the arcade, etc.*

** Those concepts can be taken partially, or inversely globally, by joining the different viewpoints that are useful to describe them from an urbanistic viewpoint: {uses, forms and arrangements}, that is also to say {conception, realisation and utilisation}.*

** Let us call all those "global" urban types as "urbanistic design kinds". It is possible to form, from those "kinds", a multitude of design models, more accurate in their form and in their references to certain mode of uses and in their relying on specific arrangements.*

Example 7: Is the "levelled street" only a "street" that has been "levelled"?

The "levelled street" is a street whose sidewalks are built at the same level than that of the roadway. To balance this levelling of space, an alignment of bollards is generally installed to stop cars that would attempt to access to the lateral parts of the outline. The gutter line is switched from the bollards line and thus forms with this one an intermediary space between the lateral part, dedicated to pedestrians, and the central part, dedicated to vehicles. The levelling of the street and the layout of that intermediary space finally conduce pedestrians to use a wider part of the roadway when conditions allow that wider appropriation. This would has been tricky in an "ordinary street", where pedestrians used to walk on the sidewalk in all circumstances…The model of the "levelled street" is then not only the model of a "ordinary street" that has been levelled. It means also all the subtleties previously described. This gives consistency to this model, which is from there, shareable and understandable by pedestrians and drivers, by the person who is in charge of the water drainage and those who insure pedestrians' safety. This, of course, may be true only to the extent that each of them attempts to know a description, even succinct, of that way of organising a street.

3) "Open" and "closed" models as a useful knowledge for design

To conceive within a cooperative process is always difficult. Street conception is indeed essentially a mental exercise that consists to imagine some modes of organisation, some spatial and material dispositions that may be able to support and promote some uses, intentions and functions.

The activity of conception consists in handling some ideas together: idea of a sidewalk, idea of the tree alignment, idea of the parking row. All those ideas, taken together, can create for example, the idea of a "border" between the sidewalk and the roadway, welcoming the urban furniture and separating those two spaces in order to protect pedestrians from vehicles: trees, parked cars, sidewalk and gutter are lines that it is possible to dispose in a same path and close together so that they finally seem one arrangement, one idea.

There is no need to draw or to build those elements to imagine those assemblages, for these ideas are common and known enough to allow their easy manipulation by the mind of the multiple designers involved in their conception.

But in the designing process, more difficult and precise problems appear that make the assemblages of ideas and forms must harder a task, for ideas require more elaboration and finer thinking. Designers thus appeal to some more specific ideas and concepts, to a particular essence of trees for example, or to a specific kind of parking row. The mental manipulation of those concepts, if it is still possible, becomes more difficult to conceive and, as a result, drawing is often used as a visual support.

The situation becomes more complex when many persons have to discuss and elaborate together the forms of a new street, its *parti*. If there is only one word to identify the "sidewalk", there is however many ideas about what is a sidewalk, according to the different situations and positions of peoples being involved, *i.e.* positions of the mayor, of the transportation engineer, of one resident, one trader...

The common language is not yet a set of common ideas. Even while using the same words, two peoples do not necessarily understand the same meaning or idea. In a similar manner, to talk about the same street layout does not mean that everyone will see, in that drawing, the same elements or the same organisational ideas that may be represented.

Conceiving common ideas take for granted a common language. But additional efforts are needed. Regarding a design work, in other words a work of imagination and creation of concepts, supports that may be used shall keep a certain "open" character while being precise at the same time… they may remain not completely defined and closes in order to allow the mind to "grasp" the ideas represented and then to put it together.

Here, the model has both an advantage and a disadvantage as regards this role consisting in providing a good support for cooperative works of imagination. A model is more abstract than a concrete case study, and even more than the drawing of a particular project. Thus, by this formal (or mental) nature, the model is closer to ideas and organisation principles than specific situations or examples that may contain several details too tricky to handle and making difficult the abstraction of the overall patterns. On the other hand, a model has this vice to present things as being "ended" and "defined", built by modelling and fully explained.

Hence every model can be taken in both ways: as a "model to apply" and / or a "model to reach".

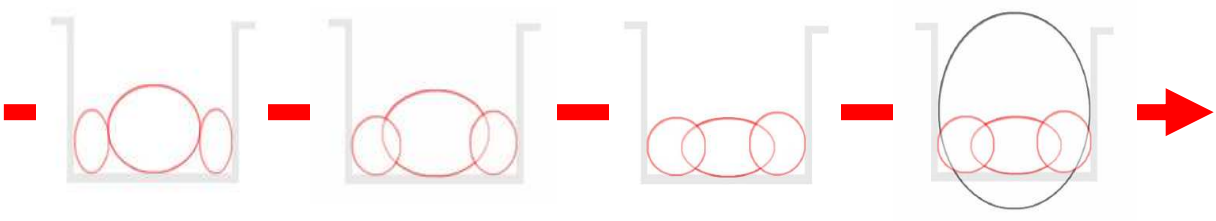
In the first case, the model does not appeal to the conception and imagination mind, but to deductive inferences. Trying to conceive common ideas is much more difficult with such a kind of supports, for each person will try to apply the consequences of his own models and theories instead of trying to form new and adequate ideas, principles and street forms.

Inversely, in the second case, the model appears as a principle, as a set of never exhaustively formulated ideas (the model is always a reduction of reality, of "what" is constructed by the modelling), that shall be re-conceived each time this model may serve as a support to apprehend a new situation. Each designer is thus naturally brought to seek and go beyond his own conceptions, which are by nature partial and thus not perfectly accurate, even if they may be considered as quite good supports to approach some more precise ideas.

Those two complementary aspects of a model correspond, in our formalisation, to what we have called until now the "*parti*", the "intentions" and the "configurations" of a model. The *parti* is the modelling of models' forms, of its organisational principles: here is the part of the description that is the less "applicable" and which is appealing the most to imagination. *Intentions, configurations* and their *relations* are a modelling of uses and arrangements' interlocking: imbrications which may be the parts of the model that will be the most attempted to "apply" in specific contexts for they are pointing out directly on concrete relations between "things" and "purposes".

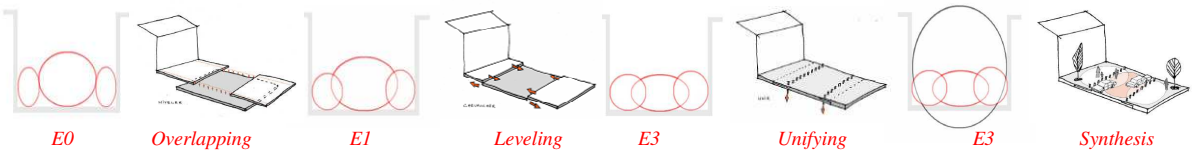
To form the *parti* of a model, (corresponding to the "model to reach" aspect of a *design model*), we propose to describe not only the form of the "curtained street" or of the "levelled street's" final organisation, but rather the *formation process* of that specific idea. As for the specification of the overall common language in forming an urbanistic language, we can specify the *generic partis* of the *design kinds* (streets, places, avenues…) in order to form the *specific partis* of some *design models* (curtained streets, multifunctional streets, levelled streets...).

Such processes can be described by the succession of a small number of steps proceeding to the progressive transformations of the considered model. Some diagrams that show the formal relations between the different *entities* or *elementary fields* that compose the model then describe its successive states:



These diagrams show the successive states of the "leveled street", starting from the form or the diagram of a regular "main street": a primary field formed by the roadway and bordered by two secondary fields that are the usual sidewalks.
*Thus, throughout a series of transformations, the diagram' form is going to change: roadways and sidewalks won't be separated anymore, but now overlapped, they won't have their former proportions and will be included in a more global form of the street. This is a switch from a "***1:2***" street form of organisation toward a "***1:3***" mode of organisation where both sidewalks and the roadway will play balanced roles.*

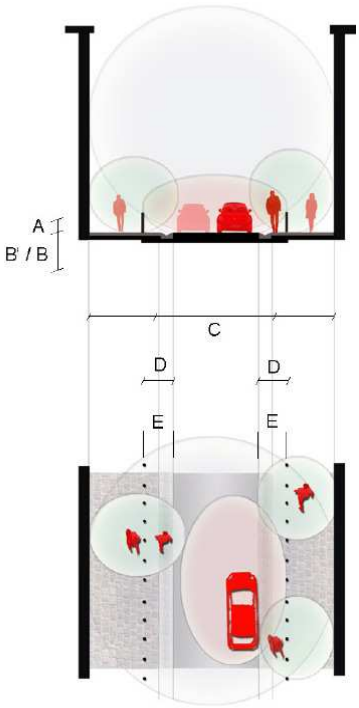
Transformations are described by actions of conception, by action "verbs of action which have spatial character": moving up, turning, separating, stretching, etc.



The actions of transformation (overlapping, levelling, unifying) build the modelling of the transition from a state to another state of the model's parti: they show the determinant operations that transform the organisational mode of a regular "main street" toward those of the "levelled street".

As much into the diagrams than in the actions of transformation, it is obvious that trying to apply directly those elements to a particular project is impossible. The description of the process that leads to the formation of the parti is useful only to the extent that the undertaken transformations are especially conceived for a specific form in its project. The *fields* of each diagram (represented by circles), are not "given" by the model: their content must be conceived (in term of utilisation, conception and realisation) for each specific project in order to proceed to the transformations depicted by the *parti* of the model. Thus those *fields diagrams* are not linked to a specific viewpoint: they may be interpreted as circulation entities, atmosphere entities or even aesthetic elements for example.

To represent the second aspect of the model (the one which should transmit relatively "applicable" information) we shall use a *table* that confronts the different *intentions* to the *configurations* of one model: this table keeps the possibility to consider interactions between forces, tendencies and purposes coming from various viewpoints.



INTENTIONS / CONFIGURATIONS	Animation / Calme	Usages d'arrêt / Flux	Sollicite l'attention / permet l'inattention	Ambiance sobre / Ambiance foisonnante	Adaptable / Fixe
	(a) *Permettre une activité commerçante importante*	(b) *Privilégier les flux plutôt que les usages d'arrêt*	(c) *Inciter à une vitesse modérée, ainsi qu'à une attention mutuelle et active*	(d) *Donner une unité visuelle forte, un caractère sobre et spacieux à la rue*	(e) *Induire plusieurs lectures de la limite piétons / véhicules*
-A- Construire des bâtiments relativement hauts, aux façades régulières et bien ordonnées, avec commerces en RdC	●	○	•	●	•
-B- Mettre à niveau toute l'emprise de la rue	•	•	●	●	●
-C- Dégager le volume intérieur du tronçon, notamment de tout stationnement et de tout étal de commerce	○	●	•	●	•
-D- Equilibrer le rapport des surfaces piétons / véhicules (surfaces à peu près équivalentes)	●	○	●	•	○
-E- Former un espace intermédiaire de chevauchement d'une largeur inférieure à la moitié de celle de l'espace piéton	○	●	•	•	●
-F- Compléter et pondérer les délimitations visuelles de cet espace intermédiaire		•	●	•	●

Configurations / Intentions table of the" levelled street": each intention may be supported by several configurations and inversely, each configurations may participate in the realisation of several intentions.

If the *parti* of the model (the succession of transformations) does not constitute a part empirically "testable" on its side (the only thing to test here is the efficiency with which this special sequence of actions is able to communicate well the ideas that are to be synthetically expressed, *i.e.* its "conceivable" character), the *intentions* and *configurations* table constitutes a group of partial propositions, each one susceptible to be infirmed or confirmed.

Indeed this table crosses a pattern of configurations

$$\{A, B, C\ldots\}$$

with a pattern on intentions:

$$\{a, b, c, d\ldots\}$$

Those two *congruent* patterns create the interpretation and evaluation *context* of all the partial relations:

$$A \rightarrow a$$
$$B \rightarrow a$$
$$\ldots$$
$$E \rightarrow c$$
$$E \rightarrow d$$

For if it is logically impossible to establish a relation such as "A → a" in a general sense (for example: "does shrinking the roadway reduces drivers' speed?"), this relation may be tested and confronted to empirical data when its validity frame is sufficiently restrained.

In fact, this frame is restrained when, at the same time, other intentions are targeted and other configurations are used to reach those intentions, when, for example, street animation is desired, when a clearer perception is wanted... when the decision is to level the street, to enlarge the sidewalk.... Thus a model gathers a whole range of propositions individually testable (more or less easily, accordingly to the nature of those propositions) that form, when taken all together, the contextual interpretation framework of each of these individual propositions.

This is how the *design models* express both a *knowledge of* "what it is possible to design" and a knowledge of "what could happen", in a specific situation, if one undertake to lay a street according to a certain strategy. This is even how each one of those two aspects of a model can enable the articulation of various heterogeneous viewpoints, several designers and multiple knowledges:

- The *parti,* which is the "open" aspect of a design model, is a description of a formal transformation that might take part in the explanation of every particular phenomenon singularly approached (pedestrians' motion, security, atmosphere…).
- The *intentions / configurations* table, that is the "closed" aspect of a design model, is the intersection, in a same framework, of patterns of configurations and intentions that may also come from multiple viewpoints.

We thus realize that the core of the *parti*'s description and of the *intentions / configurations table* is also a way to join, in a single modelling, the 3 phases of the street production process: *utilisation*, *conception* and *realisation*.

Principle 8: Producing contextual "design models" rather than "applicable solutions"

** When a cooperative design process is planned, the possibility of working with intelligible common supports is determinant. However, the conception task, even cooperative, remains an activity relying on faculties of imagination of new ideas. In order to be useful for the design, expected supports shall have a relatively "open" character, involving inductive and analogical reasoning, the generation of new possibilities rather than the restriction of choices.*

** On the other hand, each form of knowledge, if it is to be experienced and tested, must formulate refutable affirmations. Each model is then necessarily "closed" and involves deduction and restriction of the domain of possibilities: each model is thus, in a certain sense, the application to a specific case of some more general rules.*

** Those two "open" and "close" aspects of the urbanistic modelling are articulated in the formalization of the "parti" which described as a series of successive transformations applied to a initial fields diagram (good support for conception) and by the "intentions / configurations table" which describes the nesting of patterns of uses and patterns of concrete arrangements within a certain context (good support to refute parts of the models).*

Example 8: The NYMBY phenomenon (Not In My Back Yard) and participatory design

It is always tricky to serenely discuss with residents about future transformations of their life environment and this is quite understandable as they are going to be the first recipients, or the main victims of the operations. The mode of discussion is often chosen in way that does not help in this respect. For frequently, are presented at the sketch or preliminary steps, some drawings with a realistic and ended appearance, when the first aim is only to communicate and discuss about some principles. Inescapably, each resident will look at the architect's plan, regarding what is going to happen in his own courtyard: he will spend more time to think about details than the few principles that the sketches are expected to present. Instead to present a model, in other words, the imagination's support of a general principle, a document that seems to represent the final outcome is presented, thinking that the residents are not able to understand something else than photo-realistic images. This kind of images is in fact, a quite inadequate design support (if it is thought that resident must be involved in that task) for it hides project's ideas instead to display them in an intelligible manner.

4) Common models as local reference frames for political deliberations

A certain number of difficulties occur when the models of reference, which are used as source of inspiration in the cooperative street design process, are slightly shared between professionals on the one hand, but also between designers and users on the other hand.

It is especially in this type of situation that models are not taken as *design possibilities* but more as kinds of morals values, sometimes set up in dogmas. It is thus forgotten that a model is not better than another in itself, that every model can be well conceived, well implemented, and well used *in its kind*.

Carrying out a systematic analysis of the "advantages" and "disadvantages" of each model is generally not better convenient, for such an analysis supposes, implicitly, to choose a point of view rather than others. This special one leads to a kind of hierarchy of the criteria involved which is not an articulation between various needs or various points of view, as one would believe, but simply a relative weighting which characterizes a single and relatively ordinary opinion.

What is an advantage for the pedestrian can be a disadvantage for the motorist. What is an advantage for the cyclist can be a disadvantage for the storekeeper. Such assumptions seem to consolidate the multi-criteria methods of optimization. But appearances are often misleading on that matter.

A high sidewalk pavement is not necessarily a disadvantage for a person with reduced mobility. A broad sidewalk is not necessarily an advantage for a cafe terrace. For all depends on the *way* in which these people wish to organize themselves. Certain cafes are not organized to exploit terraces and do not wish any: they target another customer. In certain circumstances, a person in wheel chair will prefer to ask assistance from someone to help him go up on this pavement rather than to conceive that a special slope of several meters has been especially built for his only access.

All the models that actors convey who take part in the development of a street project are not "good" or "bad" in themselves. These models are not either some list of advantages and disadvantages which could be compared point by point. They are about modes of structuring, ways of making, possible forms of spatial and social organization which have been tested, which are potentially inspiring in the process of working out of a special organization of uses that would be appropriate in a specific context.

All the difficulty of a political deliberation (a collective decision-making concerning the way people wish to organize) arises from the task of making these implicit models communicate so as to overcome the simple and primary conflicts of interests and values.

"To articulate the contradictory goals of each people in order to bring a real intelligence to the process of deliberation", such could be the role of urban models if we consider them from the owners and users point of view.

For very often, if *goals* appear contradictory, between that of the motorist and that of the pedestrian for example, the first one seeking to go quickly from a point to another, the second to stroll at the fallen night, the *means* are sometimes compatible: indeed at night, the traffic can be a source of animation and a comforting presence for pedestrians...

All these relations of complementarities and relationships between these various points of view are invisible from the multi-criteria tables which are only fast shortcuts for deliberation. It is necessary, indeed, to conceive these relations, to truly integrate these points of view in kinds of political organization rather than being satisfied to abut them in a list. It is necessary to deliberate how pedestrians and car traffic are not only sometimes antagonistic but very often complementary and needing one another. In brief, if people are to be able to deliberate in a truly political manner, they need to engage themselves in a process evolving in parallel of the design process so as to imagine, being inspired by the transformations of these technical forms, various ways of organizing the uses and goals of everybody.

To build a process allowing a true choice is really another thing than to abruptly present to the decision-makers all the possibilities of a street design.

What one needs to understand is that moral interpretation of models on one side, and multi-criteria methods of evaluation on the other side, are two avoidance strategies adopted by actors that have to face situations that are too complex to be judged rationally.

It is argued indeed, that beyond five or six elements approached in a single framework, faculties of reasoning cease to operate and pass, inevitably, to an instinctive mode of handling ideas (choosing values: greener city, safer city, cleaner city, more connected city…) or to a statistical mode of data-processing (integration of a multitude of indicators).

It is thus clearly impossible to rationally compare 30 solutions answering the same problem, just like it is impossible to compare 3 solutions according to 30 different criteria and still impossible to solve a problem comprising 30 factors related to the movement of the cyclists, the health of the trade, the road accidents, the feeling of insecurity, noise, pollution, the distribution of natural light, the flows of water, wind, snow, car congestions, aesthetics, parking, technical networks, accessibility, cleanliness, etc.

What can we deliberate?

- We deliberate first of all on the "things" on which we are able to exercise some power: on the things, which, to a certain extent, depend on us, which are finally a very restricted part of the whole things one could think about.
- Then we deliberate of things that interest us, of the things we belong to, things which are, again, an even more reduced part of all the things we could possibly consider.
- We ultimately deliberate of elements that are presented together in a reasonable and conceivable *number*. If the preceding reductions did not make it possible to reach such a number, one divides the questions into several relatively autonomous sub-questions, and so on.

The first condition of deliberation ("we only deliberate of what depends on us") defines the concept of a *problem*: a problem, such as we shall define it within this modelling framework, is the interaction of several *forces* arising in a certain context. These forces are natural laws, human constraints or tendencies which one decides not to reconsider: the climatic conditions for example, the laws of resistance of materials or certain psychic and psychological phenomena that can be described and formalized, all the things that the project can take as a basis for reasoning.

Forces are also cultural and professional habits (the fact, for example, that French took the practice to drive on the right side make it difficult for them to temporarily drive on the left side in passing a special bridge for example), or moreover administrative norms that designers do not have the possibility to avoid. Hence the problematic part of a model is made up of several problems which are contextual patterns of congruent forces entering in mutual relations.

Let us note now that if the *forces* that constitute the *problems* are a modelling of "what does not depend on the project", the definition of problems is already the beginning of "what depends on the project".

As urban problems are to define relationships between all kinds of heterogeneous forces, the only manner of setting them together consists in forming an intermediate concept: that of *intention*. The laws of gravity, of material resistance and of visual perception may be contradictory only to the extent that they are helping or obstructing one special common intention.

The choice of what is problematic and of what is not is, already in itself, a deliberation: to choose what will not be the object of deliberation (components of the problems) is, already indeed, the commencement of what will be the object of it, a restriction to some kinds of intentions.

In the same way, whereas a homogeneous problem (a geometrical problem, or a mathematical one, or a physical one…) implicitly contains its solutions in its definition, this is absolutely not the case as regards urban problems: the heterogeneity of their forces (which can articulate sociological, acoustical, aesthetical, administrative, psychological, structural forces…) make them impossible to be abstracted by a set of equations.

Thereby, if the action of defining and formulating urban problems is already the start of deliberation, if it is already a progression towards some special intentions, we cannot deduce from these steps however some list of final configurations that will solve the problems involved.

It is, in fact, the second condition of deliberation ("one deliberates only of what interests him") that brings us to consider the concept of *intention*. Intentions are, to some extent, natural followings of problems: for among the natural and artificial forces that may raise some problems, one only considers those that seem obstructive to its own intentions.

If problems are not yet intentions, they are already pointing towards restricted types of intention which one will be able to formulate in order to solve them. It is not false to affirm, in spite of that, that any intention is more than the simple intention of solving a certain problem: aiming to reduce the speed of vehicles in a street mall is obviously "more" than solving a simple problem of road safety in an urban environment. Intentions define different *ways* of solving problems.

The third condition of deliberation ("one deliberates only on things which are presented in small number") brings us to the concept of *parti*. It is to be able to *conceive*, to *imagine* and to *figure out* things and their ideas that we need no manipulate them in reasonable proportions.

In other words, the passing from problems and intentions to configurations, which are in some extent their "solutions", requires the synthesis of a *mental form* susceptible to bind all these elements together in an understandable way, in a same diagram, a same parti.

If we need, for each model, to limit our considerations to a certain number of problems, intentions and configurations, it is finally to be able to form a specific *parti*, an idea capable of articulating these elements so that they can be deliberated.

Each model must therefore restrict itself to constitute a kind of *local reference frame* for deliberation, with specific and limited dimensions (problems, intentions and configurations). The sum and diversity of models will end up by covering, from models to models and from scales to scales, the whole of the problems, intentions and urban configurations which it is possible to consider. Thus the whole set of models will achieve this first without trying the impossible task of thinking everything at the same time and second without the resigning that consists in considering only one special type of phenomena (acoustic, light, parking, etc).

Each "model of deliberation" could therefore be described as the process of passing from a certain *context* to unquestionable *problems*, from these *problems* to certain *intentions* and

finally from these *intentions* to the design *configurations*. The *parti* that we place at the core of this process plays a synthetic role: it constitutes a mental form to which it is possible to resort when considering the problems and their overlapping forces, the multiple intentions compared to the various patterns of configurations that one will implement to reach them.

{Contexte – Problèmes – {Parti} – Intentions – Configurations}

Principe 9 : Modelling the process of delibaration

** The principle affirming that "each design model is not more adequate than another, but constitutes only a way of organising a street among many others" is very hard to follow when decision makers are confronted to some quite complex situations. The two most common avoiding strategies then consist either in using multi criteria statistic tools or in choosing a solution responding to some moral value (environment, economy, aesthetic…).*

** Nevertheless, it is possible to organise the design models' division in such way that each of them may join a pattern of information that can is "deliberable": it suffices, for that, to distinguish what is depending of the design and what is not (definition of the* problems*), to insert the notion of '*intention *into the transition from problems toward the configurations and, finally, to only consider a small and consistent number of each one of those "ingredients" to be able to articulate them within a same imaginable form (the parti).*

**Thus each design model may be presented as a process of transition from a context toward problems, from these problems toward intentions, and finally from these intentions toward the configurations of de design, the parti being, throughout the whole of the process, a synthetic form always available to imagination and reasoning of that model of deliberation which we may formalize as such:*

{Contexts – Problems – {Parti} – Intentions – Configurations}

Example 9: Inconvenient of the environmental labels coming from the building domain

Some environmental labels define a priori *a certain number of targets or objectives reachable for every project: air quality and visual comfort for example, are applicable notions for all objects, as much for a kitchen as for a façade, as much for a sidewalk as for a roadway. Because the quantity of targets is certainly very high (the HQE label has 20 targets) the winning of these eco-labels only require taking into account one or two targets, in order to take a step toward sustainable development…*

There, we typically have a case where the division of information and objects attain a group of ideas that may not be "deliberable": it is almost impossible to think about twenty targets at the same time, and every hope to join them together accurately within the architectural and urban work must be given up. The main lack of those approaches is to attempt to constitute some general frames of reference, worthy for all objects and all contexts, instead of making do with the formulation of a multitude of reference frames, more local and less ambitious but easier to get intelligible, that is to say, finally, more useful to political deliberation processes.

5) Urban fields and urbanistic models

Which phenomenon are the "urbanistic models" trying to describe? What is the object of that modelling process? It is possible to say that this modelling can be both useful from a technical design viewpoint and from a political deliberation viewpoint?

We are modelling here the *urban fields* which are kinds of "units" or "elements" of a more general phenomenon that we describe: *the continuous transformation by individuals and societies of their urban environment*, that is to say, simultaneously and in a coordinated manner, the modification of some concrete arrangements, the substitution of uses and the evolving of the ideas we make of it.

How to divide these units? According to which dimensions and to which criteria?

Each model is the description of the *transformation of an urban field* considered as relatively autonomous in its context: this is the *internal coherence* criteria of each field that determines its existence and then, the possibility to analyse it, for itself, and to model its transformation with the single constraint that each field must be a relatively balanced interweaving between patterns of

{Uses / Forms / Arrangements}

These *fields transformations* are thus modelled by *differences* of uses (*intentions*), of form (*parti*) and of arrangements (*configurations*) all put in relation to the stable parts of the environment: those that are not subjects of transformations (*contexts* and *problems*).

The format of a *design model* for urbanistic conception and political deliberation is thus finally the following one:

{Contexts – Problems – {Parti} – Intentions – Configurations}

Roles of the urbanistic design models

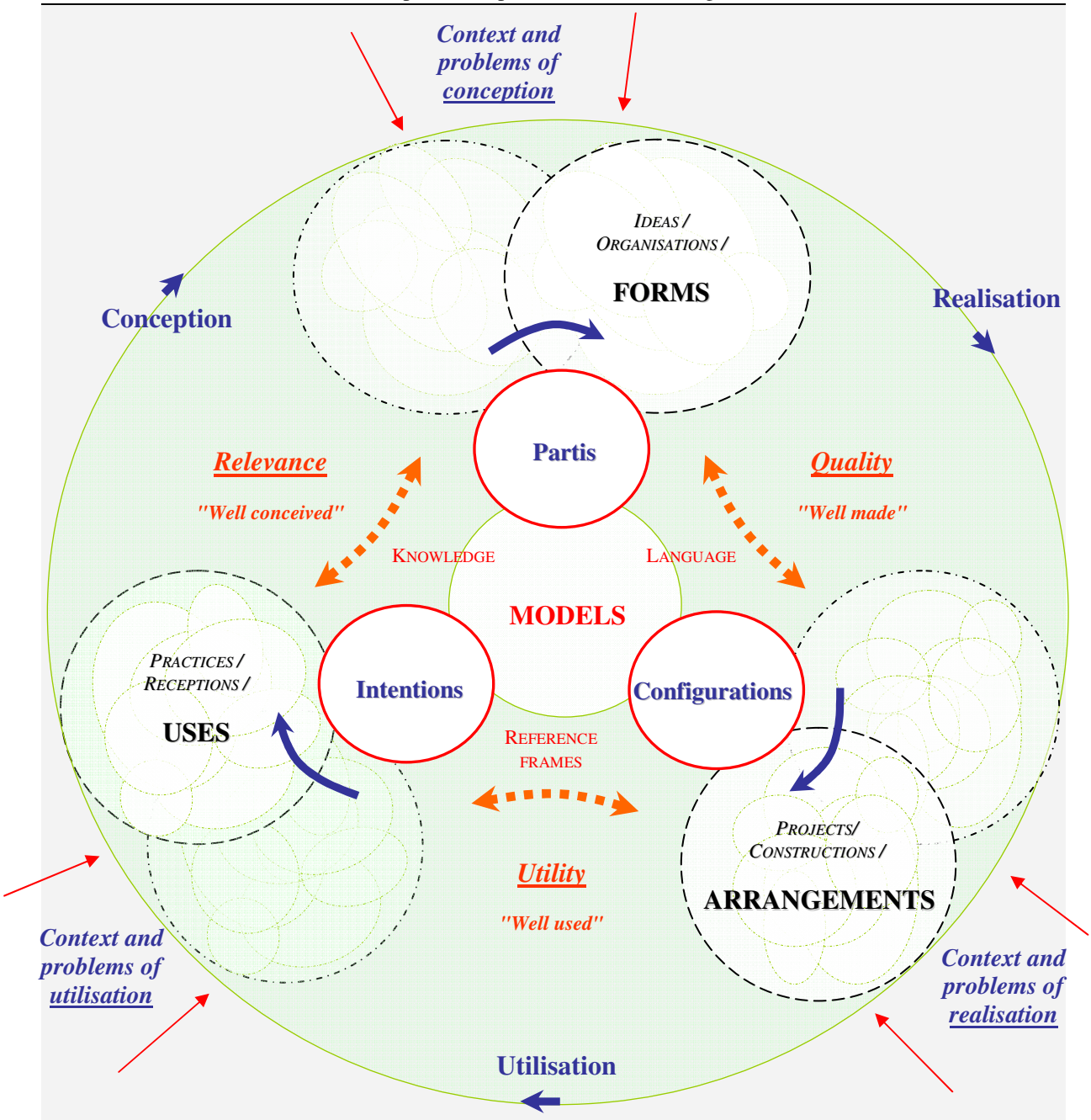
We have extracted in the previous parts three essential roles that the urbanistic *design models* may play in the elaboration of street projects:

* First, that of constituting a *common language*: denominations shared by all from which a shareable urbanistic language is formed.

* Next, that of constituting *knowledge useful to conception*, which may be experienced to a certain extent and which constitutes at the same time a good support for imagination.

* And finally, that of proposing a set of *local reference frames for political deliberation processes.*

Diagram 9: The transformation of an urban field {forms, uses, arrangements} and its modelling process {contexts, problems, partis, intentions, configurations}



Urbanistic design models: first layer of an urbanistic knowledge

We have started, in this second part of the study, by restoring to the notion of "form" its sense of "principle of organisation", of "mental form" or "idea" produced throughout a work of conception, a cognitive pattern that links functions and uses of a design to its concrete configurations.

This adjustment has allowed describing, in a second part, the both simple and complex organisation of the street, as it is articulated in three poles: *{conception, realisation, utilisation}*, that is to say *{forms, arrangements, uses}* which are the constitutive dimensions of each *urban field*.

We have been able thereafter to describe the implicit modelling that is inherent to all the production of streets process.

- First the notions of *intention* (differences of uses), of *parti* (differences of forms) and of *configuration* (differences of arrangements).
- Subsequently, the measures of *relevance* (adequacy of the parti to the intentions), of *quality* (adequacy of the configurations to the parti) and of *utility* (adequacy of the configurations to the intentions) that are all driven in reference to implicit urban models.

We have noticed afterwards that this implicit character of the urban models engendered a certain number of difficulties, notably preventing those models to play the role that could be theirs in the cooperative processes of the elaboration of an urban project:

- To serve as a shareable urban language.
- To be a useful knowledge for the work of conception.
- To form useful reference frames for the political work of deliberation.

We have finally defined a certain modelling process and format that satisfy those 3 purposes:

- By deciding to start from an already shared common language (the *design kinds*) in order to further specify a sharable urbanistic language (the *design models*).
- By taking, to describe all the design models, the general format of a deliberation process: {contexts – problems – parti – intentions – configurations}.
- By describing, on one side, the aspect of a model that may be "imagined" through its parti, taken as a process of transformation of some *elementary fields*, and on the other side, the "testable" aspects of a model in a table that crosses its intentions and configurations.

The so defined and formalized modelling method proceeds in two steps:

- Starting from the recognition of those well-known ideas, from those global concepts and from the *urban fields* they cover: the *design kinds* which are patterns of {forms, arrangement, uses}.
- Specifying these *design kinds* to inform them, avoiding deforming their *parti* while articulating around each of them the few considerations (contexts, problems, intentions, configurations) that seem particularly relevant to explain their principles.

The first step consist in locating, identifying, naming, comparing and dividing the design elements that are recurrently employed by designers and that correspond, more or less, to those fields and their well-known ideas of streets: pedestrian paths, trees alignments, pavements, arcades, roadways, etc.

The second step consists in experiencing, testing and studying each model for itself so as to explain its principle, to bring legibility to the inherent and specific intelligence of each model. To reach this purpose, it is needed to articulate a limited number of dimensions, theories, trades and disciplines that usually do not communicate very well: according to the nature of the idea, to mix some economic questions with hydrologic concerns, economic concerns with acoustical hypothesis, climatic strengths with questions related to the utilisation of space… while referring to the logical categories defined by the modelling method: *contexts, problems, partis, intentions and configurations*.

Thus the whole of the *design models* will form a kind of streets design *state of the art* that won't belong to a specific trade, neither to a particular discipline, but on the contrary, that may articulate all these viewpoints in the formulation of a repertory of urbanistic models of conception and deliberation.

From this *first layer of knowledge*, quite long and drawn-out to elaborate regarding the whole range of the urban field, some other levels of thinking may be initiated as regard the urbanistic modelling. We may produce *models of thinking,* which are more general than models of sidewalks, bus lanes and arcades. We shall elaborate *design operators* allowing to generate new *design kinds* and theirs specific *design models*, to generate new models from existing models and to explain general mechanisms that are common to several of them. We shall start to provide tools supporting the design processes where and when no specific and adapted models seem available to deal with a particularly complex problematic. We shall launch, in brief, a second work, a *second layer of knowledge*, based on that first empirical layer constituted by these urbanistic *design kinds* and *design models*.

-C- Some design operators to imagine and to conceive new models of street

Introduction to design operators

The *design operators* are theoretical tools able to organize the empirical material of the whole of the *urbanistic design models* that were elaborated to support the *technical conception* and the *political deliberation* processes.

These design operators constitute a *second layer of urbanistic knowledge*, more general than the first one, which has been emancipated from the specific urban objects (sidewalks, roadways, alleys…) in order to focus on some general characters and features related to the utilisation, the conception and the realisation of urban designs.

If street projects are not simple or automatic applications of street models, but rather the achievement of a works of conception which are based and inspired on such models, design operators are, analogically, some *models of thought* not used to generate new street models automatically but rather to support, in many different ways, the works of conception of this kind of models.

In other words:

- The models of conception and deliberation are *particular manners* to imagine, to organise and to design street projects.
- The design operators are some *particular manners* to handle, to organise and to conceive these design models.

The *design operators* are then useful mostly for researchers and for street models producers. Notwithstanding, when the street models' repertory is few developed, as it is nowadays where plenty of urban fields do not have their explicit models, design operators might serve as good *tools to support urban projects*: they allow fast recognition of new possibilities and enable to reason about new models, even if those ones have not yet been subject of a previous modelling work.

In common practice, designers, as model makers, will often use in an implicit manner such models of thinking. To formalise some of these operators enables the profession to consider those tool as things in themselves, susceptible of development and refining to best serve their purposes. As for street design models, the formalisation of these operators may put these tools in their right perspective by notably restricting their potential domain of utility.

In brief, this new layer of *urbanistic modelling* may authorize designers to make a clever use of the street models such as they may be formalized, but even also to make a clever use of the *models of thinking* leading our manners of formalizing these models…We shall thus describe, in this third part of the report, a large range of *design operators* of different kinds.

Those operators will be firstly ordered according to the 3 "poles" already used to constitute the street models: *utilisation, conception* and *realisation* taken in their *recursive* sense[28], *i.e.* in this sense that these notions concern every representations and all document being needed to the production of streets, as well as the concrete arrangements themselves.

Next, we will classify, those operators according to their *valence*: in fact there is univalent operators, as well as bivalent, trivalent… according to the *number* of conceptual entities that those models articulate.

We will use the univalent operators as "units", bivalents operators as "dimensions", trivalent operators as "levels", tetravalent operators as "relations" and pentavalent operators as "elements".

Such as we have defined them until now:

- The *unit of utilisation* is the "use".
- The *unit of conception* is the "form".
- The *unit of realisation* is the "arrangement".

What we have named *urban field* (meaning the object of the modelling such as defined in the previous part) is the reunion or the antecedent principle to the distinction of those 3 partial units: an *urban field* is a whole pattern of *{uses – forms – arrangements}* that are relatively congruent, *i.e.* "standing together ".

A *recursive* notion of the *unit* should now be built. Let us take a "line of parking" as an example. It could be admitted that this *urban field* is a kind of interlocking between a pattern of uses (parking, starting the engine, waiting…), a pattern of forms (a sequence of lots, aligned, with exit on the right…) and a pattern or arrangements (a roadway structure, a street pavement, vertical signs, parking lots surfaces and delimitations…)

Let's take now any one of those elements: "waiting in the car" for example, which we have included in the pattern of uses. It is still possible to consider that unit as an *urban field* in itself, taking it not only as one use but still and recursively, as a pattern of uses (observing pedestrians, looking at the clock…), a pattern of forms (a squared space, oriented forward…) and a pattern of arrangements (driver's seat, bench, digital screen of a parkmeter…).

Here are the reasons why units are recursive operators: they are used to distinguish, within the same phenomenon or same *urban field*, what is more concerned with *use*, with *form*, and with

---

[28] It is possible to link that distinction of those 3 "poles" of the streets' production and the documents needed to their production with Plato's proposition concerning every *artificial* productions in general:

* (*Republic*, 342c): « For each thing exists three kinds of art: the art that will utilize the things, the art that will make it, the art that will imitate it », in other word, the art of *utilisation*, the art of *realisation* and the art of *conception*.

* (*Laws*, 667-669): "Anyone who wants to be able to judge with intelligence must satisfy these three conditions: knowing what is the reality that is imitated ; then knowing in which way this imitation is correct ; and finally ... knowing what makes it useful", that is to say successively assess the *relevance*, the *quality* and finally the *utility* as we have defined them in the preceding part of this report in reference to these three kinds of art: *conception*, *realisation* and *utilisation*.

arrangement. And still, for each of those elements, retaken as a field in itself in order to distinguish within it what appears to be most from *utilisation*, *conception* and *realization*…

Thereby, let us consider the bivalent operator[29]:

- As *dimensions of utilization* (of a use), we shall take "life" and "time" : a use is all the more important that it is lasting a long time and being "intensely living".
- As *dimensions of conception* (of a form), we shall take "number" and "form" : a form is all the more important that it is general (simple number, omniform) and well-formed (not deformed, with one form).
- As *dimensions of realisation* (of an arrangement), we shall take "space" and "matter": a realisation is all the more important that it occupies a greater space and that it involves a greater quantity of material.

Once again, it is needed to take those *dimensions* as recursive operators: one may easily consider that:

[the time of {the parking line}] = "the temporary parking"

and that

[the form of [the time of {the parking line}]] = "a short an irregular rhythm"

and so forth…

These first operators, univalent (units) and bivalent (dimensions) do not bring a lot of new considerations that were not established till now by the yet extended description of the urbanistic modelling.

But it may be noticed, for example, that if relevance is defined as an adequacy of the *parti* (differences of forms) to the *intentions* (differences of uses), giving the *dimensions* of *utilisation* and of *conception* provide further precisions: the measure of relevance confronts "some life" and "some time" on one hand to "some numbers" and "some forms" on the other hand, enabling to envision different *kinds of relevance*: a "rhythmic relevance" for example, may be essentially based on an agreement between

[the number of the {parti}] = « 2 »

and

[the time of {intentions}] = "an alternation day / night"

Or even a "geometrical relevance" for example, which may be essentially based on an agreement between

[the form of the {parti}] = "circular"

[29] The definition of such operator is not definitive :here are only some postulates relatively efficient.

and

[the life of {intentions}] = "to circulate"

The kind of hypothesis we have formulated on specifications of different kinds of *relevance* may easily be extended to the cases of *quality* (adequacy of the *configurations* to the *parti*) and to *utility* (adequacy of the *configurations* to the *intentions*): those notions may be recursively differenced under the action of the bivalent operators of the dimensions.

I. The constitutive levels of a street

1) Recursive acceptation of the notion of level

The utilisation, conception and realisation levels of a street are trivalent design operators: in fact, at each time will be distinguishable a superior level, an intermediary level and a lower level. This distinction is to be repeated recursively in identifying within the superior level, for example, a superior, an intermediary and a lower level...

Levels keep up continuous relations between themselves together: to pass from the lower level to the superior level, or to bring some constraints from a level toward another level, one ought to pass by the intermediary level.

2) Three levels of utilisation of a street: physical, perceptive and cognitive

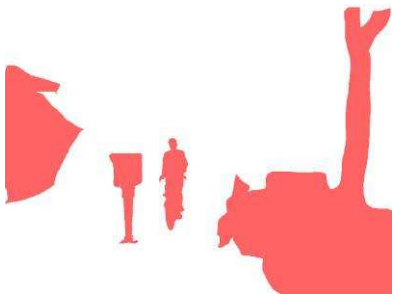
The street network, the street and all their constitutive elements may be used according to three different manners, *i.e.* according to three levels:

* *The physical level:* the buildings bordering the street, roadway structure, paving, shops' displays, vehicles and pedestrians themselves are *physical bodies occupying small portions of a the street space*. Simple objects remain motionless, while persons and their vehicles may be set in motion and constrain each other in their movements. For each of those bodies, a *physical field* may be discerned and defined as an areas of space both continuous and coherent from the viewpoint of its utilisation: the space occupied by a pedestrians in motion, the space occupied by a bench and the people sitting on this bench, the space of a bus stop and the people waiting at the bus station, or even the bus shelter space itself and people on the queue along the sidewalk: thus every field defined by contiguity of the physical space.

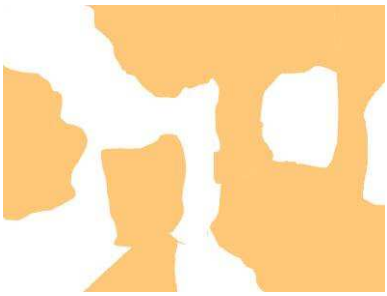
* *The perceptive level:* from the perception viewpoint, physical bodies are no more the only entities to manifest some existence and influence on the street organisation. The empty spaces, perceived as having coherent forms, may be added that that of objects and physical bodies. *The perception brings physical bodies' properties on their direct domain of influence and on some empty but well-formed spaces.* Perception depends on the nature and movement of the observed objects, of the abilities and the particular attention of the people perceiving it and even on the general functioning of the street space. For each entity of the street, a *perceived field* can be identified and afterwards, defined as an area of the space relatively continuous and coherent from a perceptive viewpoint: for example, it will be added to a bench and the peoples sitting on that bench, the trees thereabouts that cover them and seem to define the whole as a single space. It is important to notice that the perception introduces a first notion of *anticipation at the reflex's scale*: *a* pedestrian perceives “around” the cyclist approaching the space that he is going to occupy soon, he perceives that space is wide enough and that the cyclist moves faster than pedestrians.

* *The cognitive level:* all the perceptive elements of a street have significations; they are set by some implicit and explicit rules guiding behaviours. Users understand to varying degrees the functioning of the street in which they move, take decisions and modify their conduct in function of their aims, projects and anticipations. *Every entity of the street, the whole of the*

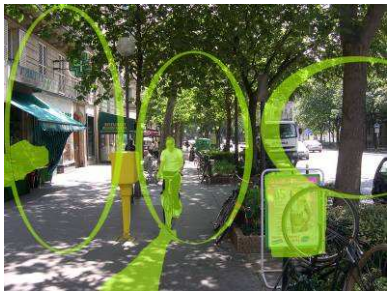
"things" and perceived 'things" are susceptible to be interpreted as messages, as information of various kind, some suggesting for example the functioning of that space and the right behaviour to choose: the continuous white line informs the driver that he cannot go across, even if physically, no obstruction seems to be there; a way going under an arch suggests a transition between a space toward another, this with no need for a sign "entrance". To those implicit messages induced by the street's configuration are added a whole of explicit messages: road signs, shop signs, etc. The *cognitive fields are the areas of space about which users carry certain significations and mental projections. Those fields have theoretically no limit:* some kids imagine the trees as inhabited by gods, while some traffic specialists consider that trees as a deadly threat for drivers... The *cognitive fields* are some kinds of images and mental maps proposed by the imagination that head our conducts, our interpretations and our reactions to events.



Physical fields



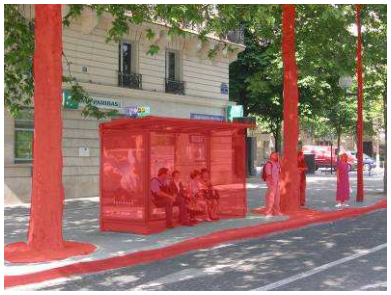
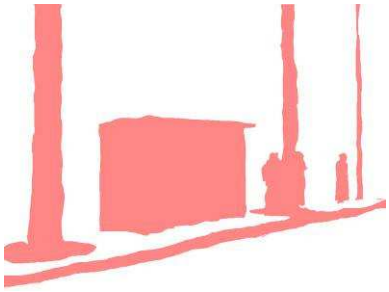
Perceptible fields



Cognitive fields

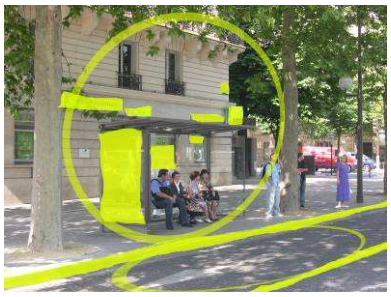
Meeting a cyclist in the midst of a sidewalk

Coincidence between physical, perceptive and cognitive fields

Physical fields


Perceptive fields

Cognitive fields

Waiting for the bus

Coincidence between physical, perceptive and cognitive fields

With those 3 constitutive levels of utilisation, it is possible to expect some new perspectives with regard to urban designer' actions. If the action of making a street transformation is inevitably material, (the construction of the design needs the building of such elements as façades, sidewalks, trees alignments...), those material elements have, by definition, an existence and an influence that is measurable on the perceptive and cognitive utilisations of the street.

Each design action influences in some degree the physical, perceptive and cognitive utilisations of a street.

Principle 10: Three utilisation levels of the street: physical, perceptive and cognitive

** Three levels of utilisation, apprehension and reception of a street may be distinguished, those level being physical, perceptive and cognitive.*

** The urban design action consist in transforming physical objects and devices in order to sustain a certain form of the street organisation of uses and functions by some physical, perceptive and cognitive means.*

** In a street any element is susceptible to be apprehended at a physical level as a potential obstruction, at a perceptive level as a kind of delimitation and, last at a cognitive level as a sort of message informing users on the specific functioning of the street.*

Example 10: A pedestrian tries to make a call to a correspondent

Regarding the pedestrian viewpoint, upright, standing on the pavement and dialling a number to give somebody a call with his cell phone: his body and the immediate space around him form his physical field, relatively small and steady. His attention is directed toward his phone keyboard, on which his fingers inscribe a message. The perceive space is then focussed on that keyboard. His mind is totally disconnected from the street in order to focus on the message content and his correspondent. Conceived space is elsewhere: regarding the street, space does not exist.

Let us suppose that his attempt fails, because his phone does not run on that place of the street, his phone having connection problems. The pedestrian then seek for a phone booth; as he begins to walk, his physical space is going to change and become wider. His eyes will peer at the street and the others streets nearby, searching for phone booth. Perceived space then goes up to the visual limits within the street space. He does not care no longer to his close space, and may also hit someone by accident, while he was looking far away. His mind construes every signs of the street as some possible clues of the presence of a phone booth. He looks for a major crossing, being usual in France to install it there. The conceived space then stretches over the perceived space: he reads the streets' hierarchy, imagines theirs intersections in which he only perceives small parts, he forms a mental image of the situation, of the place where he could find what he is searching for.

The pedestrian finally finds a phone booth, goes in and afterwards he dials and gets the line. His physical space is then completely enclosed by the walls of the booth, while his body must remain steady, and his eye may observe the street and its uses. The perceived space goes beyond the physical limits of the booth, going where his glance will be oriented. The conceived space corresponds to the booth's space itself; as a certain intelligence is needed to use a phone booth. The cognitive utilisation will be able afterwards, to focus on the talking point, which is out of the street: the user is still absent cognitively.

Example10': Which "space sharing" are we talking about?

That distinction of the 3 utilisation levels of an urban arrangement brings new clarifications about the central question of the space sharing between uses and, notably, displacement modes. It is realistic to imagine a share of the space at those 3 physical, perceptive and cognitive levels:

- At the physical level, "share" means that on a same place, several modes of displacement will be able to pass, as this happens for instance in pedestrian precincts, which take in a tramway in the midst, and in which pedestrians move aside at the last moment when the vehicle come closer (at Istanbul notably), or as in most of German trams that circulate on the roadway within the cars.

- At the perceptive level, "share" means that several modes of displacement will seem to evolve within a common space whilst their body follows specific pathways, in order that they do not intersect the other pathways, as in some streets with a "U" profile. This is firstly in this global volume of the street that pedestrians and vehicles will have the feeling to evolve, rather than on a roadway or on separated

sidewalks. Inversely, some streets levelled in an attempt to promote space sharing, finally produce the opposite effect when an important bollards installation reinforces more flagrantly than the simple sidewalks, this demarcation between pedestrians space and the space dedicated to vehicles...

Equally, a cycling track in the midst of a planted mail no longer exists in itself: painted lines are no longer significant, perceptively, with comparison to trees' trunks alignments and the covering provided by those trees.

-At the cognitive level, it is enough that a user understands the justification of a space, its principle of operation in order that he could mentally enjoy the space, i.e. engage his mind into the space. As such, spaces simple and clear to understand benefit to everyone even if each one does not make a physical and/or perceptive use of the whole of those spaces. It is as well obvious that possibilities of sharing are much more developed and easily doable at cognitive and perceptive levels. This is even how they will cost cheaper and will be the more profitable. In a classroom, where every students stare and concentrate their mind at the teacher that make is lecture, it is clear that every student have a complete experience of the whole of the room, even if each of them does not to move. Conversely, the strict sharing, i.e. at the physical level, is inevitably much more constrain firstly, by some space limits outcomes, and thus, by safety and convenience considerations, that make such physical cohabitation impossible, as soon as the differences of speeds become too high.

Example 10'': Three action patterns of road safety

Several actions intending to improve displacements' safety may be likened among the different kinds that exist:

- To install a series of fences on the sidewalks of a dangerous crossroads is an action at the physical level, which intends to prevent some movements of pedestrians.

- To shrink the width of a roadway in order to reduce vehicles' speed is an action at the perceptive level, which intends to modify drivers' behaviours by an accentuation effect of the perceived speed.

- To install road signs that warn a series of dangerous curves consists clearly to transmit messages to drivers at the cognitive level. Similarly, to put in benches and other urban furniture in open country may constitute an attempt to surprise drivers, in order that this one take into consideration the situation, and wonder about the conduct to choose.

3) Three levels of conception of a street: plotting, composition and distribution

The streets network, the streets and all their constituent elements may be conceived according to three different modes: as a line (the plotting), as a surface (the composition) and at last as a singular element (the distribution).

The associations of ideas that are produced during the conception and imagination phases lean strongly on formal considerations: the lines, that are oriented lines, some kinds of movement from a point to another, follow other lines; they delimit surfaces that superimpose and juxtapose themselves, or even sometime are overlapping; the third vertical dimension is generated by the lines crossing and the composition of singular elements that form some places.

A street is first of all a linear street path. The link from one place to another characterizes firstly the longitudinal dimension of the street, its movement and orientation functions. The plotting defines the whole of the topological properties of the street: its pathway, its ascents

and descents, its eventual diversions, its rectilinear or circular character, or even its uniform or variable character, etc.

A street is even a surfaces composition: the delimitation of districts and parcels on both sides of it, the facades and building face-to-faces, the crossing from a side of the street to the other, the exchanges between public and private spaces, the friction, the disturbance of longitudinal movements. *The composition defines the whole of the geometric properties of the street*: its width, the internal partition of its space in central and lateral ways, the uses organization, the distribution of activities, in surface and in elevation, in plan and in sections, the assignment of spaces, etc.

The street is afterwards a volumetric and punctual distribution: an establishment of unique elements along a pathway, an accumulation of points, crossroads, intersections, monuments, objects, trees, bus shelters, telephone booths, etc. Each place of the street is a fixed and vertical point opposed to the longitudinal dimensions (plotting) and the transversal street (composition). *The distribution defines the whole of the arithmetical properties of the street*: its rhythm, the number of its openings, its connections to the street network, the quantity and the distribution of its unique points, activities and attention's attraction points, the multiple exchanges place of all kinds, etc.

The identification of those different formal properties categories and of their involvement in term of uses and functions, allows to clarify the essential characteristics of the street arrangement, to know for instance, that orientation and visual mark, outcomes of the urban scale work, depend almost exclusively of the street plotting, or even that the space sharing and space repartition outcomes come essentially from the composition level.

Those levels of conception also find a utility in the definition of the realisation steps: whether it is to draw sketches or to build the construction itself, or even to evaluate the costs of the operation, one may always distinguish, in fact, the quantities measurable in linear meters (plotting) from the one that are measurable in square meters (composition) and from the one that are measured in volumes or quantity of elements (distribution)…

Principle 11: Three levels of conception of a street: plotting, composition and distribution

***** *One may distinguish three levels of conception a street design that correspond to plotting, composition, and distribution. Those levels refer to different categories of formal properties:*

- *Longitudinal and topological properties for the plotting,*
- *Transversal and geometrical properties for the composition,*
- *Vertical and arithmetic properties for the distribution,*

** Those formal properties refer directly to some uses characterizing the street, to some functions that are essential in all circumstances:*

- *The transport uses, the servicing and the city orientation for plotting;*
- *Activities welcoming, their repartition and the lots delimitations for composition;*
- *The street network connections and the definition of central elements for the distribution.*

** Those formal properties even refer directly to the different steps of realisation: plotting, composition and distribution are steps that can be done successively and relatively independently to draw a sketch, write a program, evaluate the costs of an operation or built the arrangements themselves.*

Example 11: Orientation within the city depends essentially of plotting

One of the street's characteristics that it is hard to achieve today is as good orientation device at the district scale. Most of the residential ways are maze, made of dead ends and perpendicular ways, which quickly discourage anyone. If some paths are built throughout rules care, by a king of pseudo-rationality concern, planners forget that a homogeneous grid needs a significant number of unique elements (as the diagonals in the plan of Barcelona) to differentiate its parts and to provide visual markers. If some other path are inversely, more curved, more sinuous for picturesque reasons in the plan composition, there designers even forget than uninterrupted changes of orientation with no apparent reasons quickly disorients peoples who pass by... In every cases, this is the line and its changes of direction that provide the mental guidelines necessary to users orientation, and it is then on the plotting conception level that it is necessary to work if it is wanted to offer to citizens the possibility to orient themselves without needing a GPS.

4) Three levels of realisation of a street: solids, fluids, voids

When one wants to pass from the *parti* to the configurations, from an idea or a principle to its concrete realization, several actions strategies are offered simultaneously:

- *Solid objects* might be formed.
- *Various kinds of fluids* might be formed, natural and artificial.
- *Voids* that compose the space might be formed.

What is a “rectilinear street that is directed toward a monument”? Is it the *solid* street material that has been placed in a linear configuration? Isn’t it the buildings, trees and sidewalks that have been aligned? Isn’t it even the street space and the voids that are offered to uses and everyone's sight that seem to follow a rectilinear form toward the monument? Or isn’t it rather the uses of that street that takes a strait line form, the cars' flow that comes closer and the wind that blows into the street?

There is not necessarily a perfect coincidence between the solid dispositions (objects, furniture, buildings...), material and peoples flows (traffic, wind, outflows...) and the voids disposition (spaces, sites, parcels...) although often, each of them may correspond to a certain extent to the others:

- Streaming water (fluids) follows the free surface of the roadway (voids) to flow in the gutter (solids).
- The vehicular traffic (fluid) circulates on the right lane (void) of the roadway (solids) with a certain liberty (voids).
- The pedestrian is not very constrained in its movements (fluids) on a large sidewalk (void) oscillating between the buildings (solids) and the circulation (fluids)

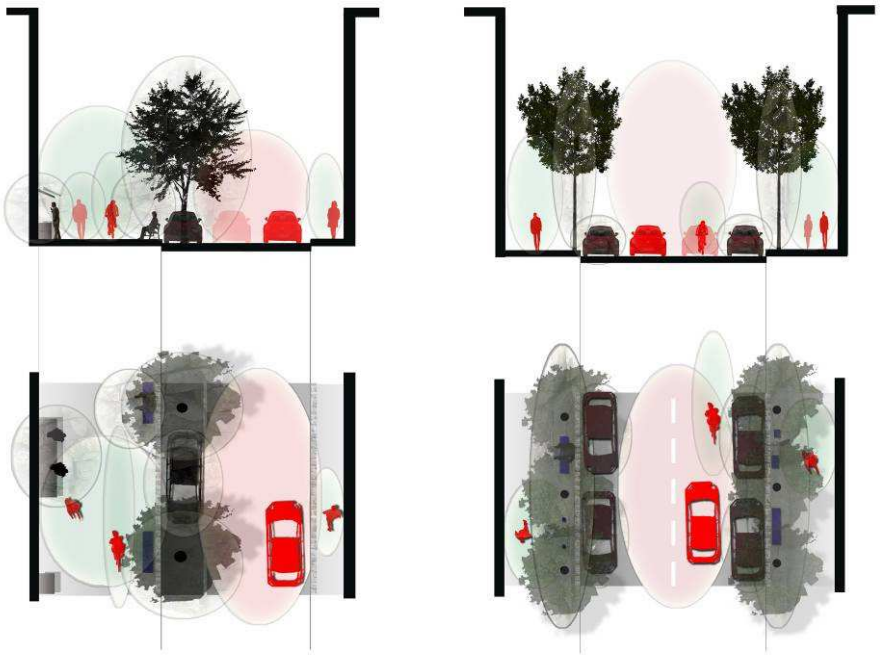
All the topological, geometric and arithmetical qualities of the street such as we envisioned them in the previous part are "feasible" at the voids, fluids and solids levels. From the quality characteristics of urban arrangement standpoint, both voids and fluids have as much strength, "reality" and capacities to configure the organization of collective life than the solids: for a pedestrian, the danger may comes from the size of the vehicles circulating next to him (solids), as much as from their speed (fluids) or from space unwelcoming (voids).

A “rectangular” piazza such as the Places des Terreaux, in Lyon, is no longer of this form when one considers that the principal pedestrians flow stretches this place in diagonal. This is here an example of an arrangement within which voids and solids correspond relatively well, but in which the movements (fluids) take a radically different form. This place is consequently not purely "rectangular", as could give to understand its plan. The place is also "triangular" in some respects, notably when it is cut in two by the continuous flow of pedestrians going towards the town hall subway station.

The arrangement of a street is thus not only a simple accumulation of solid materials and technical devices. It is even not only a whole of voids and matters that play under the sun light and the prevailing winds. The installation of a street is equally structured by a whole of *fluids*, mechanical, human and natural, which continuously orient and configure the street: a street is not the same on the morning and on the evenings, in the summer and in the winter...

These three levels of realisation of a street design correspond also to thee distinct scales of time: the voids, which are the most immaterial of those levels, are even the more perennial elements:

- Cities history demonstrates that this is the forms of the voids let between the building that last the most, despite the processes of demolition and reconstruction.
- Following the voids come the fluids, in constant motion, that construct the ephemeral and continuously changing structure of the city but of which the forms repeated days after days and years after years keep, even so, a significant durability.
- Despite their stable and fixed character, the solids are the first to fall, to be demolished and to incessantly stop to exist, the first *to lose their form*.



“Levelled street” and “curtained street” models are two different ways of organizing the street through voids (black circles), fluids (red and green circles) and solids (black drawings).

Principle 12: Three levels of *realisation* of a street: solids, fluids and voids

**One may distinguish three levels of realisation of a street that correspond to their existence as solids, as fluids, both natural and artificial, and finally as voids:*

** Those levels of realisation refer to distinct time scale:*

- *The level of voids is the most perennial; these are the forms that last the most;*
- *The level of the fluids is in an intermediary scale of time, relatively perennial;*
- *The level of the solids is by definition the one that is going to be the first to disappear.*

** The structure of an arrangement is consequently composite: from a qualitative point of view, the voids' forms and fluids' forms have as much effects than the forms of solids; one may then consider that those three realisation levels are all quite as much real and influent.*

Example 12: Several ways to protect oneself against car's speed.

How to protect pedestrians walking on a sidewalk against potential risks of a quite fast traffic?

- At voids' level, in creating a bus lane that will be unoccupied most of the time and that will keep cars far away from pedestrians.
- At fluids' level, in programming a slower right lane, restricted to 30km/h for example, and serving notably as a service and access way, in addition of its function of pedestrians protection devices...
- At solids' level, in establishing a series of trees with strong and massive trunk, which will form a natural protection, or by establishing a parking line, having a more significant impact in this regard.

In considering the actions according to those three levels, ones multiplies the solutions available in order to target some outcomes, to produce the desired effects, i.e. to organise the urban life as we have imagined it.

5) Nine constitutive levels

We have analyzed three kinds of streets constitutive levels, taking successively the points of view of utilisation, conception and realisation. Those distinctions allow describing the range of effects (utilisation), methods (conception), and means (realisation) that street design may operate.

The nine constitutive levels of the street

** 3 levels of reception (design **effects**): physical, perceptive and cognitive.*

** 3 levels of conception (design **methods**): plotting, composition, distribution.*

** 3 levels of realisation (design **means**): voids, fluids, solids.*

Diagram 10: The 9 constitutive levels of a street

Utilisation	Conception	Realisation
Cognitive	*Plotting*	*Voids*
Perceptive	*Composition*	*Fluids*
Physical	*Distribution*	*Solids*

II. The constitutive relations of a street

1) Recursive acceptation of the notion of relation

The interesting question that brings this logical distinction between the 3 levels of utilisation, the 3 levels of and the 3 realisation levels is the following one: what kinds of relation keep those 9 levels together? How do they interact? And what do these interactions learn us on the functioning of the street?

We will distinguish 4 types of general relations that will be recursively applied following the viewpoints of utilisation (uses relations: cohabitation), conception (formal relations: integration) and realisation (concrete relations: cooperation). Those 4 generic relations are the following ones:

- *The final relation*: a *field* is the *purpose* of another *field*, as when a workplace may be the goal of the "home-workplace" run.
- *The formal relation*: a *field* is the *form* of another *field*, as when buildings take the curved form of the street that borders them.
- *The efficient relation*: a *field* is the *mean* of another *field*, as when a parking line contributes to the protection of pedestrians who walk on the sidewalk.
- *The material relation*: a *field* is the raw *material* of another *field*, as when a part of the roadway space is converted in a cycling track.

To conceive those relation recursively, it suffices to accept that each *field* may be in relation with some other *fields* according to each of these 4 kinds of relation simultaneously: a sidewalk may be the goal of the roadway (final relation), its form (formal relation), its mean (efficient relation) or even its raw material (material relation), and vice-versa.

2) Four relations of cohabitation: subordination, obedience, support, conversion

Then we define 4 modes of cohabitation of *usages* within a street:

1. *Subordination (final relation):* a use is subordinated to another use when the goal of the former is a declination of a the general goal of the latter, when a move is transport by nature to its aimed activities or when a step of one journey is naturally allotted to the journey itself taken globally.
2. *Obedience (formal relation):* a use obeys to another use when the form of the former takes the form of the latter: for instance, when the cycling track follows the path of the roadway, or when pedestrians tend to turn according to the tram's curvature radius, etc.
3. *Support (efficient relation):* a use leans on another use when the latter depends of the former to accomplish its purpose, when the night traffic provide a feeling of safety to pedestrians, or even when the multiples flows of a crossroad serve the corner's shops are reading in this configuration a great number of peoples likely to pass by…
4. *Conversion (material relation):* a use may convert into another use when the latter is a sort of transformation of the former, when a move from a point to another becomes consequently a stroll, a stop on the road side, or even when the traffic on the Champs-Elysées becomes a continuous parade having no else goal than to parade...

Here is how the uses aren't exclusive between themselves, how they are organised, some *for* the other ones (subordination), some *following* to the other ones (obedience), some *by* the other ones (support) and finally, some *on* the others ones (conversion) when certain uses are only transformations of existing uses.

The uses cohabitation within the street demonstrates several significations. It is not only to attribute a space more or less well-dimensioned to each user, neither is it to mix or to separate everything. It is rather only to think wisely those relations of uses as human relationships, relations by which citizens are able to practice their intelligence in the complex patterns of relations that inevitably mix everyone's concerns.

According to those 4 modes of cohabitation, one may even envision especially the relations existing between the different *levels of utilisation* that we have previously identified: the cognitive, perceptive, and physical levels.

A level can be subordinated to another: the physical level subordinated to the perceptive level for instance, when we walk on a waste land or on a wide public place, taking directions with visual marks: these are the goals that we discern and which consequently orient us toward a certain direction. The cognitive level can even, for example, be subordinated to the physical level, in threatening situations, when driver's attention is directed toward their own path, trying to avoid cars coming in the opposite way. Generally, it may be said that a "functionalist" the street space partition (dedicated spaces for pedestrians, cars, buses, cyclists, etc.) is a general subordination of the cognitive and perceptive level to the physical level itself: it is the safety and the body's motion fluidity that prevail over atmosphere, comfort, politeness, mental activities; it is there the physical level that constitutes the first and the last resort in the uses organisation

A level can even obey to another. The physical level obeys to the perceptive level for example, as when the shrinkage of a way slows down motorists. A level may leans on another, the physical level leans on the cognitive level when the border of a reserved bus lane is not only felt as an obstacle to the overcoming, but equally as a mental and functional limit of a space, clearly displayed as a place reserved to the public transports.

Ultimately, a level may ensue from a conversion of another level. The cognitive level can result of a transformation of the physical and perceptive levels, for example, as when a driver decides to give up a road apparently jammed and uses another itinerary, or when he finds a shortcut, taking a street that seems going directly on the desired direction...

Principle 13: Four relations of *cohabitation*: subordination, obedience, support, conversion

**4 modes of cohabitation can be distinguished: subordination (final relation), obedience (formal relation), support (efficient relation) and conversion (material relation).*

* *Those modes of cohabitation are applicable from a street use to another, as when a cycling track obeys to the cars trajectory, for instance.*

* *Those relations are even applicable from a level of utilisation to another, from the cognitive level to the perceptive level for instance, this within the same use or the same field, enabling a deeper understanding of the nature of its organisation, distinguishing among its elements the uses that are set by the physical level from those which are set by the perceptive and cognitive levels.*

Example 13: The unpleasant riding of cyclist in the city.

The cyclists are definitely users that have the most to obey to other uses within the street spaces: stuck between the side walk and the roadway, their pathway is quite constrained, i.e. quite away from those that they normally could adopt in a "free terrain". This is often how, for important traffic reasons, the physical level (do not hit the borders, vehicles, pedestrians) rules cyclist's perceptive and cognitive levels, this one being more worried by his own pathway, by his own safety, while pedestrians have all their time to think about something else or to look elsewhere safely despite the encumbrances.

3) Four relations of integration: assimilation, conformation, articulation, deformation

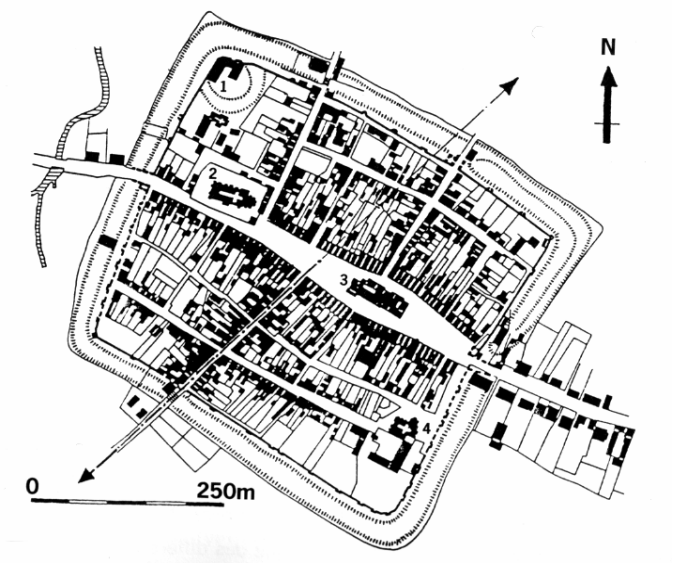
We define 4 modes of integration of the street designs:

1. *Assimilation (final rapport):* an organisation form assimilates another one when the former absorbs within itself the latter, as when the linear form of the street assimilate the successive forms of each lane, the whole form seeming then a unique plotting.
2. *Conformation (formal rapport):* one street form conforms itself to another one when the former takes some principles of the latter, as when a cycling lane is created and set in a functioning which is analogue to that of the reserved bus lane for example.
3. *Articulation (efficient rapport):* a street form is articulated to another when those ones maintain a distinct organisation while coming in contact together. For example, when the hall of a building looks out over the street throughout a special window while the street and the hall keep their identity.
4. *Deformation (material rapport):* A street form distorts another one when the former disturbs the latter, as when a building is bevelled to allow more space at a crossroads, or when a sidewalk is suddenly shrunk by a building that goes forward on the sidewalk.

Here are 4 modes of street forms integration, relations that could help to envision in a more subtle way the questions of mixing and separation of spaces. Some forms (ideas, scheme and organisational principles) are articulated with some other forms, distorted by some others, assimilated by some stronger forms, and maybe at the same time conforming themselves to some principles coming from the surroundings' forms...

Those relationships of "form to form" could even be envisioned as relations of "conception to conception" levels: between the level of plotting and the level of composition, between the level of composition and... The *plotting* level may comply, for instance, to the *distribution* level when the street pathway slightly diverts to avoid a particular monument, or inversely, when it diverts its way to bring its users in an important site.

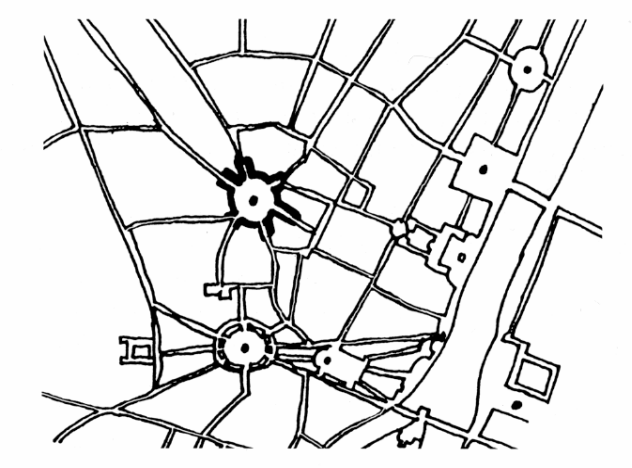
The *composition* can even *be assimilated* to the *plotting* level, when the urban fabric is a homogeneous grid that defines regular blocks, those blocks being only some spaces let free between the "meshes" of the street network. The *plotting* level can also be *articulated* to the *composition* level when the streets orientation changes in front of a place in order to arrive perpendicularly to that one. It may also be *deformed* by the *distribution* level when a regular grid plotting is modified by a hill or a particular urban centre.



These examples and some of theses notions are taken from Borie A., Micheloni P., Pinon P., *Forme et déformation des objets architecturaux et urbains*, éditions Parenthèses, Marseille, 2006.

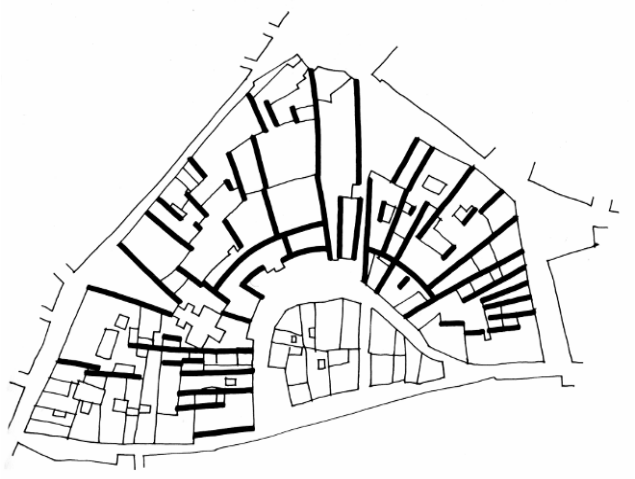
Deformation

The plotting of the central way is deformed by the composition of the piazza.



Articulation

The street plotting is articulated on the central points of city distribution, arriving perpendicularly on the piazzas.



Conformation and assimilation

The parcels composing the urban fabric are conformed to the radial street network itself assimilated, in its central parts, to the two central building blocks.

Principe 14: Four relations of *integration*: assimilation, conformation, articulation, deformation

***** *4 modes of integration can be distinguished: assimilation, conformation, articulation and deformation that describe the relationships between the various streets forms of organisation.*

** Those relations are applicable from a form to another form of the street, as when a street path is deformed by the form of a piazza.*

** Those relations are even applicable from one level of conception to another level, from the plotting one to the composition's one for instance, within a form or among several forms.*

Example 14: The sidewalk that overhangs at the pedestrian crossing and buses stops.

Pedestrians crossing and buses stops are singular points that are distributed along the street according to needs. When one decides to move forward the sidewalk so as to shorten the pedestrian crossing, to put it in front of a bus shelter and to free the sidewalk space, this is the composition level of spaces that is articulated to the level of distribution, the sidewalk getting additional extensions that serves as a junction space between itself and each of those particular distributed points.

4) Four relations of cooperation: pursuing, imitation, consolidation, recycling

We define 4 relations of cooperation that are 4 attitudes that one designer may adopt in consequences to the work done by previous designers or by those who work more or less on the projects, 4 ways to contribute to the progressive and continuous construction and modelling of streets.

1. *Pursuing (final relation)*: an urban design action can pursue the purposes of previous actions, as when one decides to totally take off car's traffic within an avenue while this has already begun that way by having previously dedicated half of the avenue space for buses.
2. *Imitation (formal relation):* a new arrangement can imitate or be inspired by a work previously realised, in taking from it some organisation principles *i.e.* some formal properties that will be reused as, for instance, hen a tree alignment follows the curve of the buildings that border the street rather to follows the sidewalk line, or when benches do the opposite in following the line of the sidewalks rather than the building facades...
3. *Consolidation (efficient relation):* a new arrangement can reinforce an existing arrangement, as when a trees alignment reinforces the separation between the sidewalks and the roadway already well-marked, or even when a group of public benches are in front of the facade and complete a certain treatment of the interface between the street and the buildings.
4. *Recycling (material relation):* a new arrangement can simply reuses the elements of a previous arrangement which have become useless, as when a car's way becomes a bus lane, or even when the butt of a tree freshly cut down is used as a seat for customers of a famous bakery.

The cooperation relationships which have been considered between successive design actions and there results (in building or in elaborating a project document) may also be considered between the 3 levels of realisation of street: between the level of the voids and the level of the fluids of a same action for example.

The *solid* level can thus *pursue* in some cases the work done at the *fluids* level: notably when one remakes a roadway structure on which it have been decided to only let buses circulate for example.

The *voids* level can also imitate the *fluids* level, as when one intervenes in the arrangement of the banks of a river in parallel to the river flow itself, or when one divides the parcels of land in the same and perpendicularly way to the main axis of circulation: this is still the *fluids* that determine in that case, the configurations of the voids. The level of *solids* can even *consolidate* the *fluids*, as when a monument is established along the existing pathways, in order to emphasize those trajectories or when one disposes a group of sidewalks big enough to avoid cars to go out of the road.

Each of those levels can gradually tend to serve or to command the two other ones, by pursuing, imitation, consolidation or even by recycling. These are suggestions for several different ways to think cooperation in the production of streets by the many actors of urbanism.

Principle 15: Four relations of cooperation: pursuing, imitation, consolidation, recycling

***** *4 cooperation relations can be distinguished between different design actions: pursuing, imitation, consolidation and recycling of one street arrangement by another one.*

** Those modes of cooperation are applicable from a design action to another, during the development of several successive phases of a project or in the accumulation of a small number of interdependent actions.*

** Those cooperation relations between professional disciplines are even applicable from a realisation level to another one: from the voids level to the solids level for example, allowing characterizing more accurately different ways of cooperating.*

Example 15: From the "street coming from the pathway" to the "street coming from the road"?

The history of the creation of a street is often explained as starting from an initial pathway, which has become wider afterwards and consolidated during the evolution process of its environment. The increasing flows, the dwelling becoming higher up to form a very dense U profile characteristic of urban strongly constituted districts.

Multiple situations occur in the modern urbanism in which the perspective is reversed: where some attempt to set right some problems in reducing speeds and flows of some main axis, which went into the city heart too curtly.

In those situations, it is more today to pass "from the road to the street", than to pass "from the pathway to the street" as in the past.

If this logic of progressive growth should lean essentially on the three first cooperation modes (pursuing, imitation, consolidation), it is relatively new that we may considers manners to reuse spaces that have been too largely dimensioned. Additionally to the large transportation infrastructures, plenty of residential ways, too large today regarding their few uses, would benefit to be recycled in the next following years...

5) Twelve constitutive relations

We distinguish 12 streets constitutive relation, which are even different *modes* to conceive them, to use them and to realise them.

The twelve constitutive relations of a street

* ***Utilisation:*** *4 modes of cohabitation between the various uses of street: subordination, obedience, support, conversion.*

* ***Conception****: 4 modes of integration between the various forms of a street: assimilation, conformation, articulation, deformation.*

* ***Realisation****: 4 modes of cooperation between the various arrangements and transformations of a street: pursuing, imitation, consolidation, recycling.*

Diagram 11: The 12 constitutive relations of a street

Utilisation	Conception	Realisation
Subordination	*Assimilation*	*Pursuing*
Obedience	*Conformation*	*Imitation*
Support	*Articulation*	*Consolidation*
Conversion	*Deformation*	*Recycling*

III. The constitutive elements of a street

1) Recursive acceptation of the notion of element

After to having envisioned different *levels* of streets constitution, and different modes of *relations* between those levels and their respective *units* (uses, forms, arrangements), we are now to dive into the question of their constitutive *elements.*

The notion of "element" is distinguished from the notion of "units" according to the points of view one takes in front of these urban "entities": the *elements* are firstly some *components* where the *units* are *composed*, the *elements* are defined in function of their capacity to contribute to some "wholes" when the *units* "are" such "wholes". In brief, the elements are some kinds of "ingredients" with various properties that will serve to create some good utilisations, conceptions and realisations of streets.

In order to pass from the notion of *element* to the notion of *recursive element*, it is needed to think that each element, if distinct from other elements by its properties, is in fact, also constituted of all these elements: that a certain "warm" is both constituted of "warm" and "cold" for instance, that a certain "red" is constituted of "red", "blue" and "yellow"...

2) Five elementary qualities: vitality, reliability, firmness, accessibility, sympathy

In the first part, we have emphasized the multiple viewpoints, intentions, functions, motivations and use of the street. We have even formulated the idea that streets design models should have as principle outcomes to try to articulate and integrate those multiple "dimensions" of the street, in such a way that one could put the fundamental issues: what is street that is a pleasant, convivial, vital and not noisy, calm and not deserted, hearty and not untidy…?

We are thus to elaborate a manner to describe and to think in a *systemic* way the qualities and the performances that we expect from the streets and their design.

We propose a model with five *aspects,* or five *elementary qualities*, following Kevin Lynch, notably[30], who has attempted some years ago to extract five "fundamental scales" to measure the quality or goodness of a city form.

The fundamental difference between our approach and Lynch's approach, that leads to some significant modifications of its system, comes from the fact that Lynch sought to formulate *independent scales* when, inversely, we attempt to tackle not only the more important dimensions of street's human experience, but even the relations that link intrinsically together those dimensions.

Contrary to those *analytic* approaches, we start from the assertion that all *qualities* that interest us are, in the city at least, contingent one another: we start from the principle that the

[30] Kevin Lynch, *Good City Form*, MIT Press, Cambridge, 1981. Our approach is then very different, as a contemporary example, of the *Haute Qualité Environnementale* approach, as it is nowadays practiced in the building industry.

safety and the reliability of a street are not independent of its vital and convivial character, that the adaptable and appropriable characters of the street are not independent of its practical and legible aspects.

Then, we assert that every expectable qualities of a street, that are even different modes of using a street, can be formulated in the 5 following *elementary qualities*: vitality, reliability, accessibility, firmness, sympathy.

Those 5 qualities are "transversal" to the three levels previously described. The cognitive, perceptive, and physical levels are consequently all relevant to describe each of those qualities. Those five fundamental qualities are, in addition, organised in such a way that two types of process may explain their mutual production:

- *A relation of generation (in circle and clockwise):* vitality generates reliability, which generates firmness, which generates accessibility, which generates sympathy, which generates vitality...
- *A relation of control (in star and clockwise):* vitality controls firmness, which controls sympathy, which controls reliability, which controls accessibility, which controls vitality...

Diagramme 12 : The 5 primary qualities of the utilisation of a street

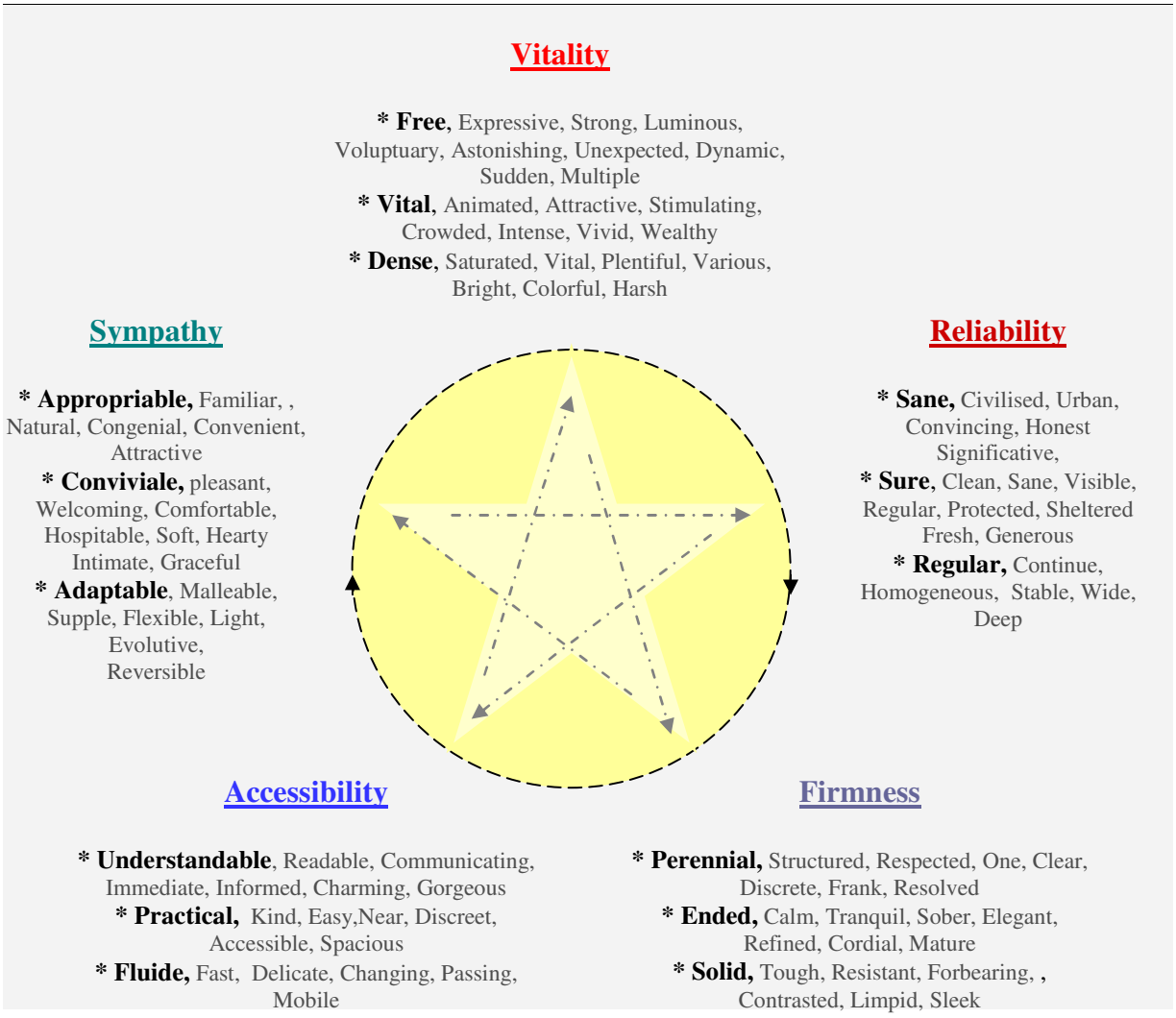


Table 4: The 5 elementary qualities derived at the physical, perceptive and cognitive levels

	VITALITY	RELIABILITY	FIRMNESS	ACCESSIBILITY	SYMPATHY
Cognitive	***Free,*** *Expressive, Strong Luminous Voluptuous Surprising Unexpected Dynamic Multiple, ...*	***Sane*** *Civilised, Urban, Convicting, Honest Significant, ...*	***Perennial*** *Structured Respected Serene Clear Distinct, Resolved ...*	***Understandable*** *Readable, Communicating Immediate, Informed Charming Gorgeous ...*	***Appropriable,*** *Familiar, Natural Convenient Engaging Hospitable ...*
Perceptive	***Vital,*** *Animated, Attractive, Stimulating Crowded Intense, ...*	***Sure,*** *Clean, Sane Visible, Protected Sheltered, Fresh, Generous ...*	***Ended,*** *Calm, Tranquil Sober, Elegant Refined Cordial, Mature, ...*	***Practical*** *, Likely Easy, Near Discrete, Accessible, Spacious ...*	***Convivial,*** *Pleasant Welcoming Comfortable, Soft, Hearty Intimate, Graceful, ...*
Physical	***Dense,*** *Saturated, Plentiful, Various, Colourful Harsh ...*	***Regular,*** *Continue, Homogeneous, Stable Wide Repetitive ...*	***Solid,*** *Tough Resistant, Durable, Contrasted Limpid, sleek, ...*	***Fluid,*** *Rapid, Changing Delicate, Changing , Mobile ...*	***Adaptable,*** *Malleable, Supple, Flexible, light, Evolutive, Reversible, ...*

We shall try to understand that according to such logic[31], designers and users and owners are not only, for each project or for each model, to choose between "reliability", "vitality", and "accessibility". They are to comprehend how if some "vitality" is wanted, consequently a minimum of "sympathy" is necessary, whilst it is needed to prevent an excess of "accessibility". Understanding that if a resident or a mayor may be interested in "accessibility", then a minimum of "firmness" is necessary, while is even needed to watch excess of "reliability", etc.

This system of thought of street quality is definitely to the opposite of the "multi-criterion" methods. It does not allow making choices, to arbitrate and to select for a quality rather than another, but allows, contrarily, enabling peoples to understand that all those qualities are necessary one another.

This operator allows to explain how the "safety" or the "security" for example, are not measurable phenomena in themselves, but rather properties of certain modes of organisation of street uses: the *vitality* of a "levelled street" (complexity, crowding) is not the *vitality* of a "multi-functional street" (rapidity, simplicity). An avenue's *reliability* is not boulevard's *reliability*, arcade's sympathy is not fountain's sympathy, and reserved bus lane's safety is not either the safety of a roadway available to everyone…

[31] This logic is inspired from some ancient "theories of elements" reused here, not for their special content, that obviously depends on place and time conditions, but rather for the organisational models of conceptual entities they propose, that are accurately elaborated and relatively relevant to describe the phenomenons that we want to get understandable with this design operator of the *5 elementary qualities.*

None street model is more reliable or more sympathetic than any another. It is rather needed to understand the many different and specific ways by which each of those models may carry out sympathy, reliability, accessibility, etc.

We thus find, throughout this operator of those five *qualities*, a non trivial way to constitute *intentions categories*: every intention can in fact, attach itself to one or several of those five qualities. Those ones constitute *recursive* categories of those intentions, having already in their definition, some hypothesis related to the way in which the different intentions of a same model or of different project can be in mutual dependence. This role of *category* is in a way, the opposite of the *ingredient* role that these five primary qualities can hold by the way.

Principle 16: Five elementary qualities: vitality, reliability, firmness, accessibility, sympathy

** We identify 5 elementary qualities that may help to describe what streets are expected to achieve: vitality, reliability, firmness, accessibility and sympathy. These qualities are transversal to the physical, perceptive and cognitive levels that we have previously identified: each of these5 qualities is present on each of these 3 levels.*

** These 5 qualities are essentially dependant one upon the others. They have two kinds of mutual relations:*

- *Relations of generation: vitality generates reliability which generates firmness which generates accessibility which generates sympathy which generates vitality...*
- *Relations of control: vitality controls firmness which controls sympathy which controls reliability which controls accessibility which controls vitality...*

** These 5 qualities both play a role of "ingredients" to create intentions and of "categories" to classify and organize those intentions..*

Example 16: The problematic or urban safety and security

We find, according to the 5 elementary qualities diagram, some hypothesis telling that security and safety are elements of "reliability"… things that everybody already knew. So what's new? This diagram proposes indeed 4 more hypothesis on safety and security interpreted as kids of a "reliability".

1. That safety and security are produced by "vitality": Urban designers know, for example, that pedestrian streets are perceived unsafe at night, in comparison to streets with more traffic: a minimum of animation and people (vitality) seems necessary to produce a feeling of safety.

2. That safety and security produce "firmness": there would be not "firmness" (and the qualities derived from this one: respect, calm, serenity…) without safety and security.

3. That "sympathy" controls safety and security: too much "sympathy" (familiarity, comfort, softness, flexibility) is not good for safety and security. Most of road accidents, for instance, take place in the daily trips which are the most familiar ones and in which attention is low down…

4. That security and safety controls accessibility: too much safety and security kills all possibilities of access (speed, fluidity, facility, discretion, etc.): the most secure places are those which are literally inaccessible.

What is important to mind in these various hypothesis is not these ones in themselves, for they are relatively obvious when one takes the time to think about them, but more their mutual articulations, the way in which different problems are linked together as factors or products of other problems and qualities that seem at first sight very distant from each other.

3) Five elementary actions: founding, orienting, defining, opening, partitioning

As we have drawn 5 *elementary qualities* describing the content of the *utilization* phase, we shall now formulate a set of *elementary actions* that will allow us to explore the content of the *conception* phase: that which consists in imagining a form of spatial organization that may reach the desired intentions and qualities. This new *operator* is, in brief, about useful *elements of conception*.

We'll take again 5 terms designing *elementary actions* by which designers give form to their ideas of street organization: actions by which they progressively constitute the future content of the street arrangements, actions that corresponds, to a certain extent, to the *5 elementary qualities* that we've just described.

These actions are the following ones: founding, orienting, defining, opening and partitioning. They are transversal to the *3 levels of conception* (plotting, composition, distribution) yet identified. They are also *recursive*: one may apply them at all scales from the front door and the public bench to the city design. These actions evolve in the following sequence:

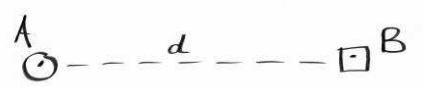
1. *Founding*: determining the site and the reason of an arrangement, placing the crux of the design, the *primary field*.
2. *Orienting*: determining the main directions of the place, the "front" and the "back", "left" and "right" sides, "up" and "down".
3. *Defining*: giving spatial and physical limits to the place, drawing its contour, creating its "inside" and "outside".
4. *Opening*: determining the number, position and size of the place's centers and openings, the nature of the connections between the "inside field" and the "outside field".
5. *Partitioning*: dividing and balancing the inside *field* into many *fields* on which the same sequence of actions may be applied: *founding*, *orienting*, *defining*, *opening* and *partitioning*.

Table 5: The *5 elementary actions* of conception of a street

	FOUNDING	ORIENTING	DEFINING	OPENING	PARTITIONING
Plotting	***Beginning***, *Coming, Advancing, Crossing, ...*	***Prolonging,*** *Continuing, Following, Aiming, Steering, Rising, Falling, Turning, ...*	***Finishing***, *Ending, Separating, Spreading, Closing, ...*	***Connecting,*** *Joining, Grouping, Articulating, Attaching, Uniting, Binding, ...*	***Cutting,*** *Dividing, Slicing, Spitting, Parceling, ...*
Composition	***Situating***, *Placing, Putting on, Positioning, Meeting, Mobilizing, Concentrating, ...*	***Establishing***, *Structuring, Guiding, Slipping, Locating, Inclining, Polarizing, ...*	***Containing***, *Enclosing, Delineating, Leveling, Holding, Equalizing, Flattening, ...*	***Enlarging,*** *Overlapping, Digging, Widening, Extending, Spreading, Dissipating, ...*	***Modulating,*** *Sharing, Dispensing, Staging, Branching, Juxtaposing, Undulating, Superposing, ...*
Distribution	***Raising***, *Erecting, Planting, Lifting, Spurting, Emerging, Growing, Glowing, ...*	***Supporting,*** *Sitting, Basing, Leaning, Pressing, Wedging, Blocking, Skinning, Pushing, ...*	***Covering***, *Sheltering, Coating, Enveloping, Circling, Casing, ...*	***Entering,*** *Passing, Breaking, Penetrating, Introducing, Circulating, Diffusing, ...*	***Proportioning,*** *Adjusting, According, Equilibrating, Adopting, Grading, ...*

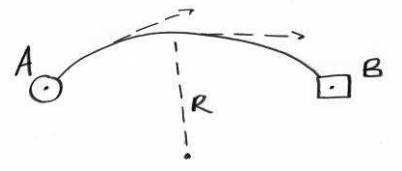
In order to show all the extension of this operator we are now going to apply it a first time on the « general street » *form.* This form will be taken successively at the plotting level, the composition level and the distribution level. For each *action of conception* we will consider its formal consequences from the *uses* point of view (*form / intentions = relevance*) and from the *arrangements* point of view (*form / configurations = quality*).

At the plotting level



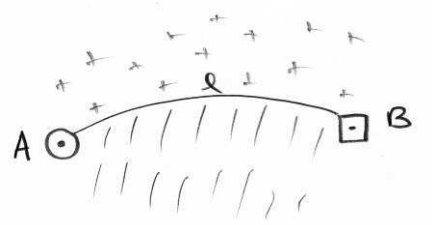
Founding: going from one point to another

* *Form / Intentions:* A street is founded by the choice of two geographical places, A and B, the places that forms its extremities. As an idea, a street is first of all two points, two poles that manifest some influence on their spatial environment. From this point of view, the first function of a street is to connect A to B, to conduct people from one place to another. The street is the physical support of human exchanges and at the same time, their symbol.
* *Form / Configurations:* These exchanges are moved by the difference in nature between these two places, the ratio "A/B" modulated by the distance separating A from B. This distance will be more or less extended according to the configuration of the plotting.



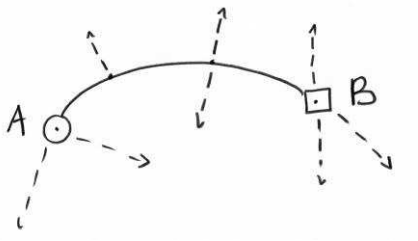
Orienting: constituting the city directions

* *Form / Intentions:* A street is a path, an arc or a line AB the curvature of which is determined by the line's changes in direction. The general direction of a street allow its users to locate themselves by pointing to the North, to the nearer urban pole or to any other significant point.
* *Form / Configurations:* There are many ways for a street to provide city orientation to its users: by pointing towards a centre, by turning around it, being parallel to the North axis, etc. It follows that the path is straight, turning, undulating, raising, coming down… At each moment, the change in direction is characterized by the radius of curvature of the trajectory.



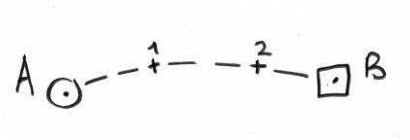
Defining: separating two regions

* *Form / Intentions:* A street is a line that delineates beside itself two regions of space that can be two districts, two neighborhoods, two building blocks, etc. The street serves as a frontier between two living spaces that need to be separated. It defines the inside from the outside and gives a limit to their spatial extension.
* *Form / Configurations:* This limit can be straight, curve, in one direction or in the other. It conditions the kind of relations those separated spaces will maintain: one can be outside of the other, nearer to the centre; they can have also equal and symmetrical relations... These relations may be minimal or in the contrary very important. According to the length and to the shape of this common frontier, contact will be more or less extensive and imbricate.



Opening: completing the street network

* *Form / Intentions:* A street may crosses other streets and the intersections places may become special points of the line AB. The creation of a street is thus both a completion and a modification of the way the local environment is functioning. The organization of the network is widened, set more complex and able to answer to new tendencies and problems. The new street participates in a new street hierarchy.
* *Form / Configurations:* There are several types of intersections that are as much modes of relating one street to another: "T junctions", "crossroads", "rotaries", etc. These openings may be located in special places and have special characteristics. The number of streets to which a street AB can lead is one of its most important features: its "connectivity".



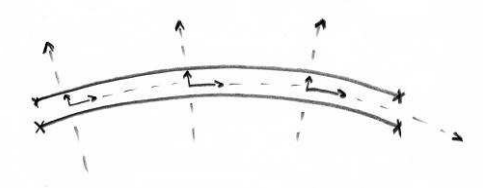
Partitioning: punctuating the course

* *Form / Intentions:* Going from one extremity to the other takes a special speed and rhythm. The street offers different steps and stopovers, regularly or irregularly dispersed. It organizes the temporal pattern of transport.
* *Form / Configurations:* The journey may be achieved in one time, two times, three or even four times, according to the number of punctuations. It can also be achieved by several modes of transport that may be convenient to users. The journey can be based on a kind of module or pattern that may calibrate the measures.

At the composition level

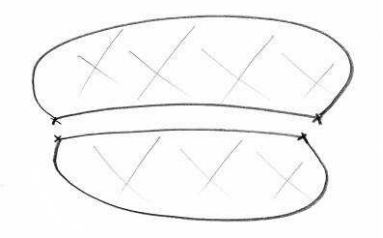
Founding: passing over

* *Form / Intentions:* The surface of a street is founded by the existence of two distinct lines both linking the same places A and B but through different ways. The street as a surface brings the possibility of a transversal movement, of crossing the street and of access to the side-parts of it.
* *Form / Configurations:* The quality defined by these two lines lies in the ratio of their directions: these lines can be parallel or not. They can move aside from each other or join each other. Crossings may be more or less easy along the way, possible everywhere or, in the contrary, concentrated on special door points that may acquire a special status. The street is defined by its width that indirectly characterizes the difficulty one may face while trying to cross it.



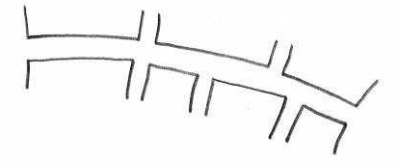
Orienting: constituting the local directions

* *Form / Intentions:* The surface of a street can be assimilated to a rectangle, even distorted. In all cases, this form presents two primary directions: the longitudinal axis and the perpendicular transversal axis. The street is thus constituted of a local landmark serving immediate and proximity orientation: its points at first towards the two extremities of the street which are among the potential goals of bystanders; its points secondly towards the two regions of space that are located on both sides of the street and which may be two building blocks, two districts, two cities…
* *Form / Configurations:* The proportion of the rectangle denotes the relative balance between these two directions. We may find well balances landmarks and others completely dominated by the longitudinal axis (origin / goal, transit, flows) or by the transversal axis (public space / private space, "stay uses", access).



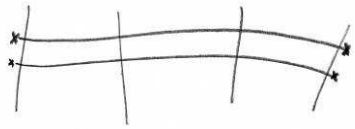
Defining: delineating public spaces and private domains

* *Form / Intentions:* Without being relatively enclosed, outlined and bearing a form (at least for the mind), the public space of a street would not be able to vehicle certain rules of acceptable public behavior and would neither be able to expect certain precise movements, speed, rhythms, attitudes, and conducts of its own users; these behaviors are in fact very distinct from those one can find inside the private realms.
* *Form / Configurations:* There are different manners of delineating a certain space, which correspond to many qualities that users and urban designers may convey to a street. Physical limits are mostly "reminders" or "signs" of the limits of use: they support the perceptive and cognitive limits that guide users' behaviors.



Opening: continuing the public space

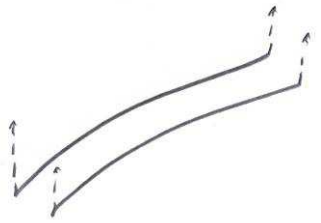
* *Form / Intentions:* The surface of a street is ongoing the surfaces of adjacent parts of the network. To join one place from another it is always possible, in a city, to follow a continuous path going from one point to the other through the public space.
* *Form / Configurations:* The configuration and the location of openings define different manners of continuing the public space of a city. These are especially strategic points for shops, visibility, orientation and definition of identifiable street sections.



Partitioning: giving rhythm to the journey

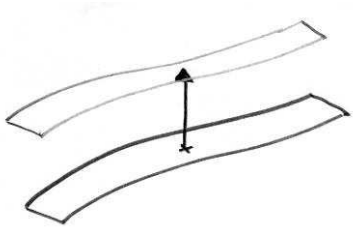
* *Form / Intentions:* The rangy surface of a street is divided in a set of successive sections. Journeys are organized into several steps each possessing special and proper characteristics.
* *Form / Configurations:* The succession of sections may proceed by an alternation of disparate elements; or in the contrary by a continuous progression, for example from outside of the city to the city core. The pattern of the street section may maintain regular dimensions or change abruptly when passing over very particular places, etc.

At the distribution level



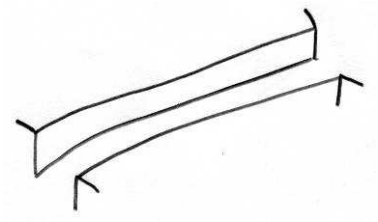
Founding: settling, staying, dwelling

* *Form / Intentions:* The volume of a street is above all defined by two surfaces: that of the ground on which the street is taking place, and that of the sky where will appear its zenith. These two surfaces are separated and kept distant by the vertical of the place. The street is a dwelled place where people live, where they can establish, stay, trade or practice any other kind of professional activity.
* *Form / Configurations:* The height of the street, reported to its width, will contribute to define the atmosphere of that place, the degree of sunshine it can receive, the feeling of elevation it may procure, but also the degree to which that space is protected and the density of people living here, accessing their home and buildings.



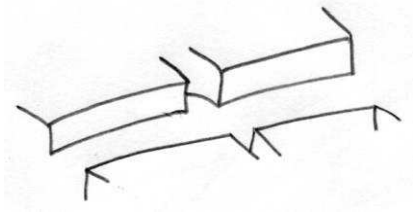
Orienting: giving directions to proper spaces

* *Form / Intentions:* A street is like a parallelepiped contained between earth and sky. The vertical of buildings, trees, furniture and people occupying the street space gives the necessary direction to the bodies' spatial equilibrium. The elevation of the street, which is directly reported to its width, reinforces indirectly its longitudinal character.
* *Form / Configurations:* The height reported to the width marks the verticality or on the contrary the horizontality of the profile and the perceived building density may depend very quite simply on this proportion. From another point of view, the height of a street may also function like a kind of parcel depth: the higher parts of the street volume and buildings are at the same time those that are the most distant from direct access on street public space. They maintain quite perceptible but hardly attainable.



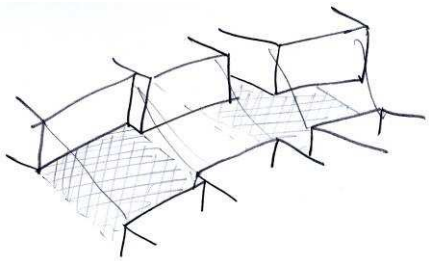
Defining: sheltering and protecting

* *Form / Intentions:* The empty parallelepipeds of a street are themselves delimited by the solid parallelepipeds of buildings. These volumes thus define the inside and the outside of buildings and conversely, the inside and outside of the street. A street contains its uses and protects its users from rain, sunshine and winds.
* *Form / Configurations:* The degree of enclosure of the street space lies essentially on the position of buildings and on the architecture of their façades. This degree will support the degree to which public space may be appropriable: the more space is enclosed (first in the mind of its users), the more this one may be appropriable and foreign of the public space.



Opening: accessing

* *Form / Intentions:* If the street volume is defined and delimited, it may naturally present openings and access points that will constitute among the strategic places. These connections are the complementary aspect of street space enclosure. In the public space, all space is in fact open: everybody can enter it and go out of it as he whishes.
* *Form / Configurations:* These openings and connections may be focused on or, in the contrary, quite hidden according to users' and inhabitants' desire to reinforce or to attenuate the street space delineations.



Partitioning: continuing and completing private spaces

* *Form / Intentions:* When the longitudinal volume of a street is subdivided into several smaller volumes we may obtain kinds of "public rooms" that form some sort of forecourts, anterooms, waiting rooms or even back rooms of the building private realms: the continuing of people homes.
* *Form / Configuration:* These extensions of private realm on the public space convey the special qualities of those buildings, of their inhabitants and activities that progressively build the local living character of a street.

The *models of conception and deliberation,* the principle of which have been set in the previous part of this study, are in fact special combinations of some of those actions that are modeled and coordinated in some particular sequences forming the *parti* of each model.

Possessing the art of *conception* is precisely to know how to draw these actions, to know which goals they should point toward and the special ordering sequence in which they should be employed. It is to know how to pass from one action to the other, from one model to another without loosing the continuous formal flow that design activity is combining and transforming in the process of elaborating the *parti*.

This operator is thus a very useful tool to describe the *actions of transformation* leading the designer from a *generic parti* to a *specific parti* as we have described this task and process in the modeling of the *parti*.

Principe 17: Five *elementary actions*: founding, orienting, defining, opening, partitioning

** We identify 5 elementary actions that describe the processes of formal differentiations of a street: founding, orienting, defining, opening and partitioning.*

** Those 5 operations apply to all urban fields taken together or individually, so much at the plotting level as at the composition level or as at the distribution level. These actions form a continuous sequence of successive operations that can be repeated and repeated, from scales to scales, from the public bench to the drawing of a city.*

** These 5 actions are also the archetypes or the categories of transformations that allow describing, within the formalization of a design model, the various steps of formation of its* parti.

Example 17: A set of 15 actions to conceive a street

We have been able to list, while applying these 5 elementary actions at the plotting level, the composition level and the distribution level of the general form of a street, a set of 15 special actions that a designer may draw in order to evolve a street project.

1. Plotting:

** Founding: going from one point to another*
** Orienting: constituting the city directions*
** Defining: separating two regions*
** Opening: completing the street network*
** Partitioning: punctuating the course*

2. Composition:

** Founding: passing over*
** Orienting: constituting the local directions*
** Defining: delineating public spaces and private domains*
** Opening: continuing the public space*
** Partitioning: giving rhythm to the journey*

3. Distribution:

** Founding: settling, staying, dwelling*
** Orienting: giving directions to proper spaces*
** Defining: sheltering and protecting*
** Opening: accessing*
** Partitioning: continuing and completing private spaces*

Consider now that if we have drawn 15 actions of conception that are relative to the general form of a street, we could easily do the same for a roadway, a sidewalk, a tree alignment or a cyclist lane taken individually, or even a pattern of street, a grid or a full network for itself.

4) Five elementary scales: macroscopic, ordering, mesoscopic, disposition, microscopic

If the *five qualities* and *five actions* are the elements of streets *utilization* and *conception*, we are now to consider the case of the e*lements of realization*.

"Space" and "matter", that we have yet set as being the two *dimensions of realization*, have both as primary property the fact of being *indefinitely divisible* in parts : its is thus the concept of *scale* that comes to discussion. The notion of *scale* is essentially quantitative: it depends on the size of what is considered, quantities of *voids*, *fluids* and *solids* that are engaged in the *realization* of one project.

We distinguish first the *macroscopic* and *microscopic scales*, secondly the *mesoscopic scale* which is intermediate between these two, and then the scales of *disposition* and *ordering* that link, respectively, the microscopic and mesoscopic scales on one side and the macroscopic and mesoscopic scales on the other side.

1. *The microscopic scale* covers all *configurations* or aspects of each *urban field* that are too small for being taken for themselves. All these constitute, rather, the elementary modules on the basis of which the work will be done, modules that may be assembled and laid out together during the realization.
2. *The macroscopic scale* covers all *configurations* or aspects of each *urban field* that are, conversely, too big for being taken in themselves. These constitute, rather, the general context inside which work will be ordered and realized, the many "wholes" to which each considered spatial arrangement will be integrated.
3. *The mesoscopic scale covers* all *configurations* or aspects of each *urban field* that are, precisely, the object of work and production: it is on this one scale that the attention and care of designers and owners may concentrate.
4. *The disposition scale* is that one which links the mesoscopic scale to the microscopic scale, that one in which various *patterns* are formed to articulate and combine many of the microscopic configurations and to set them as full parts of the mesoscopic scale.
5. *The ordering scale* is that one which links the mesoscopic scale to the macroscopic scale, in which are formed various kinds of mesoscopic fields organization so as to sustain and form the macroscopic fields.

The *mesoscopic scale* is the easiest to apprehend for it is the one which contains the objects that are directly treated, designed and realized. Hence the mesoscopic scale of a street section project is the « section » in itself (treated at a scale of *1/500^{e}* for example). Its *microscopic scale* is also quite easy to identify: it contains those basic modules that are available to build the street section: tree alignments, bus lanes, sidewalks… (*1/100^{e}*).

The *disposition scale* may be more subtle to comprehend: it contains the various *fields of microscopic fields* that form the relatively autonomous parts of the street section. The field formed by the church square, the bus stop and some café terraces for example, or that field which relates and holds together the roadway, the tree alignment and the bus lane that runs along the sidewalk…*(1/200^{e}).*

As for the microscopic scale, the *macroscopic scale* is easy to define: in the case of our street section, the district and the whole street to which the section is integrated may well fit to this role *(1/5000^{e}).* The *ordering scale* is more delicate to formulate: its refers to all the set of

connections that link this sections to other street sections, all the patterns that articulate this street section to the building blocks which make its boarders…*(1/2000^{e})*.

This notion of scale being *recursive*, we can apply it again to study, for example, one of the microscopic part of the street section we've just considered: the *mesoscopic scale* of the sidewalk is the sidewalk itself (1/200^{e} for example) ; its *microscopic scale* covers its boarders, coating, furniture… (1/20^{e}) and its *disposition scale* the various combinations that one can organize from these microscopic fields (1/100^{e}). Its *macroscopic scale* is the street section inside which it takes place (1/500^{e}) and its *ordering scale* defines its exact location in the profile and its relations to the other parts of the section (1/200^{e}).

If the macroscopic, mesoscopic and microscopic scales refer mostly to "things" (*the whole, the parts, the modules*), the disposition and ordering scales are rather concerned by set of relations between those things (*patterns, proportions*): they are also the most "technical" and subtle scales, those that describe the links between the whole and its parts, those that may demand the hardest work.

Whatever the size of the *urban field* one considers to transform, this one may always be taken as a "departure" *mesoscopic scale* which reflects, in a second time, to *microscopic* and *macroscopic scales* and, in a third time, to the scales of *disposition* and *ordering*. All these scales may be taken as distinct domains in which the urban forms and organizations may be *realized* (programmed, drawn, built, maintained, used…) in a certain number of *configurations*.

Three remarks can now be formulated:

- The first one says that this progressive generation of scales, if it depends on that field which is considered as the object of work, is relatively independent of the *levels of realization* that were previously distinguished: *voids*, *fluids* and *solids* are dispatched among these five elementary scales.
- The second remark says that the notion of scale concerns *realization*, that is to say that scale are primary relative to the concrete configurations of the design and secondary to *utilization*, for "time", which we have set as one of the dimensions of utilization, may be decomposed in various scales (second, minute, hour… year) in analogy with "space's properties. Scales are thus "spatial" first, then "spatiotemporal" but remain, in all cases, *independent of the notion of form* taken as *a principle of organization*: form passes over all scales.
- The third remark follows the second one: it says that the notion of *quality* (adequacy of configurations to the parti), that we have associated to the point of view of *realization*, may find specific declinations among each of these scales.

In order to explore this question of *quality* and its declinations among the five elementary scales of realization, we shall start by reconsidering the definition we have given in the preceding part: the quality of a design is measured as the adequacy of the *configurations* (differences of *arrangements*) to the *parti* (differences of *forms*). What moves from scale to scale are, as we've just put it, the street concrete configurations and not its *forms*. That "adequacy" will thus be different when these configurations may appear at one or another of these 5 elementary scales. Those positions may imply different kinds of relation between the configurations and the *parti* (which do not change from scale to scale).

At the *microscopic* and *macroscopic scales*, this *adequacy* will thus be a relation of *convenience*: as the design does not modify neither the big scale (into which the design is integrated) nor the small scale (the modules of which may only be combined), the adequacy between the formal *parti* and the concrete *configurations* of these two scales cannot be very precise or exact: we do not build tailored benches for each street according to the width of its profile but one can find various types of large or narrow benches that may be more *convenient* than others. The width of the bench (microscopic configuration) is not linked in a direct manner to the street organization, whereas the width of its profile may be linked to the street organization (mesoscopic configuration).

But if we change the point of view, the one who designs street furniture is allowed to determine the exact dimensions of one special type of bench (dimensions that are, from his point of view, mesoscopic configurations) but not necessarily the exact width of the places in which these benches may be installed (macroscopic configurations : streets section width) nor the precise drawing of the bench ornaments that he may choose in a pattern catalogue or ask another designer to draw (microscopic configurations). The ornaments and the place of installation of the bench are configurations that may, at best, be *convenient* to the form the designer has conceived. The *quality* of small and big scales is in all cases a relation of *convenience*.

The *mesoscopic* scale is, indeed, that one in which the work is "tailored": the realization may finely adapt the mesoscopic configurations of the design to the mental forms of its conception. The adequacy between the *parti* and the *configurations* is, in this case, a relation of *conformity*: one will be able to read, through the concrete configurations of the design, the *form* of its parti, to understand its principles of organization.

As regards the ordering and disposition scales, the notion of *quality* that may correspond to these kinds of configurations is more difficult to figure out. We have already explained, indeed, that these two scales mostly cover the *relations*, *proportions* and *ratios* between the various fields or configurations of a design. The quality that we may consider at those scales is thus a measure of a kind of adequacy between relations and proportions: adequacy between the proportions of the parti and the proportions of the configurations or, again, adequacy between the formal relations of the parti and the spatial and concrete relations of the configurations… We are thus measuring ratios of ratios, proportions of proportions… that is to say "second order" relations[32].

Several names have been given to this subtle form of adequacy that is proper to the scales of disposition and ordering: *harmony*, *symmetry* (microscopic), *eurhythmy* (macroscopic) are different versions[33] of this same special concept of *quality* that deals with the relations of proportion between {the relations of "wholes" and "parts" in the concrete configurations of a design} and {the relations of "wholes" and "parts" in the mental forms of the design}.

---

[32] One may pay attention to the discussion of the notion of "pattern" and "meta-pattern" by Bateson G., *Mind and Nature, a Necessary Unity*, Bantam, 1977 and by Hanson N. R., *Patterns of Discovery, an inquiry into the concptual foundations of science*, Cambridge University Press, 1958.

[33] These two notions of *symetry* (in the sens of commensurability) and *eurhythmy* more or less clearly formulated by Vitruvius. These notions and that of *harmony* have known various modifications during past centuries according to the discourse on *beauty* prevailing at that moment. Let's say that the primary mistake is to take all these notions as simple relations between concrete configurations. For these relations of *configurations* are meaningfull to the extent that they are compared to relations of *forms* or ideas.

Let's give a last illustration of the possible application of this operator. The 5 *elementary scales* can be applied to the "general form" of streets and street networks in order to put some light on the questions of *hierarchy* and *streets classification* (these questions have been introduced in the part A-II of this study).

We'll simply say, for the moment (this topic will be treated in part -D-), that we can formulate 5 general *urban scales* corresponding to the *global urban field* that covers streets, street networks and their relations to cities. These urban scales may help designers to seek among the various street forms and street patterns that they may whish to realize:

1. The *urban macroscopic scale* is that of the city or "cities" which are irrigated by streets and street patterns.
2. The *urban microscopic scale* is, conversely, that of the "urban modules": street furniture, building elements, minimum dimensions and all the elementary bricks that may be employed to build a street.
3. The *urban mesoscopic scale* is that of the "urban body": streets but also piazzas, intersections, crossroads, avenues, alleys, buildings, squares, parks, etc.
4. The *urban disposition scale* is that of the "habitable space": sidewalks, roadways, various alignments, terraces… that are special combinations and dispositions of what we find at the microscopic scale.
5. The *urban ordering scale* is that of the "urban environment": patterns of transport, pieces and systems of organization that may participate to the global development of the city networks.

Principe 18: Five elementary scales of realization: macroscopic, ordering, mesoscopic, disposition, microscopic

** We identify 5 elementary scales that allow designers to differentiate 5 orders of concrete configurations that may participate to the realization of a same parti, of a same set of mental forms:*

- The macroscopic *and* microscopic *scales first, which are the stable and reference scales that are taken into account without being concretely transformed.*

- The mesoscopic *scale which is central for the considered design and which may be precisely "tailored" according to the principles of organization that have been conceived for that street.*

- The ordering *and* disposition scales which *mostly* cover *the proportions and relations between "wholes" and "parts" and make the link between the macroscopic and the mesoscopic scales on one side and between the mesoscopic and the microscopic scales on the other side.*

** These 5 elementary scales are recursive operators that may be applied to each special field one considers in the design process, from the public bench to the configurations of the whole city: it is always possible to draw 5 scales adapted to the thing which is to be made.*

** These 5 scales of realization are transversal to the 3 levels of realization (voids, fluids and solids). They imply however distinct notions of quality (adequacy between the configurations and the parti of a design) according to the scale of the considered configurations: "convenience" for macroscopic and microscopic configurations, "conformity" for mesoscopic configurations and "harmony", "symmetry", "eurhythmy", "consonance", etc. for the configurations expressed at the disposition and ordering scales.*

Example 18: Five urban scales to consider the question of street hierarchy

We have been able to set a list of 5 urban scales that may be useful to classify and to build a hierarchy of the various elements urban designers are to conceive and realize:

1. *Macroscopic urban scale: cities (street networks, districts, high places…)*
2. *Ordering urban scale: the urban environment (urban structures, urban fabrics, built environment…)*
3. *Mesoscopic urban scale: the urban body (streets, piazzas, intersections…)*
4. *Disposition urban scale: the habitable space (roadways, sidewalks, emplacements…)*
5. *Microscopic urban scale: the urban modules (furniture, minimum dimensions…)*

5) Fifteen constitutive elements

We distinguish 15 constitutive elements of a street; these are also different *ingredients* for the *conception*, the *realization* and the *utilization* of a street.

The 15 constitutive *elements* of a street

* ***Utilization****: 5 elementary qualities: vitality, reliability, firmness, accessibility and sympathy.*
* ***Conception****: 5 elementary actions: founding, orienting, defining, opening and partitioning.*
* ***Realization****: 5 elementary scales: macroscopic, ordering, mesoscopic, disposition and microscopic.*

Diagram 12: The 15 constitutive elements of a street: qualities, actions and scales.

Utilization	Conception	Realization
Vitality	*Founding*	*Macroscopic*
Reliability	*Orienting*	*Ordering*
Firmness	*Defining*	*Mesoscopic*
Accessibility	*Opening*	*Disposition*
Sympathy	*Partitioning*	*Microscopic*

Strategic positions, multimodal ways and multipolar hierarchies

In conclusion of the presentation of these *design operators*, we shall end up by exposing a last and "hexavalent" operator.

If we have formulated, for each series of operators (univalent, bivalent, trivalent, tetravalent and pentavalent), specific declinations according to the 3 points of view of *utilization*, *conception* and *realization*, we will only formulate this time, for this new operator, one general principle that will work for these 3 "poles" as they are reunited in the concept of *urban field* taken as a congruent set of:

{forms, arrangements, uses}

We thus define *6 strategic positions* that one *field* can occupy *among the other fields*. These positions correspond to different *roles* that the *urban fields* may play inside the global organization of a street, a street part or a street network:

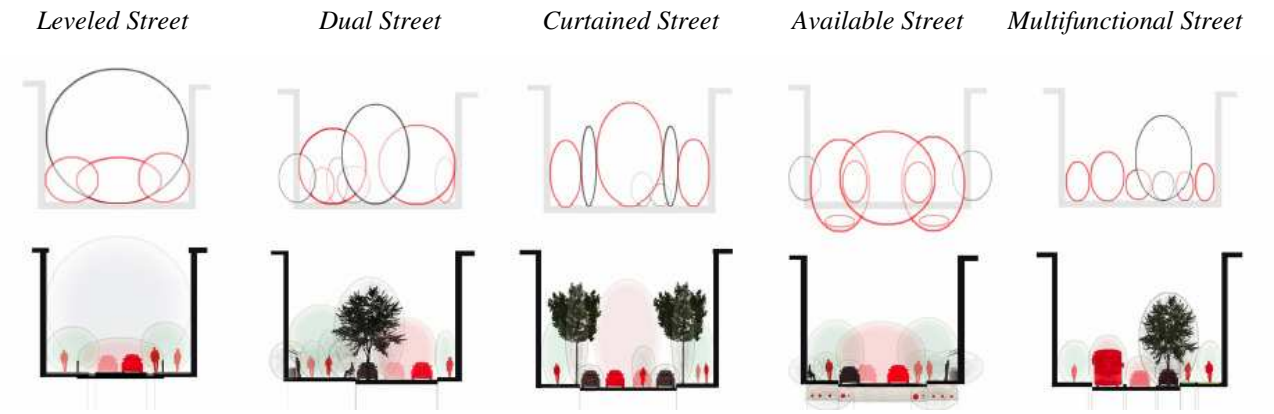
1. *Center (CE)*: the *fields* that take this kind of position play a central and prominent role over the other *fields;* they are the focus of attention, they propagate their form of order over the *fields* around: a route arrival, the fountain of a piazza, the monument of some place…
2. *Primary field (CP)*: the *fields* that take this kind of position are the most important part of the design, either because they occupy the more space, or because they gather and coordinate most of the uses: the roadway of an avenue, the central space of a piazza, a crossroads between two important streets…
3. *Secondary field (CS)*: the *fields* that take this kind of position are less important parts of the design even if they can still be considered as remarkable entities in themselves or in reference to the primary fields: the sidewalks of an ordinary street, the bus lane of a roadway, an ordinary street in the whole street network…
4. *Inter-field (IC)*: the *fields* that take this kind of position play a role of intermediaries, of interfaces or transitions between several *fields* of a same place: a tree alignment on the boarder of the sidewalk, a row of parking places, a bus lane between sidewalk and roadway…
5. *Counter-field (CC)*: the *fields* that take this kind of position occupy the frontier or the limit of the considered design: a series of arcades, the terraces of a café, a river bank, the fortification of a city, a cul-de-sac in the street network…
6. *Openings (OU)*: the *fields* that take this kind of position are located at the doors of the considered place, at the place where one passes from the inside to the outside: a bus stop, a building hall, a city gate…

These 6 *strategic positions* are independent of all scales: you may find many *centers* at the sidewalk scale (terraces, bus stop…) but also at the city scale (monuments, central piazzas…); you may also find many *primary fields* at the district scale (avenues, boulevards…) and at the scale of a series of arcades for example (central alley, main shopping front…).

According to the *recursive* acceptation of this concept of *strategic position*, one same *field* can play several different roles according to the specific *fields* with which it is considered to have relations: a bus stop is, with all the uses it gathers, a kind of *center* for the sidewalk

where it takes place; but it may also serves, in relation to the public transportation network, as a kind of *opening* of the public space towards the private space of the transportation company. In the same way, a bus lane in a lateral position may serve as a *secondary field* of the roadway while being considered, in the mean time, as a kind of *inter-field* holding a certain separation between car traffic and pedestrians' realm.

Here are, for example, various models of "main streets" (cf. the appendix section this report for a detailed version of these models) each realizing certain special combinations of several *fields* that take particular positions into the street profile:



Each model of street can be described by a diagram showing the number and types of fields (each circle represents a field) that are combined and their mutual relations. All of these models of street do not necessarily articulate every kind of strategic positions….

Each mode of transport finds a place in one *field* of the street profile. The strategic position of that field defines in return the kind of relations this mode will have with the other modes, with the other *urban fields* composing the street profile. According to each model of street, the roadway may "be" a *primary field* (curtained street, leveled street, available street), a *secondary field* (dual street, multifunctional street) or even an *inter-field* (leveled street, available street); according to each model one more time, the sidewalks may "do" the *counter-fields* (available street), the *secondary fields* (curtained street, multifunctional street), the *primary fields* (dual street) or even again the *inter-fields* (leveled street, dual street), etc.

Each *field* so defined and strategically located is then accessible to various modes of transport: a sidewalk "in" a *primary field* (dual street) or "in" an *inter-field* (leveled street, available street) may easily welcome both pedestrians and cyclists on a same space whereas this would be more difficult a task to realize in a *counter-field* sidewalk (curtained street) or in a *secondary field* sidewalk for example (multifunctional street, curtained street). But a *secondary field* roadway may find difficulties in trying to gather cyclists with public transport vehicles that shall make use, in that case, of reserved tracks (multifunctional street).

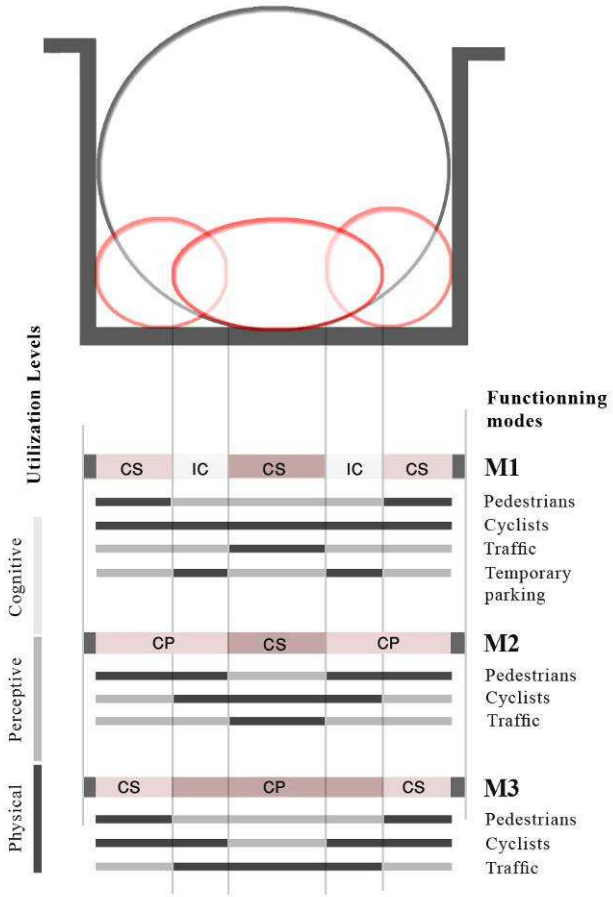
The *fields* of a street are thus a kind of intelligent composition of its space. Each of them groups certain users and separates them from the other users: the fields allow the designers to consider different *manners* of grouping and separating the various uses inside a same street: they invite to think about various *modes of multimodality*.

The separate definition of the *urban fields* on one side and of their *strategic positions* on the other side permit to define a third concept: that of the various, successive and alternating *operating modes* of a multimodal street. We shall take the example of the "leveled street" to explain this idea.

This model is based on the principle of an "overlap" between the lateral spaces dedicated to pedestrians and a central space dedicated to vehicles. The *parti* of this model consist in putting every part of the street at the same level. Two distinct limits are then set up between the lateral spaces and the central lane, sufficiently shifted from each other so as to form an *inter-field* that may be usable by those who need, in certain circumstances, of more space: minute parking, temporary extensions of the sidewalks, impermanent cyclist lane…

This decomposition induces the definition of 3 operating modes of a "leveled street" that are "built" on the basis of:

- The *fields*, their relative spatial extension and their *strategic positions* that may change according to circumstances.
- The *grouping* and *separation* of the various modes of transport and uses which are derived from the street profile composition and which may also vary according to circumstances.
- The *3 levels of utilization* of each of these *fields* by each kind of user (physical, perceptive and cognitive: cf. the levels operators) inducing 3 ways of separating and grouping the modes with each other.



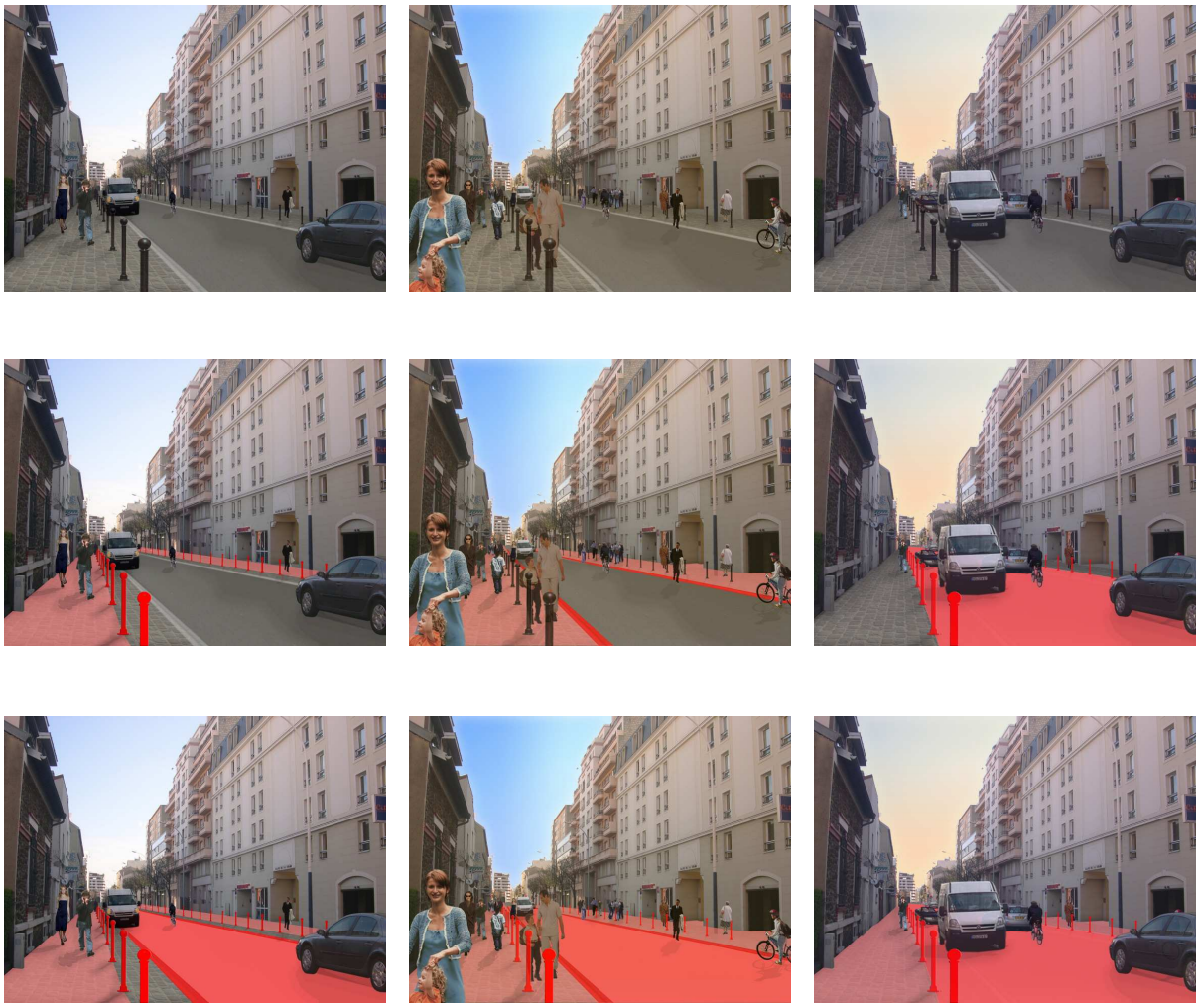
The 3 "operating modes" of a "leveled street":

[M1] *When many pedestrians and vehicles use the street, inter-fields become delimited spaces welcoming intermediary uses (temporary parking, delivery, etc). Cyclists are free to appropriate the whole width of the street.*

[M2] *When pedestrians predominate, they naturally appropriate the inter-fields by taking as limit of use, the closest line of the central way. Then, cars tend to slow down, and cyclists are redirected toward the center of the street.*

[M3] *When circulation is dense, the inter-fields are perceived and used as edges of the central way and as extensions of that space for cyclists, the pedestrians tending to stay away.*

M1 *M2* *M3*



The 3 "operating modes" of a "leveled street":

For each operating mode, the positions of the secondary fields, the inter-fields and the primary field change according to the circumstances: pedestrians and vehicles share the inter-field space at various moments of the day, or various moments of the week….

The *6 strategic positions* are thus a good tool (among others, like the *3 levels of utilization*) to conceive several manners of sharing the same and limited public space of a street.

We shall now see that these *6 strategic positions* are also very useful to raise the question of the street network hierarchy which is, from a certain point of view, the other side of the question of urban transportation *multimodality*. We can, indeed, set the following correspondences:

1. The *centers* play the role of network "cores": the nodes articulating all the city flows, the goals of every journey…
2. The *primary fields* play the role of network "arteries": the essential and structuring elements of the city: avenues, boulevards, main streets…
3. The *inter-fields* play the role of network "distributors" that connect these arteries to the streets of lower importance (secondary fields).
4. The *secondary fields* play de role of network "service roads" that receive the distributed flows in order to conduct them to the end of the network.
5. The *counter-fields* are the network "limits and access roads", that is to say the accesses to private parcels, like the cul-de-sac or local residential streets.
6. The *openings* are network "gates", that is to say the transition into the private realm and its circulation network.

If it is possible, following this operator of *strategic positions*, to "find" more or less precisely the current categories of road hierarchy (as they are today practiced by the transportation profession), this operator is not limited to this special mode of thought. First the various *strategic positions* are not defined by specific uses (service, transit, local life, speed, traffic quantity…) nor by specific configurations (width, length, number of lanes, curvature radius…) but by the role these positions play *among themselves* (that recursive character distinguishes the notion of "role" or "position" from that of "function" as we are used to understand it): this *role* may be central, primary, secondary, intermediate or enclosing… this without determining *a priori* if it is the quantity of flows, the symbolical power or even the width of the street dimensions that makes that this one may be more " primary" than these others...

The operator of *strategic positions* prompts the designers to define for each special project some adapted criteria to guide the establishment of a street "multipolar hierarchy" (cf. part A-2 of this report). This operator also invites designers to consider, in a second time, that a same street can play many different roles according to the other streets to which it is related. By engaging the same kind of work as the one we have described about the "leveled street" *operating modes*, we could easily establish different *operating modes* of a same network and of its hierarchy according to *time*, on one side, and to *users* and the way they utilize the street network on the other side.

It suffices to consider, as intermediary concepts, between that of the network uses and that of the network concrete configurations, these useful notions of *urban field* and their *6 strategic positions* that may allow conceiving:

- How a same *urban field* can on one side correspond to several different concrete configurations according to circumstances.
- How this same *urban field* can on the other side correspond to several different uses according, again, to circumstances.
- And how eventually, we can conceive several *modes of multimodality organization* inside a street or inside a street network by simple *fields* and *strategic positions* combinations.

This is how this special instrument closes this series of *design operators*. The following table is a kind of synthesis and recapitulation of these concepts before we consider, now, the development of a fourth and last part of this report.

Table 6: Recapitulation of the modeling principles and design operators

Urban fields

{Uses – Forms – Arrangements}

Urban models

{Contexts – Problems – {Parti} – Intentions – Configurations}

Univalent operators: Units

Unit of utilization	*Unit of conception*	*Unit of realization*
Use	Form	Arrangement
Intention	*Parti*	*Configuration*

Bivalent operators: Dimensions

2 dimensions of utilization	*2 dimensions of conception*	*2 dimensions of realization*
Dead ← Life → *Alive*	*Simple* ← Number → *Complex*	*Small* ← Space → *Big*
Short ← Time → *Long*	*Deformed* ← Form → *Conformed*	*Rare* ← Matter → *Dense*

Trivalent operators: Levels

3 levels of utilization	3 levels of conception	3 levels of realization
- *Cognitive*	- *Plotting*	- *Voids*
- *Perceptive*	- *Composition*	- *Fluids*
- *Physical*	- *Distribution*	- *Solids*

Tetravalent operators: Relations

4 modes of cohabitation		4 modes of integration		4 modes of cooperation	
Service	*Obedience*	*Assimilation*	*Conformation*	*Pursuing*	*Imitation*
Support	*Conversion*	*Articulation*	*Deformation*	*Consolidation*	*Recycling*

Pentavalent operators: Elements

5 elementary qualities		5 elementary actions		5 elementary scales	
Vitality		Founding		Mesoscopic	
Sympathy	Reliability	Partitioning	Orienting	Disposition	Ordering
Accessibility	Firmness	Opening	Defining	Microscopic	Macroscopic

Hexavalent operators: Positions

6 strategic positions

* *Center (CE)*	* *Primary Field (CP)*	* *Inter-Field (IC)*
* *Opening (OU)*	* *Secondary Field (CS)*	* *Counter-Field (CC)*

-D- Multimodal streets specifications

The typical design process

The preceding table shows the *archetypical design process* of a street arrangement: both in *modeling* approaches or in *project* approaches, the first and last steps of the design work are those consisting in *dividing* and *reconstructing* the *global field* into various sets of relatively autonomous *fields* that may act through different *strategic positions* and interact together in the multiple ways that can be imagined and described by the established list of *design operators*.

Dividing the global field into a set of individual fields

1. Dividing: Identify, name and divide the *global field* of study into several *individual fields* serving as linked *centers*, *openings*, *primary and secondary fields*, *inter-fields* and *counter-fields*, all coherent sets of:

{Forms, Arrangements, Uses}

That may be object of:

{Conception, Realizations, Utilizations}

Modeling and transforming the set of fields

2. **Transforming**: Analyze, dissect, articulate and transform each of these fields by using the design operators of street constitutive *units (1)*, *dimensions (2)*, *levels (3)*, *relations (4)* and *elements (5)* so as to model these fields and their relations as sets of coherent:

{Contexts – Problems – {Parti} – Intentions – Configurations}

Reconstructing the set of individual fields into one global field

3. **Reconstructing**: Rename, relate and reunite the set of *individual fields* and their *design models* so as to form a new *global field*, a same design, a same arrangement or even a same *design model* leading to:

{New Forms, New Arrangements, New Uses}

That may be object of:

{New Conceptions, New Realizations, New Utilizations}

Street forms compositions and specifications

Let's consider now a second application of all these design operators and modeling tools by establishing a *classification* of the various entities composing a street or a street network, a sort of general *street forms composition and specification*.

Any representation is drawn from a special point of view, aiming at a specific goal. Our purpose here is to support designers and their collaborators who are *in situation of conception* and who need to browse easily and quickly among street ideas, forms and models, to perceive and understand their diversity and common principles of organization in order to make better and more relevant use of that ideas, tools and models.

We thus proceed in 3 steps (*scales / orders / families*) from the global and general *urban field*, which is omniform and not yet organized, to point, finally towards the *design kinds* and *models* of street that are accessible to empirical observation: to those implicit models that are repeatedly designed and employed everywhere by French designers and others.

What depends directly on the work to be made and what depends only indirectly on this work

1. Scales of realization: We start by employing the *5 elementary scales* operator considering that the most elementary distinction to be made about ideas and street forms is that of *realization*: the nature of the various tasks to be worked out is above all determined by the nature of the "things" or the "artifacts" to be made.

We thus distinguish *5 scales of urbanism tasks* (*macroscopic*, *ordering*, *mesoscopic*, *disposition*, *microscopic*) which are interlocked in each other and which cover the whole of the task fields of urbanism and urban design:

1) The scale of *cities* (macroscopic)

2) The scale of the *urban environment* (ordering)

3) The scale of the *urban body* (mesoscopic)

4) The scale of the *habitable space* (disposition)

5) The scale of the *urban modules* (microscopic)

Determining the design formal dominances

2. Design orders: In a second step, we appeal to the *3 levels of conception* operator. We postulate that once the task domains distinction is established (by the *5 scales of urbanism tasks*), it is the *conception* of forms and ideas that is the most determinant feature of the urban workers and professionals practices.

We thus distinguish, at each one of these *5 scales of urbanism tasks*, *3 design orders* according to tendency of the conceived ideas and forms to be more linked to the *plotting level* (to the line), to the *composition level* (to the surface) or to the *distribution level* (to the point and to the volume).

1) The scale of *cities*

1.1) *Street networks* (dominant plotting)
1.2) *Districts composition* (dominant composition)
1.3) *High places distribution* (dominant distribution)

2) The scale of the *urban environment*

2.1) *Urban structures* (dominant plotting)
2.2) *Urban fabrics* (dominant composition)
2.3) *Built environments* (dominant distribution)

3) The scale of the *urban body*

3.1) *Public places* (dominant plotting)
3.2) *Collective places* (dominant composition)
3.3) *Private places* (dominant distribution)

4) The scale of the *habitable space*

4.1) *Open spaces* (dominant plotting)
4.2) *Enclosed spaces* (dominant composition)
4.3) *Built spaces* (dominant distribution)

5) The scale of the *urban modules*

5.1) *Building elements* (dominant plotting)
5.2) *Spatial patterns* (dominant composition)
5.3) *Urban furniture* (dominant distribution)

Refining the design formal dominances so as to reach most of the current design ideas

3. Design families: We appeal, again, to the same operator of the 3 levels of conception so as to distinguish, inside each *design order* previously established, several *design families* that may specify in a more precise and refined manner the street domains of interest.

We only reuse this operator at the three central scales (ordering, mesoscopic and disposition), as the two extreme scales (microscopic and macroscopic) are not directly the object of urbanism.

We also focus, at each oh these three scales, only to those of the *design orders* which dominance is in the *plotting level*, as these are obviously the ones which are the most directly concerned by the street design problematic.

Finally, the sense of each of these terms is chosen in such a way that the *design families* "point" towards the *design kinds* that correspond to current ideas of sidewalks, avenues, roadways, arcades, crossroads, etc.

1) The scale of *cities*

1.1) *Street networks*
1.2) *Districts composition*
1.3) *High places distribution*

2) The scale of the *urban environment*

2.1) *Urban structures*

2.1.1) *Street routes* (dominant plotting) → *Central ways, radial ways...*
2.1.2) *Street patterns* (dominant composition) → *Grids, stars…*
2.1.3) *Poles* (dominant distribution) → *Multimodal poles…*

2.2) *Urban fabrics*
2.3) *Built environments*

3) The scale of the *urban body*

3.1) *Public places*

3.1.1) *Streets* (dominant plotting) → *Avenues, boulevards, alleys…*
3.1.2) *Piazzas* (dominant composition) → *Forecourts, esplanades…*
3.1.3) *Intersections* (dominant distribution) → *Crossroads...*

3.2) *Collective places*
3.3) *Private places*

4) The scale of the *habitable space*

4.1) *Open spaces*

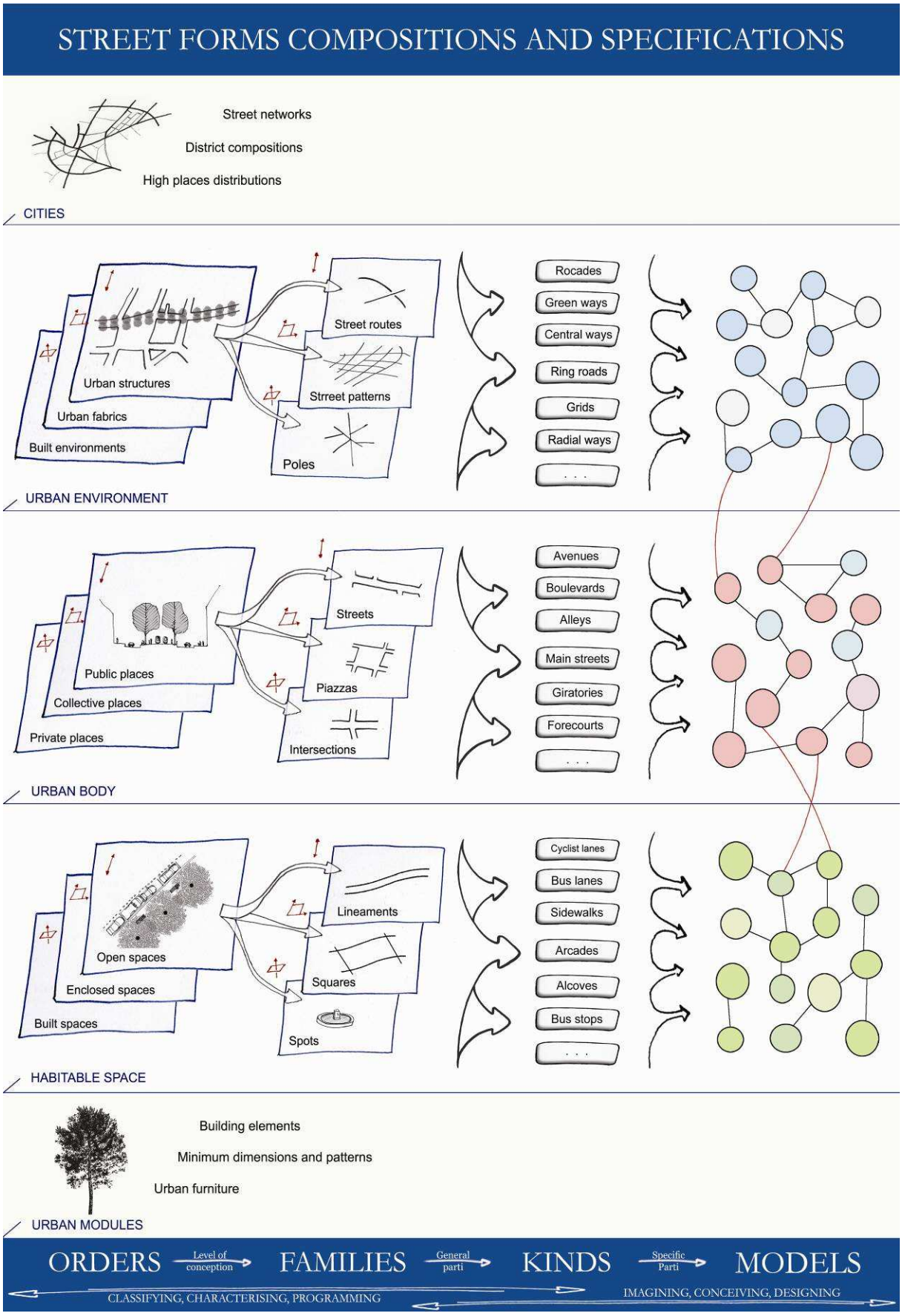
4.1.1) *Lineaments* (dominant plotting) → *Sidewalks, lanes, tracks…*
4.1.2) *Squares* (dominant composition) → *Gardens, parking places…*
4.1.3) *Spots* (dominant distribution) → *Bus stops, doors and gates…*

4.2) *Enclosed spaces*
4.3) *Built spaces*

5) The scale of the *urban modules*

5.1) *Building elements*
5.2) *Spatial patterns*
5.3) *Urban furniture*

Table 7: Street forms classification

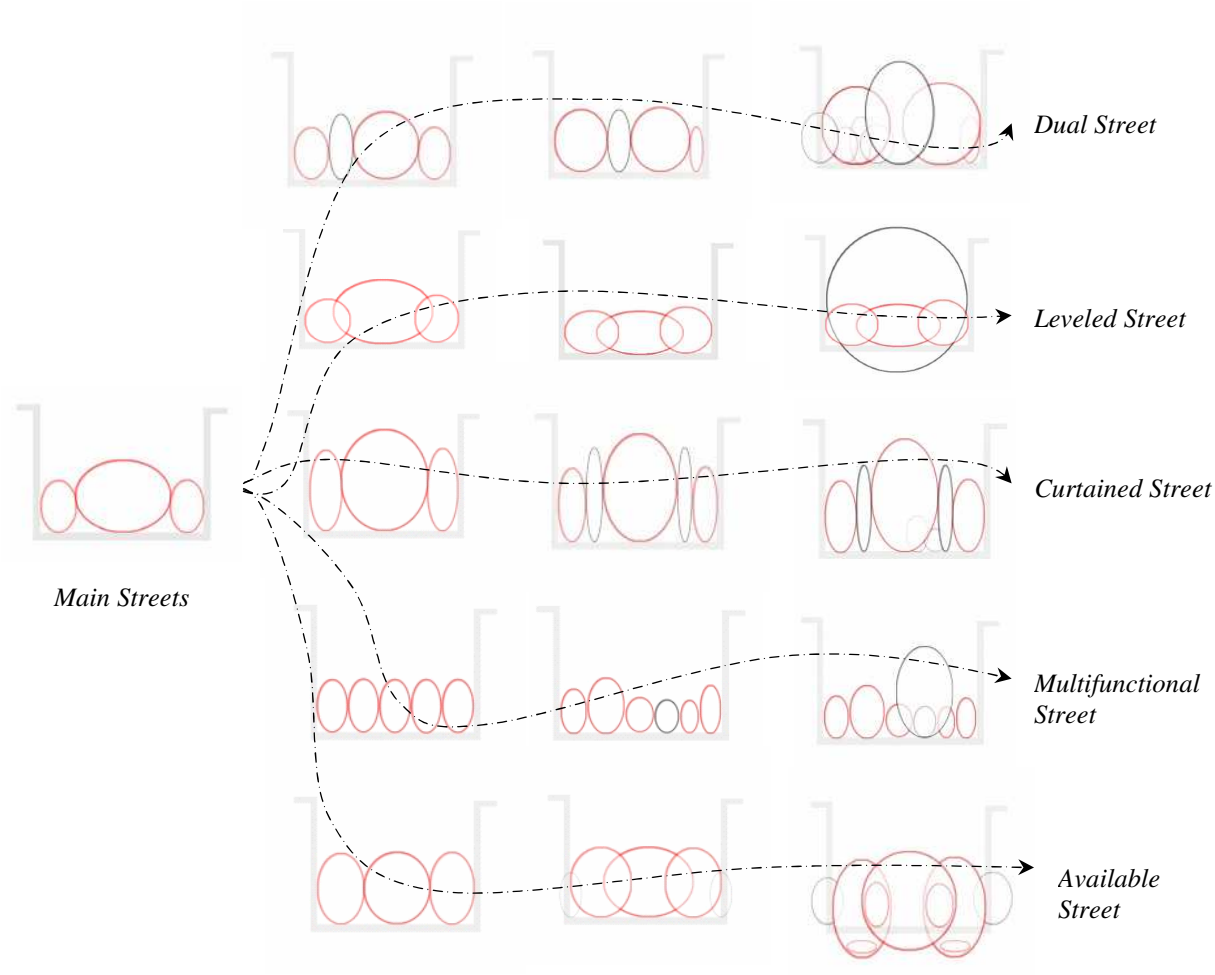


Cartography of street design kinds and design models

After having used some *design operators* to build a classification of street forms, that is to say a kind of conceptual structure *(scales of realization / design orders / design families)* pointing towards the empirical mass of design kinds and design models of street, we shall now describe some of the movements designers may operate when navigating that sort of street ideas ocean.

For if the purpose of the preceding *classification* was to locate, to classify and to build a hierarchy of street entities in order to figure out some clear ideas of the sort of form designers manipulate in the design processes, the purpose of this *cartography* will be more directly operational: supporting designers in the task of passing from one street form to another, from a model of sidewalk to another model of sidewalk, or from a concept of boulevard to a concept of avenue for example.

We have yet exposed how the *parti* of one model (its principle of organization, its form) was to be described in terms of successive *states* resulting from different *actions of conception* that were to be described, in their turn, by "spatial verbs of action": *leveling, overlapping and unifying* to reach the "leveled street" form for example, or *raising, veiling and continuing* to reach the "curtained street" form...



The tree-like design paths are produced inside the formal solution space that is proper to one type of operator taken in an only one direction.

Street *kinds* are thus easily formed (main streets, boulevards, avenues…) that correspond to the current concepts (streets, avenues, arcades…) that may be formalized, modeled and described by *generic diagrams* to be *specified*, through a certain number of *actions of conception*, into several *specific diagrams* representing the "species" of these kinds, that is to say the street *design models*.

But while proceeding that way, by one and only one operator (those of the *5 elementary actions*: *founding, orienting, defining, opening, partitioning*) taken in one way (from the general to the specific) one forms tree-like conceptual structures (design orders / families / kinds / species) into which the branching paths are definite: there is, to get from one place to another in this cartography, *i.e.* from one street model to another street model, one only possible deductive path which is one of a classification mode of thinking.

This tree-like mode of specification may have great utility when one makes do with very general concepts (as we've just done while setting the preceding *street form composition and specification table*). But it is very less powerful when we are to describe the abounding of complex ideas, forms and transformations that are the product of design activity.

To quit this tree-like mode of street forms classification, it suffices to consider not one operator but several classes of possible operators for a same operation, and to take them not in one way but in this way and its converse. Each design operator is in fact the archetype of a whole class of possible transformations of one model into another model, of possible passages from one design idea to another design idea, from one street form to another street form.

The design *units, dimensions, levels, relations, elements* and *positions* that we have described and developed are many possibilities to link one special concept of street organization to another one, to multiply the paths leading from one point of the network of urban ideas to another *significant* point of it.

The work of conception (*imagination* and *construction* of a form able to reach a certain number of intentions or purposes) is then a more or less conscious and skilled manipulation of these operators that, as the many instruments of a sculptor, serve as much the designer as he knows well what he is doing, what a tool is made for and what it is not made for.

Each design operator may *deform* a certain existing form in a certain *manner*: as for the sculptor tools, each design operator is capable of patterning certain forms and not others, of imprinting a certain rhythm but not other rhythms, of aiming at certain goals more easily than at others goals…

But contrary to the sculptor tools, the design operators, which are thinking instruments, are in a large extent *reversible*: one can, for example, apply the action of *leveling* and then operate its converse: *differentiating*. One can also *raise* a form and then *put* it *down*, *turning* it and then *returning it*…

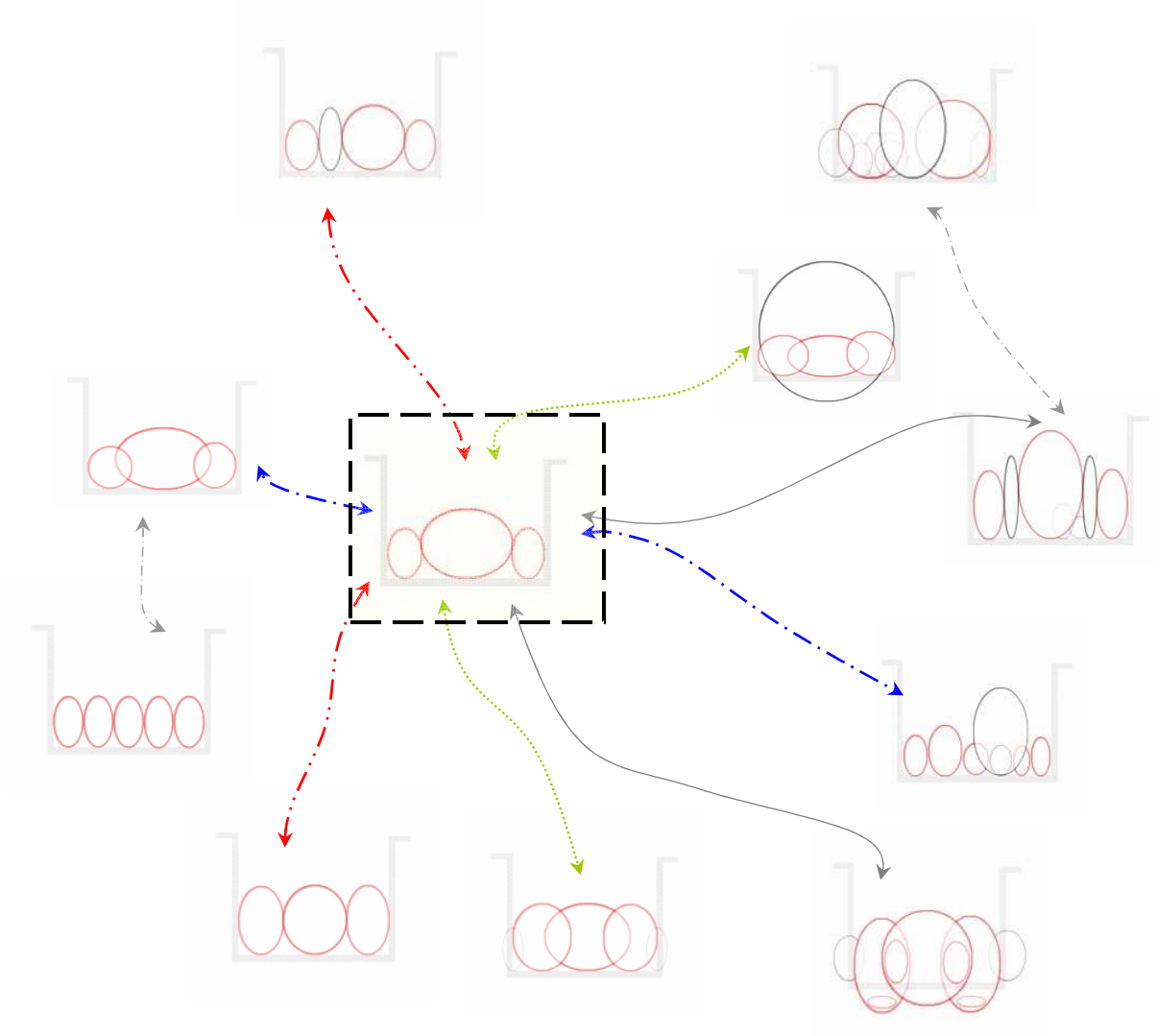
This is how one may ask, in relation to the *3 levels of conception* operator (*plotting, composition, distribution*), for example:

- What concept do we get by "forcing" the *plotting level* of a "street"? A "lane", a "path"...

- Or conversely, what is the concept which, when "forcing" its *plotting level*, produces the concept of a "street"? A "piazza", a "boarder line"...
- And again, what is the concept which, when forcing its *composition level*, produces that of a "street"? A "path", a "parcel limit"...

We already see how, through this little example, a same *form* of the formal network of ideas, while leading to several destinations according to the paths available from its departure point, is also in itself, the goal of many different design paths: one can reach the "street" idea leaving from the "path" idea (forcing its composition), or leaving from the "frontier" idea (forcing its plotting)...

These redundancies are the one characteristic that distinguish this kind of network-like conceptual structure from the tree-like ones.



Network-like design paths in the formal solution space of a whole set of reversible design operators.

We can also apply, to take another example, the *5 elementary qualities* operator *(vitality, reliability, firmness, accessibility, sympathy)*, so as to orient or incline the main intentions of one specific street model or street project:

- What is the vitality of a “leveled street”?
- What is the vitality of a “curtained street”?

But also:

- Of which model the “leveled street” may be the vitality?

Which could be interpreted, in the case of this operator (which postulates that *vitality* is a result of *sympathy* and is mastered by *accessibility*), as follows:

- What is the model the *sympathy* of which may produce the *vitality* of the “leveled street”? And what is the other model the *accessibility* of which may master the *vitality* of the “leveled street”?

And this again and again, by application of the *4 relations of cohabitation, the 4 relations of cooperation...*, the *3 levels of realization, the 3 levels of utilization, etc.*

All these design operators may serve as path generators to proceed in one way (from the general to the specific, *i.e.* from *design kinds* to *design models* or from *design models* to *design projects*) or in the other way (from the specific to the general, *i.e.* from *design projects* to *design models* or from *design models* to *design kinds*) to constitute the complex network of street form conceptual structure.

We shall set for now, a special and temporary *cartography* of this network of design kinds and design models as we have been able to recognize them among the current practices of urban designers.

The two axis of this map are:

- The ordinal axis, governed by the fundamental *scales of realization*: ordering scale (urban environment), mesoscopic scale (urban body) and disposition scale (habitable space).
- The abscissa axis, governed by the *strategic positions* of the urban fields, not in order to fix in a definitive manner the role of each *design kind* or *design model* but to notice its dominant character.

This cartography allows designers to set up, at the “urban body” scale (streets, piazzas and intersections) a sort of *multipolar hierarchy* of the street network oriented by 3 main poles:

- Le “central pole” which orients the network elements toward the central functions and places of the city.
- The “upper exit pole” which orients the network elements toward the outside of the city public space through the “high” ways.
- The “lower exit pole” which orients the network elements toward the private spaces and domains through the “small” ways.

Having defined the various regions of this map, we may observe, among other things, that certain *design models* have several “parents”, thus constituting some of the possible passage points from one *design kind* to another *design kind*…

DESIGN KINDS AND DESIGN MODELS CARTOGRAPHY

ACCORDING TO THEIR DOMINANT STRATEGIC POSITION

OPENINGS
(exits of the urban network)

- Highways
- Parks
- Fluvial routes
- Exchange poles
- Houses blocks
  - Ilots de lanières
  - Ilots communs
  - Carrés mulhousiens
  - Ilots fermés
  - Ilots en peigne
  - Ilots à étages
  - Ilots percés
- Compact blocks
  - Plots pyramides
  - Bandes à patios
- Park alleys
- Urban blocks
  - Ilots ouverts
- Giratories
- Riverside ways
- Green routes
- Cyclist routes
- Rotaries piazzas
- Access patterns
- Private spaces over street
  - Suites de jardinets de présentation
  - Débords des toits
- Closes
- Blind alleys
  - Culs-de-sac évolutifs
- Arcades
  - Arcades continues
  - Cloîtres urbains
  - Villas
  - Mini-closes
  - Suites de pergolas
- Façades
  - Jardinets de devant
  - Courettes
  - Coursives
- Entries
  - Patios d'entrée
  - Porches
  - Chicanes de livraison
  - Portes cochère

COUNTER-FIELDS
(limits of the urban network)

- Rocades
  - Rocades
- Freeways
- Bus lines
- Alleys
  - Ruelles de service
  - Ruelles simples
  - Sentes
- Small rotaries
- Squares
  - Square pour enfants
- Composed fences
  - Noues en limite
  - Chemins de ronde
  - Clôture double arrêt
  - Clôtures double flux
- Valleys
  - Noues centrales
  - Sauts de loup
- Embankments
  - Quais doubles
- Public transport stops
  - Quais sur chaussée
  - Arrêts publics
  - Arrêts en parvis
  - Arrêts adossés
  - Abris-bus retourné
- Rotaries
  - Rond-points à feux
  - Rond-points sur plateau piétonnier
  - Rond-points ceintures
  - Boucles de desserte locales
- Access streets
  - Allées à rideaux
  - Allées à niveaux
  - Allées mixtes
- Alcoves
  - Alcôves d'angle
  - Alcôves sous-olivier
  - Alcôves multiples
  - *Alcôves publiques*
- Pièces émaillées
- Bancs de face
- Bancs en terre

SECONDARY FIELDS
(service streets)

- Boulevards périphériques
- Boulevards triples
- Boulevards de rive
- Peripheral boulevards
- Boulevards promenades
- Boulevards à contre-allées
- Avenues résidentielles
- Secondary avenues
- Avenues-parcs
- Secondary streets
- Rues basses
- Rues entre deux murs
- Rues semi-piétonnes
- Rues simples
- Access streets
- Trottoirs à cheval
- Trottoirs dédoublés
- Trottoirs à corniche
- Trottoirs à belvédère
- Composed sidewalks
- Trottoirs à quai
- Trottoirs arrières
- Chemins doubles
- Trottoirs mixtes
- Rues placettes
- Urban rooms
- Parvis
- Trottoirs abrités
- Trottoirs entre deux murs
- Trottoirs bienséants
- Trottoirs surélevés
- Trottoirs bordés
- Trottoirs à rideaux
- Trottoirs bas
- Trottoirs corridors
- Simple sidewalks
- Lateral bus lanes
- Couloirs abrités
- Coulées douces
- Pistes sur double-trottoir
- Pistes sur trottoir élargi
- Pistes en noue
- Pistes sous voûte
- Cycle tracks
- Pistes en corniche
- Pistes bordées
- Pistes danoises
- Contre-sens cyclables
- Cycle lanes
- Bandes intercalées
- Bandes séparées
- Bandes de débords
- Bandes latérales
- Bandes abritées
- Benches
- Bancs intégrés
- Bancs longs
- Bancs doubles

INTER-FIELDS
(distributors)

- Orthogonal grids
- Trames à cheval
- Trames superposées
- Bus line patterns
- Parkways
- Rondes
- Cycle patterns
- Rues doubles
- Rues tranchées
- Wide streets
- Crossroads
- Rues alternées
- Distribution streets
- Rues semi-piétonnes
- Rues simples
- Intersections
  - Intersections en T
  - Priorités à droite
- Side lanes
  - Contre voies
  - Site doux
  - Contre-allées ouvertes
  - Demi-rues
  - Epis en bord de mail
  - Allées de stationnements
  - Rives alternées
- Side bus lanes
  - *Sites à cheval*
- Passages
  - Venelles
  - Jardins de passage
  - Passages couverts
  - Passages à cours multiples
- Street banks
  - Rives jointes
  - Rives enherbées
  - Rives fines
  - Bergères
  - Rives d'accueil
  - Bandes d'arrêt de détente
  - Gradines abritées
  - Stat. en épis
  - Stat. sous la voûte des arbres
  - Stat. intercalés
- Parking lots
  - Lincolns
  - Stat. en demi inclus
  - Stat. à cheval
- Tree alignments
  - Alignements mixtes
  - Alignements décalés
  - Double-rideaux
  - Rideaux simples
  - Rideaux avec interstices
  - Rideaux fins
  - Jardinières centrales
- Crossraods piazzas
- Crossings
  - Trottoirs traversants
  - Plateaux à niveau
  - Avancées des trottoirs

PRIMARY FIELDS
(arteries)

- Baroque patterns
- Boulevards multi-voies
- Boulevards intermittents
- Functional poles
- Radial routes
- Urban boulevards
  - Double boulevards
  - Simple boulevards
  - Rambla avenues
- Crossraods piazzas
- Wide streets
- Multi-functional streets
- Cours des jardins
- Curtained streets
- Main streets
  - Dual streets
  - Available streets
  - Leveled streets
- High streets
  - Promenade avenues
- Mains avenues
- Gardens
- Four lanes roadways
- Sites propre centraux
- Larges chaussées partagées
- Two lanes bus tracks
  - Contre Rues
  - Sites propres sous voûte
- Two lanes roadways
  - Double-sens réduits
- Planted sidewalks
  - Trottoirs promenade
  - Trottoirs square
  - Trottoirs distanciés
  - Trottoirs shopping
  - Arrière voies
  - Trottoirs à mail
  - Ramblas
  - Mails à alcôve
  - Doubles mails
- One lane roadways
- Central pavements
  - Terre-pleins sur trottoirs
  - Mails sous ouvrages
  - Batailles sous mail
- Promenades
  - Mails à pièces latérales
  - Mails linéaires
  - Mails sur-élevés

CENTRES
(cores of the urban network)

- Pedestrian patterns
  - Zones 30
  - Aires partagées
- Open piazzas
  - Avenues simples
  - Avenues à contre-allées
  - Axial avenues
- Closed piazzas
- Statues
  - Statues centrales
- Fountains
  - Fontaines bassins
  - Fontaines kiosques
  - Fontaines murales
  - Fontaines des rendez-vous
- Linear gardens
  - *Suites de jardins attenants*

URBAN ENVIRONMENT
- Street routes
- Street patterns
- Poles

URBAN BODY
- Streets
- Piazzas
- Intersections

HABITABLE SPACE
- Lineaments
- Squares
- Spots

Appendix: some design models

First illustration

We are presenting here 5 *design models* that all belongs to the "main streets" *design kind*:

- The "leveled street".
- The "dual street".
- The "curtained street".
- The "available street".
- The "multifunctional street".

These models have been established by observation and by reasoning on the basis of some of the *design operators* picked up in the previous developments (part C) and according to the formalization set in part B of this report.

We have also taken a real example (Jean Bleuzen Street in Vanves) to illustrate how many different designs can be imagined from a single concrete configuration.

This application case will also show that "design models" cannot be applied "directly" (by paste and copy…), without working on their integration into a specific site: the realization of a model is not the exact reflection of what we can find in its description, even when if it is solely about showing a visual simulation (as it is the case here).

What this fictive application case does not show are the relations of these design models to the purposes of the owners and users and, more generally, the whole design process and its articulation to political deliberation[34].

For the photomontages indeed, like the execution blueprints, which are meant to represent the final appearances or measures of the built work, do not represent the *content* of the design, that is to say the whole set of information, ideas and reasoning that are *created* for each special project and that constitute the real designers contribution.

The *models of conception and deliberation* and their *design operators* may have, finally, as a primary function to make this *content* explicit, robust and visible so that the work of urban design may be progressively refined and transformed, taken for what it is, augmented, tested and recognized…

[34] These subjects will be treated extensively in the real application case of Wattrelos that will be exposed in next report (D1.3).

Jean Bleuzen Street in Vanves

The leveled street

The dual street

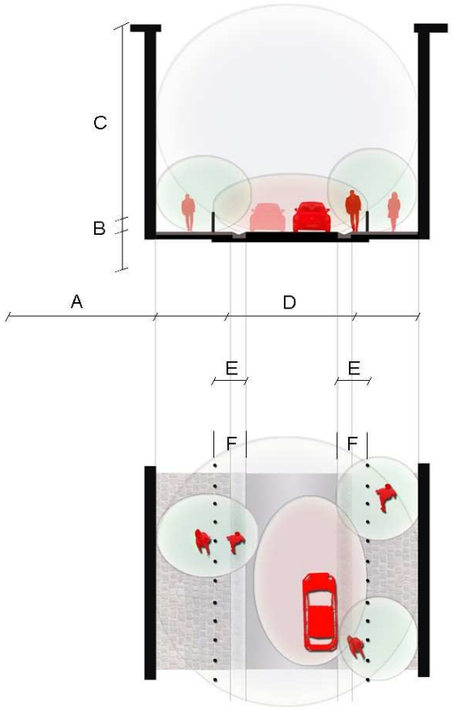
The curtained street

The available street

The multifunctional street

THE LEVELED STREET

Laboratoire Régional de l'Ouest Parisen - Laboratoire Central des Ponts et Chaussées - *New Road Construction Concept* - 2007 September the 9th



[Intentions]

(a) To support an important street commercial activity ;
(b) To dedicate the street space to the various flows more than to "stay uses" ;
(c) To incite reasonable speed and mutual attention from the various users ;
(d) To give the street a strong visual unity, a temperate and spacious character ;
(e) To allow many possible readings of the limit between pedestrian and car spaces.

[Configurations]

-A- Build relatively high buildings, with regular and well shaped façades, and commercial use at the street level ;
-B- Put at the same level all the street surface ;
-C- Release the internal volume of the street from any obstruction, car parking or shops extensions ;
-D- Balance the ratio of pedestrians / vehicles surfaces ;
-E- Form an intermediary space of overlapping uses, with a width inferior to half that of pedestrian space ;
-F- Complete and balance the visual demarcations of this intermediary space.

INTENTIONS / CONFIGURATIONS	**Animation /** Calm	Stay uses / **Flux**	**Paying attention /** no attention required	**Sober atmosphere /** Abounding atmosphere	**Adaptable /** Fixed
	(a) *To support an important commercial activity*	**(b)** *To dedicate the street space to the various flows more than to "stay uses"*	**(c)** *To incite reasonable speed and mutual attention from the various users*	**(d)** *To give the street a strong visual unity, a temperate and spacious character*	**(e)** *To allow many possible readings of the limit between pedestrian and car spaces*
-A- Build relatively high buildings, with regular and well shaped façades, and commercial use at the street level	●	○	●	●	●
-B- Put at the same level all the street surface	●	●	●	●	●
-C- Release the internal volume of the street from any obstruction, car parking or commercial extensions	○	●	●	●	●
-D- Balance the ratio of pedestrians / vehicles surfaces	●	○	●	•	○
-E- Form an intermediary space of overlapping uses, with a width inferior to half that of pedestrian space.	○	●	●	●	●
-F- Complete and balance the visual demarcations of this intermediary space		•	●	●	●

● = The configuration supports the intention, more or less strongly - ○ = The configuration is contrary to the intention

A street where the limits of uses are being adjusted according to the circumstances

[Context]

We desire to work on the ambiance and the look of a main street, to bring a significant overall unity to that place while allowing it to receive a multiplicity of uses and modes of transport. Our position is to set up sidewalks and road at the same level.

To level a street is deliberately to go out of the configuration of the ordinary street, leaving the roadwayway and sidewalks and, as well, the current practices they use to support. How then to organize and signify the new division of spaces? How to provide safety to pedestrians and how to prevent wild parking without entering in contradiction with the first intention of this model consisting in a strong unity of the street space?

[Problems]

Widening the pedstrian space?

Sometimes the street is too narrow to widen sidewalks, or even in some cases, this action isn't suitable. In fact, a too important widening could tend to "dilute" the pedestrian space: people would be walking in a space not proportionated to their number, body and speed. But too narrow sidewalks have the inconvenient of being too "weak" in comparison to the roadway: they put pedestrians in a position of inferiority regarding the wide space reserved for vehicles. Thus the size of sidewalks must concord on one side with human proportions, with pedestrian feeling of density and on the other side with the relative "weigth" of the roadway.

Perception of proper spaces

To level a street allow, while removing the limits of uses, to enlarge the proper spaces perceived by each user, this without enlarging too much the space effectively reserved to each of them: some areas of the street global volume may hopefully seem to belong properly to many different users.

Opportunities for drawing limits between central and lateral lanes

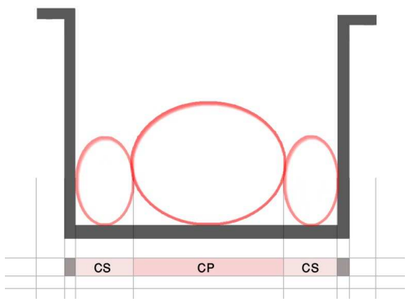
For questions of street safety perception on one side, and of wild parking and water collection on the other side, the absence of limit between pedestrians and cars spaces seems impossible. In the case of current leveled streets, designers even sometimes mark with different street furniture some concrete limits between central and lateral spaces that are finally more strong and annoying for "soft modes" than the one exiing in the ordionary street configuration...

In brief :

- A certain number of technical elements (gutter, curb, pavement, bollards, etc.) may naturally participate to the definition of visual limits between pedestrians and vehicles spaces.
- But a such delimitation is opposite to a search for unity and width of the street space perception.
- The total absence of limits between central and lateral spaces, however, is impossible if pedestrians and vehicles are to make use of the same street steadily and in balanced proportions.

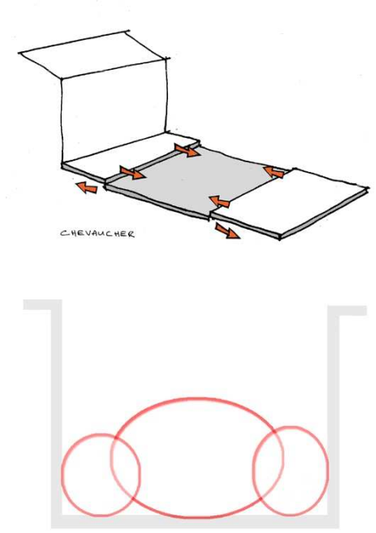
Is the road / sidewalks operating mode the only possible one from now?

[Parti]



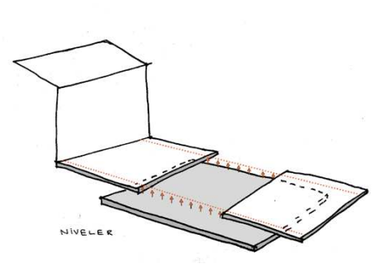
Rather than to create only one limit between a motorized central space and pedestrian lateral spaces, we can lay out two distinct limits, shifted one from each other and consequently, create an intermediary space appropriable by both type of users, pedestrian and vehicles, according to the daily or weekly various uses of that street.

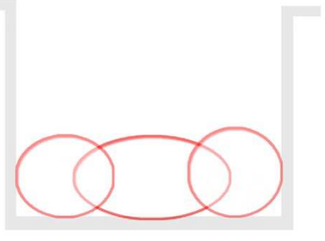
The parti of the levelled street can be declined according to 3 actions of conception successively applied to the generic diagram of the main street.



OVERLAPPING : Central and lateral spaces overlap themselves in an intermediary space. This action creates an inter-field space, the profile becoming constituted of three types of entities:

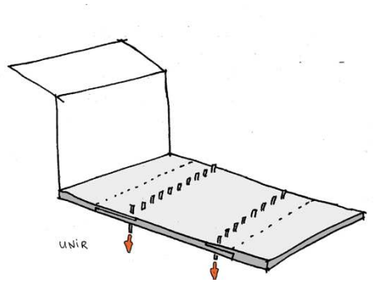
* The roadway forms the primary field, the central way, dedicated to motorized vehicles which overlap lateral lanes.
* Two lateral secondary fields are replacing the usual sidewalks and dedicated to pedestrians and "soft modes" whith overlap on the central way.
* Suggested or dedicated limits of those overlaps form two inter-fields which separate the secondary fields from the the middle of the street.

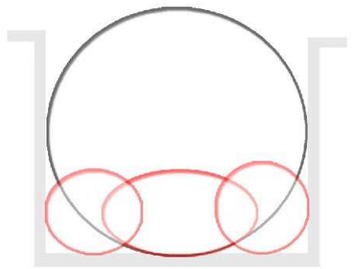




LEVELING : Street is levelled and all its parts get similar qualities. Focus is mainly directed on the lower part of the profile, *i.e.* where this model differs from the ordinary street configuration. Consequently we obtain:

* A roadway as primary field and raised at the level of lateral pedestrian ways, which progressively acquires the status of secondary field from that ways.
* Lateral secondary fields for pedestrians which are widen but lowered at the level of vehicles and which consequently acquire, in some moments, the status of a primary field.
* Two inter-fields constituting for each of these central and lateral ways, an easily accessible space.

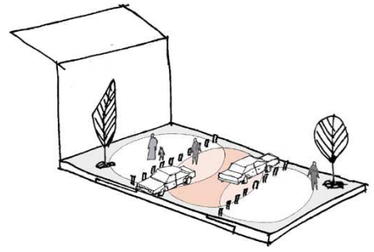




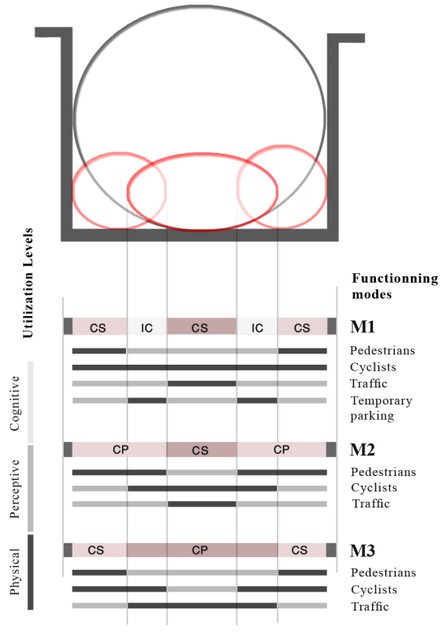
UNIFYING : Unity of the street is brougth clearly perceptible in order to provoke an evolutive interpretation of the sub-spaces divisions of the street section acording to uses circumstances.

* The global volume of the street is clear and defined, formed by building allignments and by ground homogeneity, playing the role of a primary field.
* Inter-fields are perceived sometimes as part of the central way, sometimes as extentions of the lateral ways.
* The central way may appropriate the overlapping space and play the relative role of a primary field when the trafic raises up.
* Lateral ways may appropriate the inter-fields and play the role of a primary field when pedestrians density becomes important.

[Operating modes]



The levelled street is formed of three types of space: central and lateral spaces, which are dedicated to vehicle traffic and to pedestrians amenities, and an overlaping intermediary space, also dedicated to traffic more than to static uses, which is shared as a possible extensin of both central way and lateral ways.



[M1] When many pedestrians and vehicles use the street, inter-fields become delimited spaces welcoming intermediary uses (temporary parking, delivery, … etc). Cyclist are free to appropriate the whole width of the street.

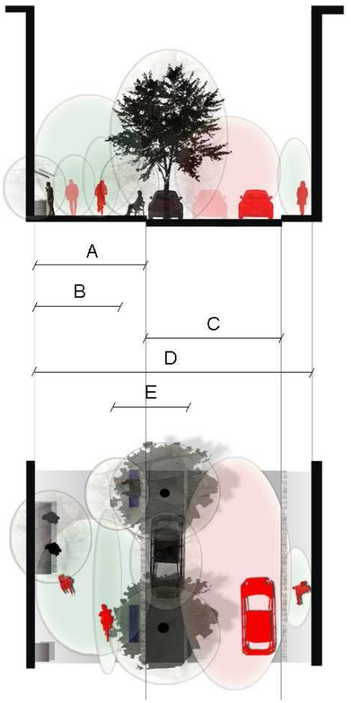
[M2] When pedestrians predominate, they naturally appropriate the inter-fields by taking as limit of use, the closest line of the central way. Then, cars tend to slow down and cyclists are redirected toward the center of the street.

[M3] When car traffic is dense, the inter-fields are perceived and used as edges of the central way and may serve as extensions of that space for cyclists, pedestrians tending to stay away.

CE = Center - CP = Primary Field - CS = Secondary Field - IC = Inter-Field - CC = Counter-Field - Ou = Opening

THE DUAL STREET

Laboratoire Régional de l'Ouest Parisen - Laboratoire Central des Ponts et Chaussées - *New Road Construction Concepts* - 2007 September the 9th



[Intentions]

(a) To give more space to "soft modes" in order to balance the transport modes ;
(b) To widen and make obvious the perception of all users' usable space ;
(c) To protect "soft modes" and local uses ;
(d) To rely on the auto-organisation of uses, politeness and good manners of people ;
(e) To balance transit and local uses.

[Configurations]

-A- Make a large space shared by "soft modes" and local uses on the main sidewalk (4 m minimum) ;
-B- Put the main sidewalk on the side which is the sunniest and closest to the stores, implying a dissymmetrical profile ;
-C- Set a roadway that mixes vehicles and public transports ;
-D- Balance the surface ratio between the sidewalk and the roadway in order to make them equally discernable ;
-E- Insert a kind of bank between the two main ways that contains parking, street furniture, plantations, etc.

	Soft modes/ Motorized modes	Requires attention / Allows inattention	Mixed uses/ Separated uses	Sober atmosphere / Abounding atmosphere	
INTENTIONS / CONFIGURATIONS	**(a)** *To give more space to "soft modes" in order to balance the transport modes*	**(b)** *To widen and make obvious the perception of all users' usable space*	**(c)** *To protect "soft modes" and local uses*	**(d)** *To rely on the auto-organisation of uses, politeness and good manners of people*	**(e)** *To balance transit and local uses*
-A- Make a large space shared by "soft modes" and local uses on the main sidewalk (4 m minimum)		●	●	●	○
-B- Put the main sidewalk on the side which is the sunniest and closest to the stores, implying a dissymmetrical profile	●	●		●	
-C- Set a roadway that mixes vehicles and public transports	●	•	•	●	●
-D- Balance the surface ratio between the sidewalk and the roadway in order to make them equally discernable	●	•		•	
-E- Insert a kind of bank between the two main ways that contains parking, street furniture, plantations, etc.			●	●	●

● = The configuration supports the intention, more or less strongly - ○ = The configuration is contrary to the intention

A street which puts cars and pedestrians in a symetrical and equitable position

[Context]

The dual street is a main street with a profile of 14 to 20 metres broad. This model makes it possible to accommodate public transport, cyclists, parking and important pedestrian use of the street space. Its *parti* suits well with dissymmetrical streets.

As regards the division of space between the different uses and modes of transport, the dual street adopts an intermediate position between the leveled street that mixes all modes and the multifunctional street that separates everything: it only tears apart "soft modes" from the motorized ones by organizing two distinct shared spaces of same importance.

[Problems]

Dissymetry of a street

A street of which the buildings and activities are dissymmetrical earns little from a classical sidewalk / roadway division: such a form being symmetric while the street is not. This dissension will be all the more strong as the width of the street will be limited. For from a certain point of view, a sidewalk islike the square or the esplanade of the buildings and spaces it hugs: they maintain a natural relationship of use and proportion. Add the fact that the street orientation will expose to sunlight one of its sides more than the other: the daylight disposal always intensify the dissymmetric nature of a street. Hence a symmetric design into a dissymmetric street is not always judicious.

The street cut off by its roadway

A street crossed over by a central roadway with a strong traffic is cut into two parts. Its narrow sidewalks are weak and too poorly protected to support a local appropriation of the street space. But the liveliness of a street mostly comes from "stay uses" and from the exchanges that take place from one side to the other side of the street. Most of the time, a large traffic that lie upon a broad roadway strongly weaken the street local use and weaken its character.

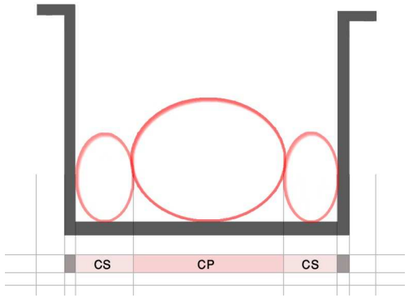
Multi-modality in small spaces

Organizing the cohabitation between many modes of transport into one same little space is not an easy task. But several possibilities may be offered to the designer by considering the fact that the perception of a proper space by any of the street users lays as much on the real space that is physically accessible to him as on the perceived space that he may think is accessible to him...

The separation of modes of transport is therefore not always a good solution : it may decrease the spaces perceived as "proper" or "useful" for each user.

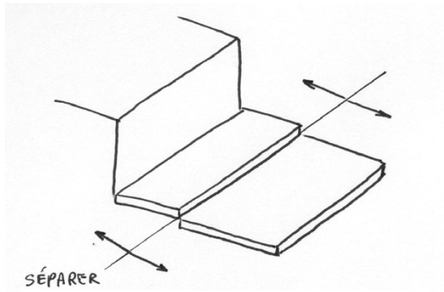
Moreover, separating all modes does not make the transport and various uses safer: they'll certainly be perceived as safer, but the attention will thus be naturally reduced and the desired effect may be finally reversed.

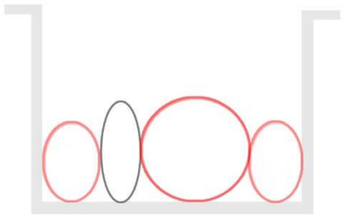
[Parti]



We decide to create a broad sidewalk, as large as the roadway and clearly separated from it, in order to gather and welcome all the "soft modes", local uses, stores extensions, etc. on the more suitable side for the liveliness of the street.

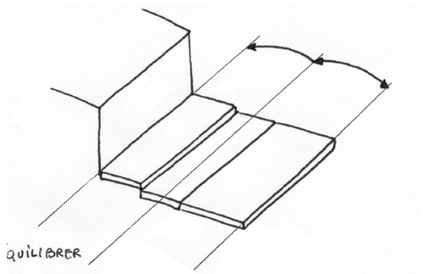
This parti can be declined according to 3 actions of conception successively applied to the generic diagram of the main street :

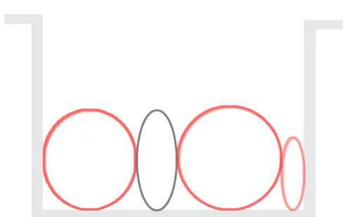




SEPARATING : We split the profile of the space into two parts, while inserting an intermediary space between the major sidewalk and the roadway :

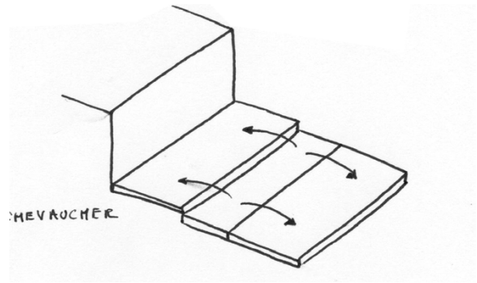
***** The roadway, as a primary field, welcomes all motorized modes and possibly parking uses.
***** The main sidewalk, which is also in a position of a primary field, gathers and welcomes all the "soft modes".
***** The inter-field separates these tow main ways so that they become relatively independent from each other.
***** The small sidewalk constitutes a secondary field on the other side of the street. It is clearly located on the roadway side.

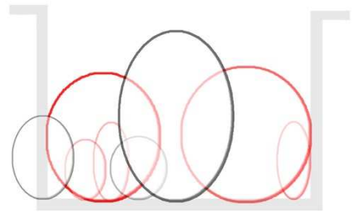




BALANCING : We widen the large sidewalk in order to give it a status equivalent to that of the roadway. Thus the little sidewalk is reduced to a minimal width:

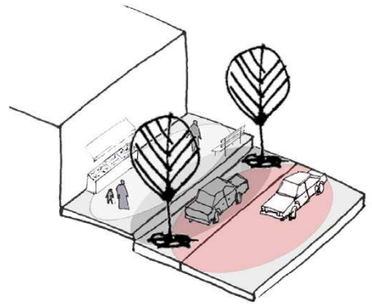
***** The primary field wich is still allocated to the motorized vehicles now occupies a lateral position in the street profile.
***** The other primary field which is dedicated to all "soft modes" (pedestrians, cyclists, etc.) has a nearly similar position except the fact that it is located on the most attractive side of the street.
***** The inter-field splits those two primary fields of equal width.
***** The little sidewalk which is reduced to the minimum becomes a counter-field when it is not used by pedestrians.





OVERLAPPING : We link and separate the two main ways while enlarging the inter-field in such a way that it overlaps the roadway and the sidewalk at the same time:

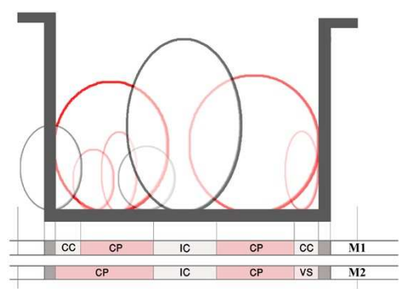
***** The primary flield allocated to the "soft modes" is edged by the uses of the inter-field and by those of the building fronts giving on the street.
***** The primary flield dedicated to the motorized modes is reduced, surrounded on one side by the inter-field and on the other one by the little sidewalk, thus making a counter-field field that protects buildings surroundings from vehicles.
***** On the side of the main sidewalk, the shop stands and the various furniture coming from the buildings make a second counter-field linking the private parts of the street to the public space.
***** The enlarged inter-field forms a space on its own, kind of repository that gathers each object and "stay use" of the street.



The dual street is formed by 4 types of space: the primary fields, which mix vehicles' flows on one side and "soft modes" on the other; a kind of bank crating an inter-field and welcoming "stay uses"; two counter-fields making the interface between pedestrian flows and buildings private spaces.

We can now form the specific diagram of the dual street and consider its operating modes.

[Operating modes]



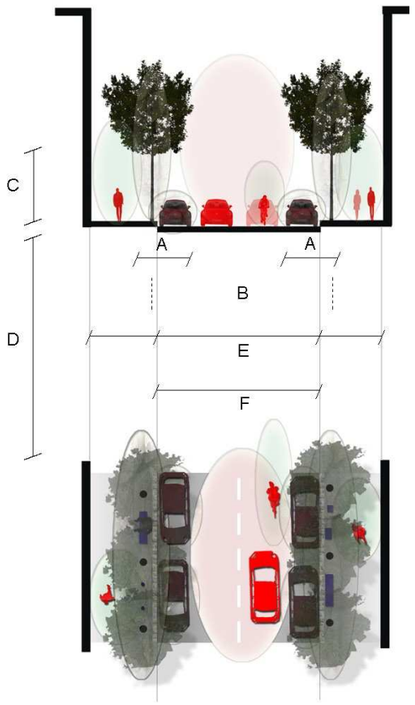
[M1] When the major sidewalk is alive and well used, all the "soft modes" prefer to move on this large, friendly and well protected space that forms one of the primary fields of the street, somewhat forgetting the second part of the street.

[M2] When "soft modes" are few, cars constitute the more "lively" aspect of the street. The small lateral sidewalk thus continue to play its role of secondary field.

CE = Center - CP = Primary Field - CS = Secondary Field - IC = Inter-Field - CC = Counter-Field - Ou = Opening

THE CURTAINED STREET

Laboratoire Régional de l'Ouest Parisen - Laboratoire Central des Ponts et Chaussées - *New Road Construction Concepts* - 2007 September the 9th



[Intentions]

(a) To attenuate, for pedestrians and motorists, the potential dangers and nuisances as well as their perception of it ;
(b) To dedicate a specific and proper space to the pedestrian ;
(c) To unify the perception of the roadway ;
(d) To form a protected access to the buildings ;
(e) To filter natural light and to refresh the atmosphere ;
(f) To produce a "stage effect" regarding the street, its uses and its buildings.

[Configurations]

-A- Plant an alignment of trees, with thin, high and clear trunks, letting the sky appearing ;
-B- Choose a small interval between the tree trunks (16-26 ft.) ;
-C- Prune the trees so that they reach half of the buildings height ;
-D- Make the street long and rectilinear or very short ;
-E- Compose profile of the street symmetric with not too large sidewalks ;
-F- Build an only roadway, large enough to host the car traffic, parking and possibly a bus lane.

	Attention required/ **innatention allowed**	mixed uses / **separated uses**		Sober and spatious atmosphere / Abounding atmosphere		
INTENTIONS / CONFIGURATIONS	**(a)** *To attenuate, for pedestrians and motorists, the potential dangers and nuisances as well as their perception of it*	**(b)** *To dedicate a specific and proper space to the pedestrian*	**(c)** *To unify the perception of the roadway*	**(d)** *To form a protected access to the buildings*	**(e)** *To filter natural light and to refresh the atmosphere*	**(f)** *To produce a "stage effect" regarding the street, its uses and its buildings*
-A- Plant an alignment of trees, with thin, high and clear trunks, letting the sky appearing	●	●	●	●	●	●
-B- Choose a small interval between the tree trunks (16-26 ft.)	●	●	●	●	●	●
-C- Prune the trees so that they reach half of the buildings height		●		●	●	●
-D- Make the street long and rectilinear or very short	●	●	●	○		●
-E- Compose the profile of the street symmetric with not too large sidewalks			●	●		●
-F- Build an only roadway, large enough to host the car traffic, parking and possibly a bus lane.	○		●	●	●	●

● = The configuration supports the intention, more or less strongly - ○ = The configuration is contrary to the intention

One street for three worlds

[Context]

A "curtained street" plays an important and strategic role into the urban network of a city. Its section is about 20m large, bounded by high buildingss creating a well formed U-section. The "curtained street" is quite long and high, and its buildings may be settled in an orderly maner. But this model can also happens in opposite situations, when the building frontage may be very discontinuous and the street very short..

Pedestrians and cars are expected to use this street intensively. Hence the space that will be dedicated to each of them may be quite narrow. Nevertheless, transit and local traffic, access to buildings and public transportation, parking, shops and even markets should be able to find their place into the whole organisation of the curtained street.

[Problems]

A large roadway between high buildings

When a heavy traffic takes place in the middle of the street, pedestrians are naturally pushed back along the buildings, in narrow spaces. On the other side, high and massive buildings also makes the pedestrians step aside, instinctively, towards the centre of the section. Hence in sections that need to keep a limited width, it may be delicate not to "strangle" pedestrians flows between these two contradictory tendances.

Nuisance due to heavy traffic in a narrow U-section

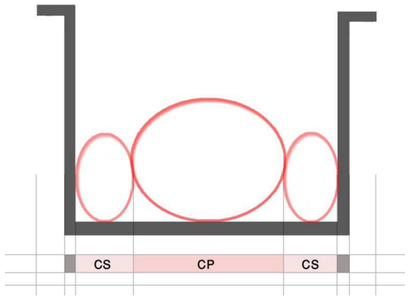
In a U-section, noise and air pollution tend to keep inside the volume of the street. Beside the climatic conditions and the importance of sources, these sections may be more easily polluted than others. It is another fact that nuisances are perceived more or less importantly according to the idea people have of their source. The width of the profile being limited, pedestrians move right beside the roadway and its nuisances may be taken more harmful than they actually are, as their sources can be directly identified.

Going home through an important street

A transit-oriented street is used intensely to go from point of the city to another. For the residents, on the contrary, the access to their parcel represents the last level in the hierarchy of paths that drive them from city to home. In highly circulated streets, there is therefore a qualitative "jump of scale" between these two functions that often put the pedestrian in a weak position.

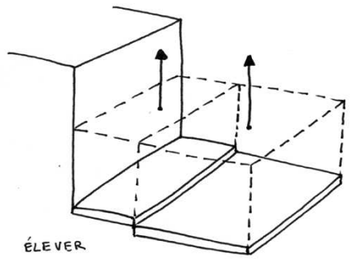
How then can we conceive a street capable of combining local uses with important traffic, transit circulation with home access, all this inside a relatively narrow section imposing proximity between all users and nuisance sources?

[Parti]



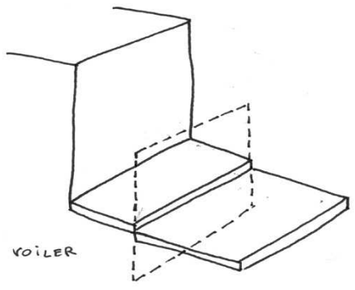
We decide to isolate the sidewalks from the roadway, so as to form 3 autonomous and distinct spaces. Two fine "curtains of trees" are disposed on the boarder of the sidewalks: they hide the lateral sight of those moving along the street.

The parti *of the curtained street can be summed up in 3 actions of conception applied successively to the* main streets *generic diagram:*

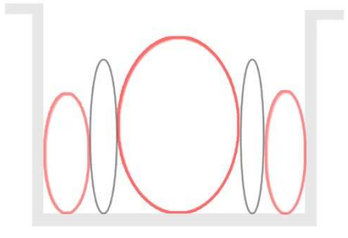


RAISING : Our street being limited in width, its constitutive spaces can only develop in the vertical and longitudinal dimensions. Moreover, if lateral sight is hidden, the user attention is raised up. The rows of trees reach half of the building height and raise both the sidewalks spaces and the roadway space. They constitute an intermediate level of scale between the users and the massive buildings. This is how we have:

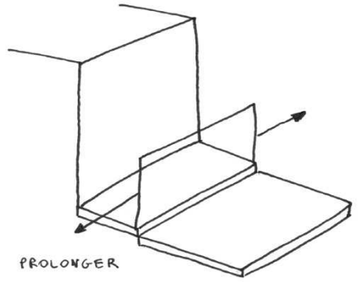
* One primary field in the middle of the street, dedicated to vehicles of all sorts, its focal point being raised up.
* Two sidewalks in position of lateral secondary field, their perspective being also raised up by the springing of the tree trunks.

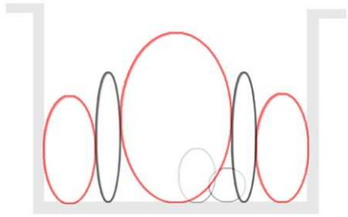


VEILING : A fine row of trees planted at a small interval veils the roadway from the sidewalk and conversely, by a "curtain effect". Nuisances and potential dangers are hidden. They are therefore at the same time less easily perceptible and slightly diminished. The street is then composed of 3 distinct microcosms, all vertically oriented:



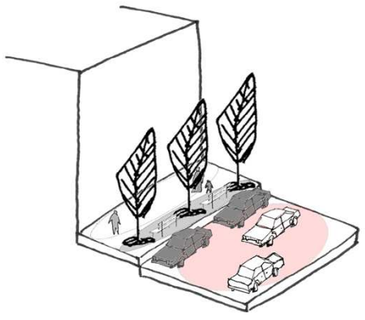
* Two curtains of trees creating fine inter-fields that visually separate the lateral sidewalks from the central roadway without occupying too much space.
* The primary field hosts an important number of vehicles that are allowed to care for their proper way.
* The secondary field users may forget a little bit the main roadway and its potential nuisances.





CONTINUING : The roadway and sideway spaces being relatively high, they will only keep their quality if they are wether continued on several sections of the same street or, on the contrary, limited to a very short section. In both cases the whole street is endowed with similar qualities.

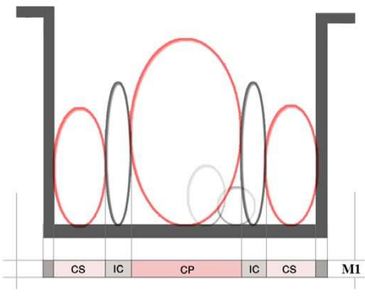
* The global field of the street is perceptible through the buildings façades if they are two times higher than the curtains of trees constituting the inter-fields.
* The roadway is the primary field of the street : it is set free from part of its lateral constraints. It is well formed and authorizes a certain laxity from its users, whose speed completely hides the secondary field.
* These qualities are also to be found in the sidewalks constituting the secondary fields: even if the speed of pedestrians is much lower, those walking in straight lines only perceive a well-formed corridor, whereas other uses may have a more extended lateral view on the street.



The curtained street is thus formed of three raised up and longitudinal spaces. These spaces are both limiting and ignoring each other. The clarity of the street form relies upon the simplicity of the way spaces are divided: one primary way bounded by two banks that are raised up and evolving according to their proper nature.

We can now draw the specific diagram of the curtained street and consider its operating modes.

[Operating modes]

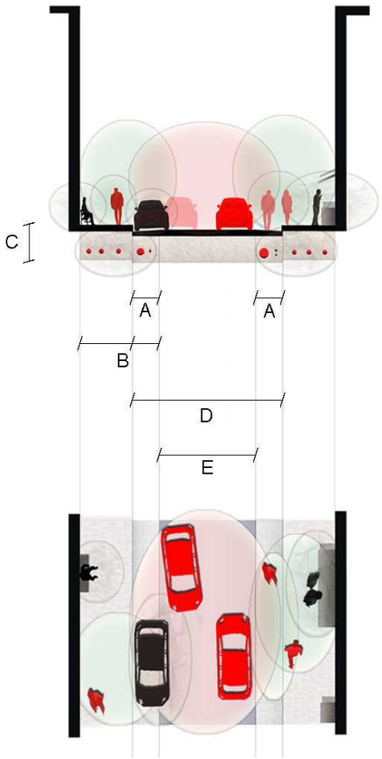


[M1] The curtained street works in one and only way: whathever the intensity of pedestrians and vehicles traffic, whatever the occupation of sidewalks by shops stands, markets or other installations, the curtained street will always be formed by 3 microcosms that are nearly independent of each other, structured and reinforced by the general perspective and the two curtains of trees.

CE = Center - CP = Primary Field - CS = Secondary Field - IC = Inter-Field - CC = Counter-Field - Ou = Opening

THE AVAILABLE STREET

Laboratoire Régional de l'Ouest Parisen - Laboratoire Central des Ponts et Chaussées - *New Road Construction Concepts* - 2007 September the 9th



[Intentions]

(a) To set technical networks more accessible ;
(b) To organize two pedestrian use modes of the sidewalks and their extensions ;
(c) To allow only temporary stops, at any time and without interrupting the traffic ;
(d) To widen the pedestrian space without showing it too much to the motorists ;
(e) To reduce vehicles speed ;
(f) To encourage the inhabitants to appropriate the public space.

[Configurations]

-A- To create an overlapping band, located between the sidewalk and the roadway, at the level of the roadway ;
-B- To give to the sidewalk a width of at least twice the overlapping bandwidth ;
-C- To cover the entire surface (sidewalk + gutter) with the same clear modular material ;
-D- To shrink the space (roadway + gutter) to a minimum width of about 8.5 m ;
-E- To cover the roadway with a black-coated material contrasting with the sidewalks and gutters surfaces.

	Adaptable / permanent		Long time parking / Short time parking	Soft modes / Motorised modes		Sober atmosphere / Abounding atmosphere
INTENTIONS / CONFIGURATIONS	(a) *To set technical networks more accessible*	(b) *To organize two pedestrian use modes of the sidewalks and their extensions*	(c) *To allow only temporary stops, at any time and without interrupting the traffic*	(d) *To widen the pedestrian space without showing it too much to the motorists*	(e) *To reduce vehicles speed*	(f) *To encourage the inhabitants to appropriate the public space*
-A- To create an overlapping band, located between the sidewalk and the roadway, at the level of the roadway	●	●	•	●	●	•
-B- To give to the sidewalk a width of at least twice the overlapping bandwidth		●	•	●	•	●
-C- To cover the entire surface (sidewalk + gutter) with the same clear modular material	●	•	•	•	•	
-D- To shrink the space (roadway + gutter) to a minimum width of about 8.5 m.	●	•	●	●	●	•
-E- To cover the roadway with a black-coated material contrasting with the sidewalks and gutters surfaces.	○	●	●	○	●	•

● = The configuration supports the intention, more or less strongly - ○ = The configuration is contrary to the intention

A street in which central and lateral ways can find a small extension according to circumstances

[Context]

We consider building a street section of an average width, located into a dense urban fabric, linked to public transports and dedicated to quite a local scale of traffic. The pedestrian activity is or will be large, and the buildings façades relatively welcoming.

It is to be taken into account that pedestrians and cars uses will vary a lot over time, at rush hours for example. That brings us to seek for a rather flexible arrangement, able to welcome several operating modes.

[Problems]

Anarchical organisation of underground networks

The different types of underground technical networks (water, gas, electricity, telephone, etc.) are implanted on a case-by-case basis, in a separate way and sometimes under the entire width of the street. Usually it's quite difficult to reach them, or just to locate them. Thus, maintenance works or modifications of the networks take a certain time and often block the circulation. The successive "rubber patches" are not really of a nice effect, the paving often being weaken by the loss of the tight character of its coating.

Variability of uses and permanence of the design

A street is a living space, which has its proper rhythm, linked for example to the home-job run, of which rush hours step into precise moments of the day. However, a street is also an a concrete arrangement designed on paper but carried out "in hard", the configurations of which remain stable for many years. Thus the variation of use modes will rely first on administrative regulations or cultural habits. But it may also be supported by spatial and physical configurations that are able to modulate the street space perception.

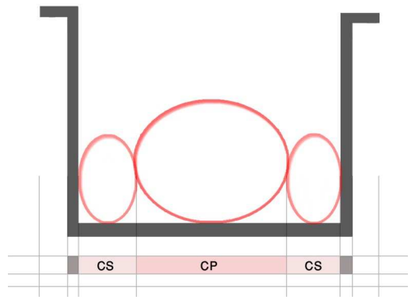
Public space appropriation and street life

If pedestrians could occupy a part of the raodway in case of high frequentation, shops and private individuals might be able, on the other side of the sidewalk, to appropriate the spaces running along the facades so as to make good use of them. Such a mechanism may easier local life as this phenomenon depends mostly on the propensity of inhabitants to take possession of the street as a true place of social life.

The gutter"s temporary uses

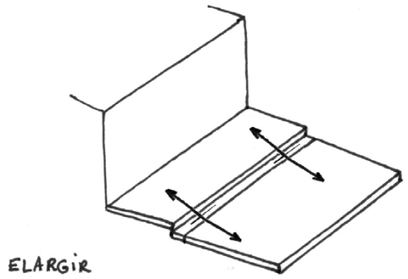
The water collection gutter is the only technical network occupying a part of the street surface.
It is also the temporary gathering place of urban rubbish and only runs out waters when it rains or when the street is cleaned out. If it were widened, it could very well form a space large enough to allow temporary parking or temporary uses bu pedestrians. But this would imply to find a way of preventing long time parking and, more generally, long time appropriation of that place so that it remains available.

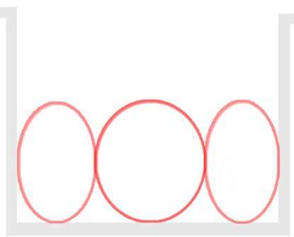
[Parti]



We decide to define the gutter for rainwaters collection as a central element of the street composition, capable of bringing together and organizing the underneath technical networks and able, at the same time, to articulate pedestrian flows, car traffic and temporary parking at the street surface.

This parti *can be declined according to 3 actions of conception successively applied to the generic diagram of the* main street *:*

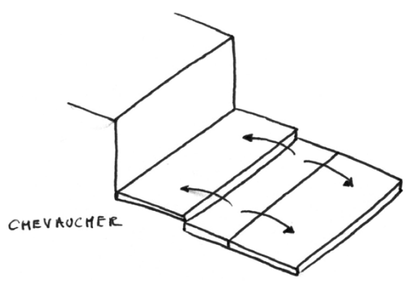


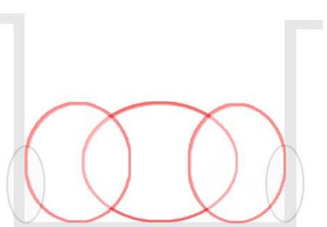


WIDENING: Usual sidewalks configurations are widened. In the same way, the enlarged gutter space takes an important part of the roadway which is thus reduced to its minimum. We get:

* A roadway as primary field which is reduced to its simplest measure in order to welcome a two-way traffic lane, and two temporary parking lanes.
* Two sidewalks as secondary fields dedicated to pedestrians and constituting enlarged spaces that balance the weight of "soft modes" and motorized modes.

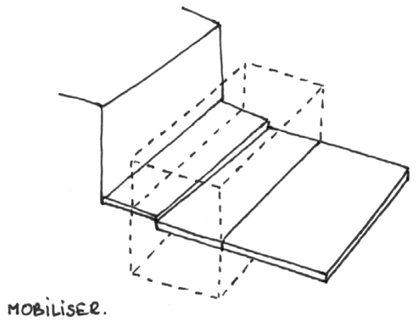
Sidewalks are not anymore simple edges of the roadway but form well defined spaces.

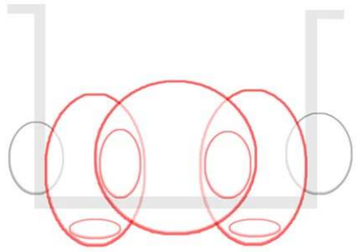




OVERLAPPING: The widened gutter is configured in order to form a large encroachment of the sidewalk on the roadway, creating an overlapping inter-field between the central way and the lateral ways. Similarly, local activities linked to the buildings can overflow on the sidewalk:

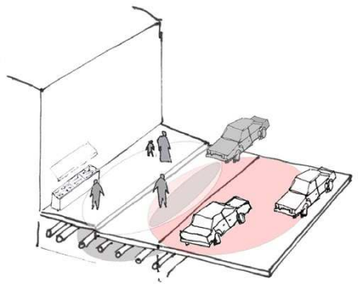
* A small roadway as primary field.
* Enlarged sidewalks as secondary fields that receive from one side the shop stands, benches and frontage uses, and from the other side the overlapping of the roadway integrating the widened gutter
* An inter-field giving to pedestrians the possibility of using a part of the roadway space.
* A counter-field articulating street activities to the buildings life.





MOBILIZING : The widened gutter covers up the underground networks with removable paving stones. In surface, it is also dedicated to the temporary uses of the street which is now composed of 5 types of spaces :

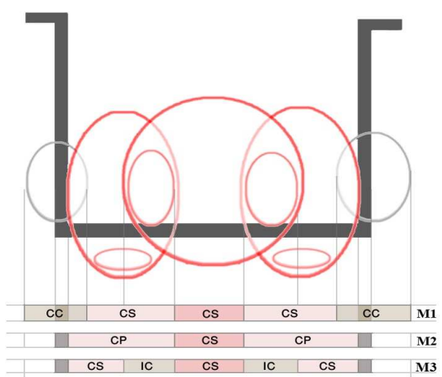
* Inter-fields welcoming temporary stops, pedestrians overtaking, water drainage etc.
* Secondary fields, under the sidewalks and their widened gutters, gather all networks into a reachable place.
* The central roadway is reserved for traffic and uses the inter-fields to stock its temporary parkings
* The sidewalks welcome the pedestrians that can appropriate the inter-fields.
* The counter-fields restore the equilibrium of the sidewalks by developing their part which is in contact with the buildings frontages: stands, terraces and elements of private life going up to the public space.



The available street is flexible, depending on the use that will prevail by taking advantage of the particularities of very changing circumstances. It reorganizes underground networks in order to set a free zone: it must stay available, temporarily, in order to provide an additional space to users that may need some.

We can now form the specific diagram of the available street *and consider its operating modes.*

[Operating modes]



[M1] : At the most animated moments, shop stands and residents take one part of the sidewalks; pedestrians encroach upon the roadway and appropriate the inter-fields, cars keep running slowly.

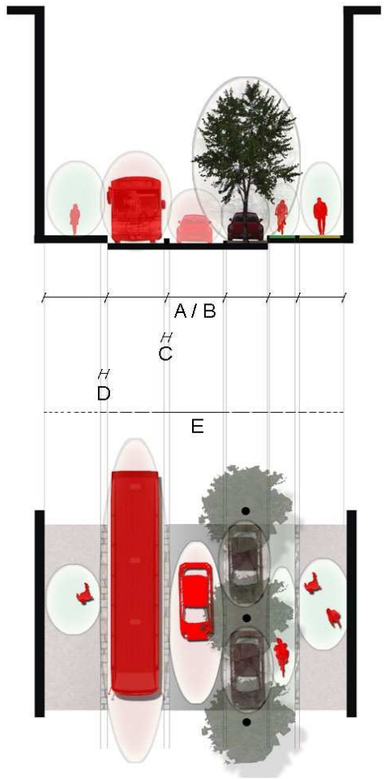
[M2] : When pedestrians traffic is important, the sidewalks are extended to the inter-fields that serve in particular to fast and hurried walkers, cyclists, etc.

[M3] : In case of strong traffic, the inter-fields are used as spaces for temporary parking in order to maintain the traffic fluidity.

CE = Center - CP = Primary Field - CS = Secondary Field - IC = Inter-Field - CC = Counter-Field - Ou = Opening

THE MULTIFUNCTIONAL STREET

Laboratoire Régional de l'Ouest Parisen - Laboratoire Central des Ponts et Chaussées - *New Road Construction Concepts* - 2007 September the 9th



[Intentions]

(a) To give more space and more safety to "soft modes" in order to balance transport modes ;
(b) To optimize transport flows according to their speed ;
(c) To make clear the demarcations of each space and relationships maintained with the adjoining spaces, and allow users to pay a minimum attention ;
(d) To provide a modest and organized character to the street ;
(e) To reduce the transversal disconnection effect.

[Configurations]

-A- Each modes of transport has a proper space physically delimited or indicated ;
-B- Each surface dedicated to one transport mode is proportioned for the uses it has to welcome ;
-C- Between the car way and the space reserved for public transports, insert a border broad enough to be used as a refuge (min 50 cm);
-D- Along the public transports proper sites, insert a sidewalk slightly raised (in case of a separated cyclist track) ;
-E- Place the fast ways in the centre and progressively, the slowest ones towards the edges of the street ;
-F- Set neat crossings, visible from far away.

	"Soft modes" / Motorised modes	Stay uses / Flows	Attention required / Inattention allowed	Sober atmosphere / Abounding atmosphere	Separated uses / Mixed uses
INTENTIONS / CONFIGURATIONS	(a) *To give more space and more safety to "soft modes" in order to balance transport modes*	(b) *To optimize transport flows according to their speed*	(c) *To make clear the demarcations of each space and relationships maintained with the adjoining spaces*	(d) *To provide a modest and organized character to the street*	(e) *To reduce the transversal disconnection effect*
-A- Each modes of transport has a proper space physically delimited or indicated	●	●	●	●	○
-B- Each surface dedicated to one transport mode is proportioned for the uses it has to welcome	●	●	•	•	•
-C- Between the car way and the space reserved for public transports, insert a border broad enough to be used as a refuge (min 50 cm)	•		●	•	●
-D- Place the fast ways in the centre and progressively, the slowest ones towards the edges of the street	•		●	●	•
-E- Set neat crossings, visible from far away	•	●	•	•	•

● = The configuration supports the intention, more or less strongly - ○ = The configuration is contrary to the intention

[Context]

To the urban scale, this street represents a major axis for traffic. The section has a width of about twenty meters. It is quite long and crossed by only few intersections. It leads many traffic flows between two circulation nodes.

This section of street hasn't any particular architectural interest. Few local activities take place along it, and its use is dominated by heavy car traffic. In addition, other itineraries are conceivable, which could deal with a considerable part of cars flow.

The principle of the multifunctional street *consists precisely to define the place given to each transport mode. The balance of functions is decided and then fixed by physical and spatial arrangements. These ones reduce the car importance in order to offer more space to cyclists, public transports and other "soft modes" that usually have difficulties to manage a space for their own in front of a heavy traffic.*

[Problems]

Mixing the modes of transport in heavy traffic conditions

An important car circulation bothers and is bothered by the traffic of other modes of transport that take the same way but with different rhythms and speed. Most of the time, "soft modes" find themselves in a situation of weakness.

Cohabitation of several modes in case of heavy traffic raises a problem of safety, of speeds coordination and of heterogeneous trajectories that are disturbing the overall street fluidity. Balance in the division of spaces is often hard to conceive.

To each mode of transport its proper space

Multifunctionality

It is easy to lay out a street proposing 2 or 3 types of transport spaces, using for example the common configuration of the "roadway / sidewalks" street. However, supporting the presence of a higher diversity of traffics while physically separating them from each others is more complex a task. Indeed, separating the modes costs a lot of space and the juxtaposition of longitudinal lines tend to create an effect of crosswise disconnection.

The division of modes by spatial and physical arrangements

According to the context and beyond a certain circulation threshold, it becomes impossible to rely on a mutual courtesy of people and on space legibility in order to regulate the various uses. Even beyond a higher threshold, road signs, slight markings and explicit regulations are not sufficient either. It belongs therefore to physical and spatial arrangements to allow or to prevent certain behaviours.

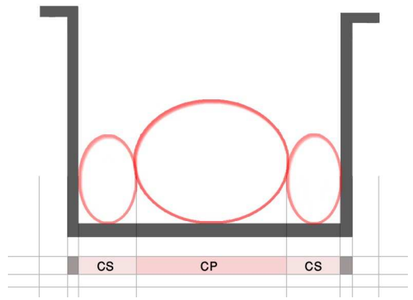
Difficulties of "hard" solutions

To settle physical limits between the street spaces tends to suppress the social self-regulation between the different users (diligence, politeness…) while rigidifying the street functionning. Moving apart and juxtaposing the flows make it possible for everyone to freely adjust speed and rhythm of motion. However the weakest modes are forced to follow the trajectory of the heaviest ones, which of course doesn't correspond to their natural trajectory.

Safety and risk perception

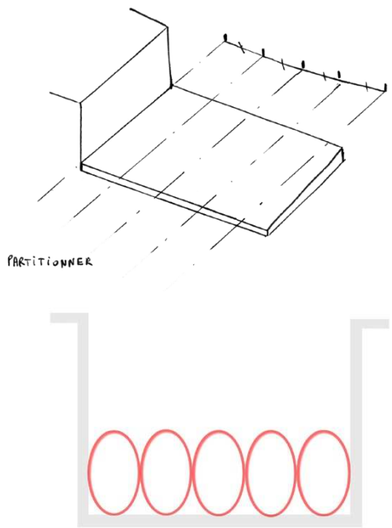
Arranements that protect users from each others increase the perception of safety. Behaviours change accordingly: risks taking, acceleration and diminution of diligence. At the end, the "real" safety may have decreased.

[Parti]



We decide to separate the street profile into several subspaces, each one being proportionated to a special mode of transport and relatively independant from the others.

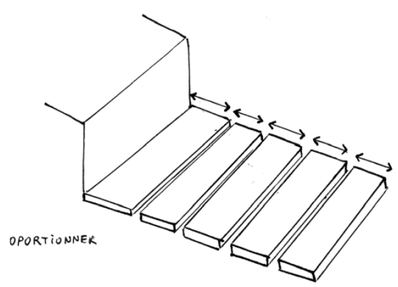
This parti *can be declined according to 3 actions of conception successively applied to the generic diagram of the* main street :

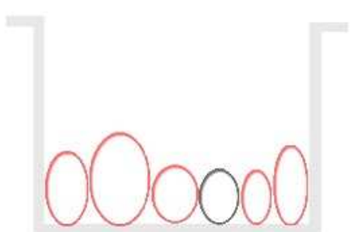


SEPARATING : The various urban modes of transport are separated according to speed, types of vehicle, trip lenght... forming several longitudinal subspaces allotted to each of these flows:

***** The global field of the street looses its initial ternary and hierarchal composition (one way, two edges): it is therefore less perceptible and plays a minor role into users behaviour.

***** Several limited lanes welcome specific transportation modes. They are in such a number and similarity that they are neither real primary fields nor truly secondary fields.



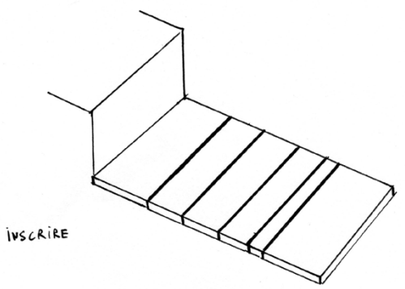


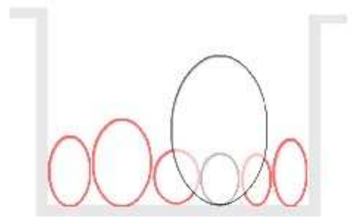
PROPORTIONING : Each space has its width adjusted according to the size and speed of its users, thus creating :

***** Several primary fields the largest being positioned toward the central region of the profile; but their "primary" character remains quite weak.

***** Secondary fields with lower widths (pedestrians, cyclists…) rather positioned on the lateral parts of the profile; but their "secondary" character also remains quite non apparent.

***** Some potential inter-fields of low width, formed by edges, by lines of furniture, trees alignements and cars parking.



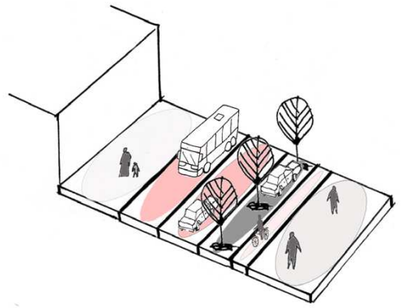


MARKING : Spaces are separated by signs and physical limits that are adjusted according to their position into the profile. Despite the functional aspects of this model, some subtleties appear at the scale of each lane :

***** Inter-fields can be rather perceived as borders of the ways than as proper spaces.

***** The primary and secondary fields are distributed according to their size and speed, clearly defined and readable. Users are mainly concerned by what takes place at the front and the back of their trajectories.

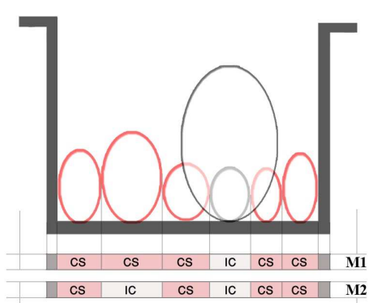
***** In some cases, certain slow or unused lanes can temporary operate as inter-fields by inserting a distance between sidewalks and the roadway for example, or between a high speed lane and an access lane...



The multifunctional street is resolutely turned to its transit and flows functions rather than towards idle uses and local life. It inevitably makes a breakup between each bank of the street, but this phenomenon is decreased by a wise repartition of the various lanes into the width of the profile as well as by the delicacy of borders treatment.

We can now form the specific diagram of the multifunctional street, *and consider its operating modes*

[Operating modes]



[M1] When all traffics are heavy, every mode follows its line at its own rhythm, without too much carrying about others. The street mainly functions in a longitudinal way, except at crossroads.

[M2] In the case of slow ways that may be intercalated between faster ways, or in the case of poorly occupied lanes, as bus lanes may sometimes appear, these may serve as inter-fields for the ways they separate.

CE = Center - CP = Primary Field - CS = Secondary Field - IC = Inter-Field - CC = Counter-Field - Ou = Opening

Synopsis of design principles

1: Polyvalence and parsimony of means

** A street is the organisation and the disposition of whole set of arrangements. If each of these arrangements can take part into the constitutive relations of the site as object, as space and as device, then all those arrangements are polyvalent and closely interdependent.*

** It is only needed then, to act on some of those arrangements, taken as spaces, as objects or as devices, to modify the global functioning of a street, its organisation.*

** This conducts to act with parsimony and polyvalence: small, simple and well-understood arrangements may generate great effects.*

2: Relations of politeness and politics

**If each use of a street is likely to be done by several users, to generate several practices and to solicit several functions of the street arrangements, then everybody might potentially understand every uses of the street.*

**It is then possible to affirm that into the street, the collective use of space is first a political interaction, in other words, that everyone can and must know how to make use of this public good and how to share it with other users.*

**The first solutions to uses conflicts may then be done at the level of individuals and their relations, at the level of rules and their respect, that is to say between intelligent persons. The concrete arrangements only come only after, supporting the modes of uses which have been politically decided.*

3: Plurality and polymorphism of urban models

** It is a significant number of designers which have to transform the configuration of a street, each one identifying the purposes and the performances related to his field of action, each one involving knowledges, ideas and models that are adapted to his own point of view.*

** Admitting that sooner or later, each of these trades may have to act and interact more or mess directly on and with every urban fields, each designer might come to confront his proper models to all other urban knowledges.*

** From that moment, it is possible to imagine some polymorphic models (of which the properties are interesting for several consultants) that may support the conception of some street forms according to various points of view and which may be taken successively by several designers without necessarily being distorted.*

Principe 4: Utility of a design is measured in reference to some models

** One appreciates a street's utility by differences: differences related to previous situations or in comparison to some others streets manifesting similar or opposite qualities.*

** Those differences are appreciated in reference to some contrasting ideas, some implicit models which tie in a reliable fashion certain configurations and certain intentions.*

** Then, when the street configurations are considered to misfit the realisation of some intentions, when the street or the planned street is considered "useless" referring to a certain model, two options are available:*
- It might be decided to improve the existing configurations in order to make they conform to their model, keeping in mind the evolution of circumstances, uses and context.
- It might be decided to change the street model of reference, choosing for a different mode of organisation which will better respond to the expressed intentions and to the context's constraints.

5: Relevance of a design is measured in reference to some models

** Owners and users' intentions being heterogeneous and numerous, it is impossible to "deduce" from them an optimal solution for the street arrangement: several design paths or "parties" are then possible.*

** The parti of a street design is a choice of a certain way to answer these intentions, a way which is different from other possible ways, the choice of a certain principle of organisation. But the definition of the street form is not yet its configuration...*

** The elaboration of a street parti responding to certain intentions and the measure of the relevance of that parti in relation to those intentions is made in reference to some models of street. Those models may bring the available observations, experience's comebacks and current argumentations.*

Principe 6: Quality of a design is measured in reference to some models

** After having imagined a form or a parti responding to the owners or users' intentions, the master builder takes this imagined form as a starting point for realization: a starting point from which he evolves his work toward the concrete configurations: street arrangements, drawings, writings, sketches…*

**He uses artistic and technical know-how consisting in some patterns of "ways of doing things" that is to say, way to evolve from some formal parti to concrete configurations.*

** This knowledge is organised by model of arrangement, which are used as references to measure the quality of each realisation taken "into its kind"*

7: Starting from the *shared* common language to specify a *shareable* urbanistic language

** In the current vocabulary, there are already some global design concepts that are shared by everyone: the street, the avenue, the sidewalk, the arcade, etc.*

** Those concepts can be taken partially, or inversely globally, by joining the different viewpoints that are useful to describe them from an urbanistic viewpoint: {uses, forms and arrangements}, that is also to say {conception, realisation and utilisation}.*

** Let us call all those "global" urban types as "urbanistic design kinds". It is possible to form, from those "kinds", a multitude of design models, more accurate in their form and in their references to certain mode of uses and in their relying on specific arrangements.*

8: Producing contextual "design models" rather than "applicable solutions"

** When a cooperative design process is planned, the possibility of working with intelligible common supports is determinant. However, the conception task, even cooperative, remains an activity relying on faculties of imagination of new ideas. In order to be useful for the design, expected supports shall have a relatively "open" character, involving inductive and analogical reasoning, the generation of new possibilities rather than the restriction of choices.*

** On the other hand, each form of knowledge, if it is to be experienced and tested, must formulate refutable affirmations. Each model is then necessarily "closed" and involves deduction and restriction of the domain of possibilities: each model is thus, in a certain sense, the application to a specific case of some more general rules.*

** Those two "open" and "close" aspects of the urbanistic modelling are articulated in the formalization of the "parti" which described as a series of successive transformations applied to a initial fields diagram (good support for conception) and by the "intentions / configurations table" which describes the nesting of patterns of uses and patterns of concrete arrangements within a certain context (good support to refute parts of the models).*

9 : Modelling the process of delibaration

** The principle affirming that "each design model is not more adequate than another, but constitutes only a way of organising a street among many others" is very hard to follow when decision makers are confronted to some quite complex situations. The two most common avoiding strategies then consist either in using multi criteria statistic tools or in choosing a solution responding to some moral value (environment, economy, aesthetic…).*

** Nevertheless, it is possible to organise the design models' division in such way that each of them may join a pattern of information that can is "deliberable": it suffices, for that, to distinguish what is depending of the design and what is not (definition of the* problems*), to insert the notion of '*intention *into the transition from problems toward the configurations and, finally, to only consider a small and consistent number of each one of those "ingredients" to be able to articulate them within a same imaginable form (the parti).*

**Thus each design model may be presented as a process of transition from a context toward problems, from these problems toward intentions, and finally from these intentions toward the configurations of de design, the parti being, throughout the whole of the process, a synthetic form always available to imagination and reasoning of that model of deliberation which we may formalize as such:*

{Contexts – Problems – {Parti} – Intentions – Configurations}

10: Three utilisation levels of the street: physical, perceptive and cognitive

** Three levels of utilisation, apprehension and reception of a street may be distinguished, those level being physical, perceptive and cognitive.*

** The urban design action consist in transforming physical objects and devices in order to sustain a certain form of the street organisation of uses and functions by some physical, perceptive and cognitive means.*

** In a street any element is susceptible to be apprehended at a physical level as a potential*

obstruction, at a perceptive level as a kind of delimitation and, last at a cognitive level as a sort of message informing users on the specific functioning of the street.

11: Three levels of conception of a street: plotting, composition and distribution

** One may distinguish three levels of conception a street design that correspond to plotting, composition, and distribution. Those levels refer to different categories of formal properties:*

- Longitudinal and topological properties for the plotting,
- Transversal and geometrical properties for the composition,
- Vertical and arithmetic properties for the distribution,

** Those formal properties refer directly to some uses characterizing the street, to some functions that are essential in all circumstances:*
- The transport uses, the servicing and the city orientation for plotting;
- Activities welcoming, their repartition and the lots delimitations for composition;
- The street network connections and the definition of central elements for the distribution.

** Those formal properties even refer directly to the different steps of realisation: plotting, composition and distribution are steps that can be done successively and relatively independently to draw a sketch, write a program, evaluate the costs of an operation or built the arrangements themselves.*

12: Three levels of *realisation* of a street: solids, fluids and voids

**One may distinguish three levels of realisation of a street that correspond to their existence as solids, as fluids, both natural and artificial, and finally as voids:*

** Those levels of realisation refer to distinct time scale:*

- The level of voids is the most perennial; these are the forms that last the most;
- The level of the fluids is in an intermediary scale of time, relatively perennial;
- The level of the solids is by definition the one that is going to be the first to disappear.

** The structure of an arrangement is consequently composite: from a qualitative point of view, the voids' forms and fluids' forms have as much effects than the forms of solids; one may then consider that those three realisation levels are all quite as much real and influent.*

13: Four relations of *cohabitation*: subordination, obedience, support, conversion

**4 modes of cohabitation can be distinguished: subordination (final relation), obedience (formal relation), support (efficient relation) and conversion (material relation).*

** Those modes of cohabitation are applicable from a street use to another, as when a cycling track obeys to the cars trajectory, for instance.*

** Those relations are even applicable from a level of utilisation to another, from the cognitive level to the perceptive level for instance, this within the same use or the same field, enabling a deeper understanding of the nature of its organisation, distinguishing among its elements the uses that are set by the physical level from those which are set by the perceptive and cognitive levels.*

14: Four relations of *integration*: assimilation, conformation, articulation, deformation

** 4 modes of integration can be distinguished: assimilation, conformation, articulation and deformation that describe the relationships between the various streets forms of organisation.*

** Those relations are applicable from a form to another form of the street, as when a street path is deformed by the form of a piazza.*

** Those relations are even applicable from one level of conception to another level, from the plotting one to the composition's one for instance, within a form or among several forms.*

15: Four relations of cooperation: pursuing, imitation, consolidation, recycling

** 4 cooperation relations can be distinguished between different design actions: pursuing, imitation, consolidation and recycling of one street arrangement by another one.*

** Those modes of cooperation are applicable from a design action to another, during the development of several successive phases of a project or in the accumulation of a small number of interdependent actions.*

** Those cooperation relations between professional disciplines are even applicable from a realisation level to another one: from the voids level to the solids level for example, allowing characterizing more accurately different ways of cooperating.*

16: Five elementary qualities: vitality, reliability, firmness, accessibility, sympathy

** We identify 5 elementary qualities that may help to describe what streets are expected to achieve: vitality, reliability, firmness, accessibility and sympathy. These qualities are transversal to the physical, perceptive and cognitive levels that we have previously identified: each of these5 qualities is present on each of these 3 levels.*

** These 5 qualities are essentially dependant one upon the others. They have two kinds of mutual relations:*

- *Relations of generation: vitality generates reliability which generates firmness which generates accessibility which generates sympathy which generates vitality...*
- *Relations of control: vitality controls firmness which controls sympathy which controls reliability which controls accessibility which controls vitality...*

** These 5 qualities both play a role of "ingredients" to create intentions and of "categories" to classify and organize those intentions.*

17: Five *elementary actions*: founding, orienting, defining, opening, partitioning

** We identify 5 elementary actions that describe the processes of formal differentiations of a street: founding, orienting, defining, opening and partitioning.*

** Those 5 operations apply to all urban fields taken together or individually, so much at the plotting level as at the composition level or as at the distribution level. These actions form a continuous sequence of successive operations that can be repeated and repeated, from scales to scales, from the public bench to the drawing of a city.*

** These 5 actions are also the archetypes or the categories of transformations that allow describing, within the formalization of a design model, the various steps of formation of its* parti.

18: Five elementary scales of realization: macroscopic, ordering, mesoscopic, disposition, microscopic

** We identify 5 elementary scales that allow designers to differentiate 5 orders of concrete configurations that may participate to the realization of a same parti, of a same set of mental forms:*

- The macroscopic *and* microscopic *scales first, which are the stable and reference scales that are taken into account without being concretely transformed.*

- The mesoscopic *scale which is central for the considered design and which may be precisely "tailored" according to the principles of organization that have been conceived for that street.*

- The ordering *and* disposition scales which *mostly* cover *the proportions and relations between "wholes" and "parts" and make the link between the macroscopic and the mesoscopic scales on one side and between the mesoscopic and the microscopic scales on the other side.*

** These 5 elementary scales are recursive operators that may be applied to each special field one considers in the design process, from the public bench to the configurations of the whole city: it is always possible to draw 5 scales adapted to the thing which is to be made.*

** These 5 scales of realization are transversal to the 3 levels of realization (voids, fluids and solids). They imply however distinct notions of quality (adequacy between the configurations and the parti of a design) according to the scale of the considered configurations: "convenience" for macroscopic and microscopic configurations, "conformity" for mesoscopic configurations and "harmony", "symmetry", "eurhythmy", "consonance", etc. for the configurations expressed at the disposition and ordering scales.*

Bibliography

- Alberti L. B., traduit par Caye P. et Choay F., *L'art d'édifier*, Seuil, Paris, 2004.
- Alexander Ch., « A city is not a tree », *in Architectural forum vol. 122, n°1 and 2*, 1965.
- Alexander Ch. *et al.*, *A Pattern Language*, Oxford University Press, New York, 1977.
- Alexander Ch., *The Timeless Way of Building*, Oxford University Press, New York, 1979.
- Alexander Ch. *et al.*, *A New Theory of Urban design*, Oxford University Press, New York, 1987.
- Alexander Ch., *The Nature of Order*, Center for Environmental Structure, 2004.
- Batseon G., *Steps to an ecology of mind*, University of Chicago Press, 1972.
- Bateson G., *Mind and Nature, a Necessary Unity,* Bantam, 1977.
- Bechmann R., *Villard de Honnecourt, la pensée technique au XIIIe siècle et sa communication*, éditions Picard, Paris, 1993.
- Boudon Ph., *Sur l'espace architectural*, essai d'épistémologie de l'architecture Dunod, 1971.
- Boudon Ph., *Introduction à l'architecturologie*, Dunod, Paris, 1992.
- Coomaraswamy A. K., *The transformation of nature in art*, Harvard University Press, 1934.
- Collectif, *La ville étalée en perspectives*, éditions Champ social, 2003.
- Barles S. et Guillerme A., « Histoire, statuts et administration de la voirie urbaine », *in Guide Pratique de la Voirie Urbaine vol. 1*, éditions RGRA, 1998.
- Borie A., Micheloni P., Pinon P., *Forme et déformation des objets architecturaux et urbains,* éditions Parenthèses, Marseille, 2006.
- Choay F., *La règle et le modèle*, Seuil, 1981.
- Gabora L., Diederik A., « Contextualizing concepts using a mathematical generalization of the quantum formalism », *Journal of Experimental and Theoretical Artificial Intelligence 14(4),* 2002.
- Gabora L., « Creative thought as a non-Darwinian evolutionary process », *Journal of Creative Behavior 39(4)*, 2005.
- Gallety J.-C., *Le concept de boulevard urbain*, CERTU, 1995.
- Gill E., *Art*, Bodley Head, 1934.
- Graham C., *Pattern, Two lectures given at the Fogg Museum of Art*, Harvard University, John Stevens, NewPort, 1938.
- Gourdon J-L, *La rue, essai sur l'économie de la forme urbaine*, éditions de l'Aube, 2001.
- Hanson N. R., *Patterns of Discovery, an inquiry into the concptual foundations of science*, Cambridge University Press, 1958.
- Jacobs J., « The kind of problem a city is », in *The Death and Life of Great Amercian Cities*, Vintage, 1992.
- Kauffman S. *At Home in the Universe,* Oxford University Press, 1995.
- Le Moigne Jean-Louis, *La modélisation des systèmes complexes*, Dunod, 1999.
- Le Moigne Jean-Louis, *Les épistémologies constructivistes*, PUF, 1995.
- Lynch K., *Good City Form*, MIT Press, Cambridge, 1981.
- Mangin D., *La ville franchisée*, éditions de La Villette, Paris, 2004.
- Marshall S., *Streets and Patterns,* Spon Press, London, 2005.
- Morin E., *La méthode vol.1 à 5*, Seuil, Paris, 1981-2003.
- Offner J.-M., « Réseaux et dynamiques urbaines : le filigrane trompeur des maillages techniques », *in* Paquot Thiery (ed.), *La ville et l'urbain, état des savoirs*, éditions la Découverte, 2000.

- Panerai Ph., Depaule J-C., Demorgon M., *Analyse Urbaine*, éditions Parenthèses, Marseilles, 1999.
- Panerai Ph., Castex J. et Depaule J.-C., 1997, *Formes urbaines, de l'îlot à la barre*, éditions Parenthèses, Marseille, 1997.
- Picon A., « La voirie cherche sa voie », *in L'architecture d'Aujourd'hui n° 355*, nov-déc 2004.
- Raynaud D., *Cinq essais sur l'architecture*, L'Harmattan, Paris, 2002.
- Raynaud D., *Architectures comparées : essai sur la dynamique des formes*, éditions Parenthèses, Marseille, 1998.
- Salingaros N. A., *Principles of Urban Structure*, Techne Press, Amsterdam, 2005.
- Salingaros N.A., *A theory of Architecture*, *Umbau-Verlag*, Solingen, 2006.
- Sieverts T., *Entre-ville, une lecture de la Zwischenstadt*, éditions Parenthèses, Marseille, 2001.
- STU, *La coordination technique, recommandations pour la coordination des VRD dans les opérations d'aménagement*, Editions du STU, 1987.
- Vitruve, traduit par Perrault Cl., *Les dix livres de l'architecture*, Mardaga, 1995.