

S.A.T. project: tetra-re-dimensioning of urban space.

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Abstract

Based upon a conceptual-statistical urban analysis regarding the critical situation found in modern cities/mega cities (saturation, pollution, degradation and lack of interrelation), a diagnosis was achieved posing the 'bi-dimensional use' of present urban settlements. As a response, the concept of an 'urban re-structure' became our hypothesis. We developed a Project that proposes the 'tetra-re-dimensioning (4D) of urban space'. To achieve this, we had to create and design a 'tool' (S.A.T.), that would, upon its implementation in cities, allow the following: decrease urban pollution standards; decrease the rate of urban accidents; lead to a decongestion of obstructed neuralgic areas; reduce the pace of urban life; promote optimisation of time; generate 'architectural mutations', breaking-up the present 'vertical-function' dependency; increase security standards in case of natural or manmade catastrophes, promote a wider range of options regarding access/evacuations means; transform existing means of transport; generate the increase of green public spaces; avoid wounds in the urban-grid; regenerate residual-urban spaces; use economical resources efficiently.

S.A.T. (Sistema Autónomo de Transporte - undergoing Patent registration) creates the first steps towards the 'breaking-up' of the 'static-way of use' in contemporary cities. It is an electric-private/public transport-system for people and/or freight. It works under different directions of movement such as horizontal, vertical and on a gradient. Its main characteristic derives from the possibility it has of connecting different spaces that are to be found, not under the same geometrical plane, but under different-direction axis (x, y and z), belonging to different planes of use. In this way, it would generate and define a 'tetra-dimensional' liveable space. The S.A.T. project is an innovation that could act in a catalytic way, towards the overall improvement in life-quality in present urban areas, drawing a trend towards 'sustainability'.

1 Present city-profile, urban crisis

In order to define our Project background we must place ourselves on a scale of megacities, such as Tokyo, New York, Seoul, Sao Paulo, Shangai, among others. The concept of mega-cities, which arose in the last period of the 20th century, involves several yet unsolved issues regarding our present and future life as citizens. The visible consequences that define the present situation that cities are submerged in were taken into account. Themes such as sound and visual contamination, pollution, increasing worldwide migrations towards cities, inadequate use of land, low proportions of inner-city green public spaces in metropolitan areas, saturation of means of transport, inflexibility of public-service systems or the lack of optimisation regarding time-lost periods generated by the unsystemic use and development of modern cities. Worldwide urban policy appears then, as a main significant factor on which to focus our attention in order to consolidate future sustainable urban settlements.

Statistics show urban populations expanding at a high rate (more than 6% annually), therefore the conformation of megacities is a main issue. Faced therefore with such a contrasting reality, we should immerse ourselves in the idea that we do not live in cities; cities make us live the way we do. There is a role-player problem, therefore, who is the actor and who plays the scenario? Have we become stunts in our own drama of life? Can we find common denominators in everyday life in present urban areas, without considering their geographical location? If this is so, how many of us arrive at work, to start a productive day and have already faced a one-hour drive? How many of us spend hours that transforms into days, on a highway, or stopped in a traffic jam? How many of us believe in achieving better quality-of-life standards? How many of us realize that the increase of inner-residual spaces leads to greater insecurity, more garbage-lots and increase social-rejection?

A conceptual reading of the developing process found in some of our contemporary metropolis shows a clear physical fragmentation, of continuous and discontinuous and a lack of compatibility between time and speed. We recognize the modern urban city as a multiplicity of fragments, which is distant from acting as a whole. We can qualify them as constantly spreading and dismembering, an addition of unconnected spaces.

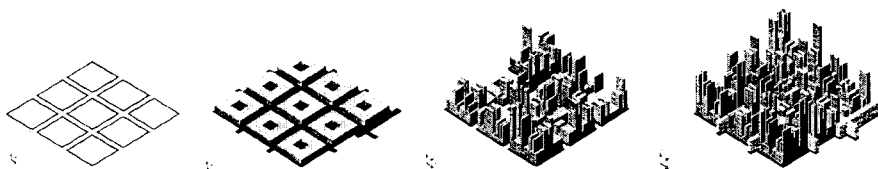


Figure 1: Urban densification and suffocation.

Does the human being play the main role in the life he lives in these cities? Nothing so obvious (in theory) and so improbable (in practice)... In early times man acted as the measurement unit and reference pattern in the development of

human settlements, concept now lost in our present cities and societies. We are no longer the rulers of our 'space'. We are not the ones to define our scenery (urban landscapes). Further more, we becomes mere 'players' in it (pre-established game with rules to be followed).

2 Urban-geometry (structure): Diagnosis

Several trends towards sustainability are, nowadays, taken into consideration. For instance, the promotion of compact-urban developments, creating therefore high-density urban realms avoiding travel distances (but increasing congestion and pollution). On the other hands, others that promote extended (sprawling) urban landscapes, responding to low-density settlements 'sustained' under a rigid road based structure (promoting long-travel distances as well as fragmentation, not encouraging the appearance of mixed-use areas). These main trends make contact in a common denominator (our Diagnosis) that could take their theoretical-basis to collapse. Therefore, by reading how cities are 'used' we are able to understand their structure (geometrical at first, and then organizations and uses).

If we analyse the role of urban space, we notice that it should constitute the supporting space of the city's activities, promoting its organization and structure. The fact of being undefined and not qualified makes it impossible (in spite of exceptions) for interactions to occur. We see then that the three-dimensionality of the city, in relation to its function, appears conceptually represented on only a two-dimensional sense (actions taking place only on the plan-level at 0.00 m, ground zero). Therefore, the city-structure is shaped by a single main public-plane, in charge of 'absorbing' every function generated in the city, although it is already saturated. The overlapping of these functions (ironically on a 'same plane') generates the chaotic situation found in present urban cores. We find mere connections, only 'materialized' in it. Realty makes us see the saturation level it possesses, and since we talk about absorption, we talk about saturation (i.e. measurements of traffic jam in the City of San Pablo show statistics such as: 292 km of traffic queues existing simultaneously in the city). Therefore, the "non-use" of this space for interaction, is what keeps this ground level in its chaotic state.

A City could be, functionally represented then, from a bi-dimensional scheme of uses (i.e. the Urban Code), which regulates and organizes urban structure-conformation (defining commercial areas, residential areas, public-green areas, among others). Therefore, we pose as our Diagnosis then, that cities work as entities deriving from a conceptual-construction in 2D. Why make such a statement? Given the fact that spaces are being defined by areas.



Figure 2: Urban code, conceptual progression from 2D to 3D.

This implies two things, first that spaces lose representation in one of their dimensions (taking what is conceptually attached to them) and in the second place that breakdowns occur, due to the limited flexibility they have to respond to each element that requires a 'piece of it' to develop. Therefore, fragmentation appears. For instance, the existence of a continuous-grid ruling this space, generated by vehicular circulation, affects the development of human activity, subjected to implicit laws of modern human-slavery vs. vehicle domain, constituting a sectorisation and atomisation of the use of space itself, in its real-three dimensional sense.

3 Hypothesis: Tetra-re-dimensioning of urban space

As a response to the Diagnosis obtained, the concept of an urban re-structure (producing mutations and changes under dimensional/functional features by altering spatial geometrical-conception and order) became our hypothesis. Understanding now the bi-dimensional (2D) functionality of existing cities and their consequences, we set up as a main objective: the tetra-re-dimensioning of urban space (4D). We believe that the close future will manifest itself based on these relationships, where the three dimensions (3D) won't be taken by default (tacit, expressed in vertical projections over a plan-structure) and the fourth dimension not taken theoretically but as a real one (TIME). Time, as a concept, shapes to what we understand nowadays as optimisation, taken as the measurement-unit, in the development of urban life. Thus, we pose the re-conformation of cities under the concept of a time-space integrated vision (this being our field as designers and our environment as citizens). It should be 'sustained' from the construction of Urban and Property Legislation Codes, making it possible to verify this concept in them, finding that at present this situation, definitely does not occur.

The tetra-re-dimensioning of urban space proposes then the 3D-use of our cities, optimised with time-factor. To achieve this; we had to create a 'tool': S.A.T. (a Project in itself) that upon its implementation in urban landscapes would allow this to happen, drawing a trend towards sustainability.

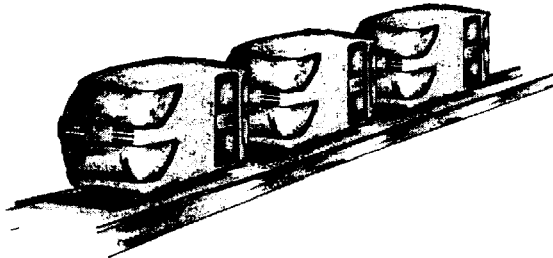


Figure 3: S.A.T. convoy.

S.A.T. Project, named under Sistema Autónomo de Transporte, (undergoing Patent Registration), creates the first steps towards the breaking-up with the bi-dimensional use of modern cities. The system has the special feature of working

under different directions of movement such as horizontal, vertical and on a gradient (three direction-axis that shape and limit urban space). It conforms a private public transportation system because of the possibility of interacting under different urban scales, from one smaller and private (given for instance in one building or in a building complex) to a larger one, involved in the conformation of urban environment and being public. S.A.T.'s main characteristic resides in connecting different spaces that are to be found not under the same geometrical plane (buses, undergrounds, cars, elevators, trains, etc), but under different direction axis (x, y, z), belonging to different planes-of-use. In this way, therefore, S.A.T. would generate and define a 'tetra-dimensional-4D' (3D + time), liveable space. It would develop mainly in an urban and metropolitan environment, in the 'open' or trespassing the 'solid', not depending on 'tops' or 'bottoms'. The tetra-dimension concept proposes, to sustain the 3D-use and function of existing cities, therefore its way of transportation in/through them. S.A.T. would therefore, generate an interrelation between different heights, levels and directions, opening a random game of multiple commuting-options. We would start travelling through space, in a continuous uninterrupted change of levels. To give 'man' the wings he lacks, redefining his pedestrian role, returning his freedom to move in his own cities.

The structure of the system is a three dimensional one, generating a volumetric virtual-grid of organization and uses, that becomes more important thanks to the possibilities of interaction with itself (on different scales) and with other means of transport. Geometrical relationships therefore are created, based on a 3D-virtual-grid; in charge of defining the way we use, no longer our base-plan (ground-zero); but our space. Why do we talk about three dimensions then? All means of transport, work under a two-dimension structure, in only one plane-of-use (either xy-plane, finding buses, undergrounds, cars, etc; or under the xz-plane, in which the elevator is situated, therefore to be considered a vertical mean of transport, always inscribed under the same co-planar axis). S.A.T. works under three directions of movement, being able to move horizontally, vertically and on a gradient, as an ordinary displacement. Therefore, we can say that interactions do appear between different planes xy, xz and yz.

The main characteristic resides in that conceptually S.A.T. allows us to connect different spaces-of-use that are to be found, not on one same plane-axis, but under different direction-axis belonging to different planes of use, in different geometrical planes. We therefore generate a 3D-network, where optimisation given by the latter would, consequently, generate and define a 4D-habitable space.

4 S.A.T Project (Sistema Autonomo de Transporte)

The system is designed for the transportation of people and/or freight (around 15-20 passengers per unit). It consists of unitary electric-vehicles that would move along two tracks. Its cabin maintains its horizontal-level position regardless of changes in track direction or even height-levels. It is powered by an electric engine (DC 220v), which is also used to reduce speed and to regenerate energy,

without producing noise or pollution by fuel-combustion. Its implementation will not create damaging electric fields. The tracks are modular structures in the form of suspended tubes, requiring minimum supports. On these, vehicles will run on tracks, made of materials that will absorb vibrations and provide adherence in every track section. The weather does not affect its deployment (rain, snow, wind, etc.). Several vehicles (units or in convoys) are able to circulate on one track, in its different displacement directions either in suspension or held in place. The duct is the space or path where the S.A.T runs, containing the guides. If the line develops outdoors, it will become virtual; but it will become blind inside a building (complemented by a security system against fire or accidents). The System is to be supervised by a Central Control Station, which may programme the route to be followed by convoys within intervals, on a same track, adding or withdrawing different vehicles from different routes. This will allow parked vehicles to be incorporated into the network as required (i.e. rush-hours). In case of accident, the CCS will be able to inject rescue or security forces (ambulances, fire-fighters, etc.) to the system for emergency attention, allowing free routes and permitting evacuation upon changes in directions generated by tracks by-passes. It will generate high-efficiency upon low speed.

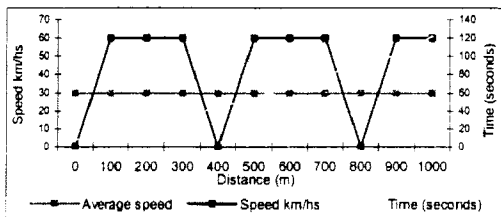


Figure 4: S.A.T. Performance

The geometrical structure of the system does not develop as a simple series of overlapping transportation planes. Our system is dynamic. It will, consequently, act as a catalytic tool towards the re-defining of urban space, generating mutations on architectural morphology and typologies. Interactions will appear between the urban grid (public) and buildings (private).

When we think of its implementation in the Cities, we can imagine a three-dimensional network, conformed by S.A.T. routes, the latter working on two tracks. We could find them externally attached to buildings, circulating internally, on underground levels, in trenches (entrenchment), at ground level, on a third or a fifth level or supported by columns, etc. It will never be evident on solid lateral or lower planes. Everything would be 'ethereal, virtual' and vehicles that roll on tracks, will appear unexpectedly due to their silent movement, only revealed by shadow projection.

Cities are 'organic' entities. Organic because they are in constant movement, in constant change and defined by a continuing mutating-structure. Progressive growth, densification, partial obstructions or inner-migration, generate these changes. Thus, S.A.T. is conceived as a system that could cover the necessities of

urban-transportation, and would possess the required versatility to absorb this changing behaviour.

S.A.T acts, as its name implies, as a system; therefore it responds to a systemic-structure. It is conformed by 'circuits', each of them acting as a sub-system working under a holistic view. They have the special feature of being 'open-circuits'. This means that they could change, expand or alter their original direction or destination, depending on passenger demand or requirements created upon changes in temporal periods given in the City's rhythm (i.e. rush-hours, accidents, natural or manmade catastrophes). This becomes possible owing to the existence of a nexus between circuits. These are known as dynamic-terminals, and would act as automated interconnection-gateways between open-circuits. From the existence of these 'nodes', it is that we define the system as a continuous and integrated circuit. In the latter, convoys could be detained or detoured, controlling frequencies between stations, quantity of passengers being transported or amount of vehicles within a convoy. Dynamic-terminals increase under a geometrical-progression, the functionality of the System. Here we will be able to recognize the tetra-dimension of public/urban spaces, due to versatility and optimisation. For instance, using a ground area of approximately 1000 square meters, creating three functioning-levels, we could manage 18 S.A.T. lines or routes (with their combinations), transporting around 2 million people per day, relating main and secondary routes, integrating the 18 lines among themselves (vertical liaisons).

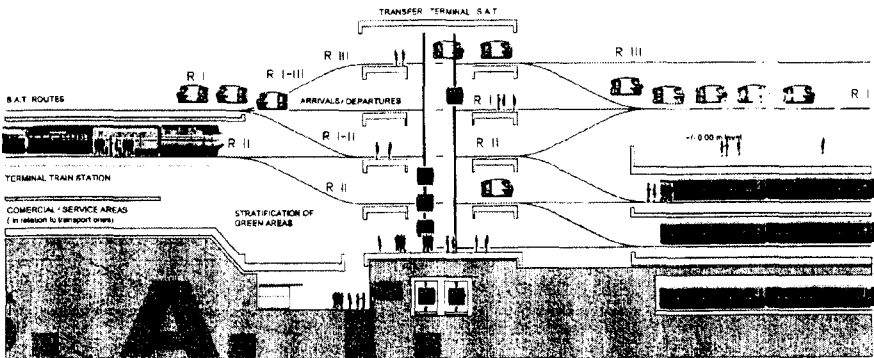


Figure 5: Dynamic terminal: systemic transformation of mass means of transport.

The systemic-structure is carried out by the interactions achieved by the different types of stops. They could be classified as passive, active or multiple stops. Passive stops correspond to common stops; passengers will use them as their chosen destination. Active stops, act as terminals, generating loops to close or derive a circuit, returning over it (in the same geometrical-plane axis). It will develop either below or above the former circuit lane; to be implemented in urban contexts where the lack of space generates the requirement of minor-scale terminals. Finally, when several circuits overlap or meet, ordinary stops become transfer centres, named as multiple-stops, where connexions are generated among

them, allowing passengers to interact between different circuits, activating the plurality of ways in which the network could be used. Here, passengers are the ones making connections or interactions between circuits (as a difference from the automated dynamic terminals); therefore, ramps, escalators and elevators will be part of this sub-system. It acts as a connection stop, evidently situated in dense areas. Its main objective is to avoid the congestion or saturation at ground zero, with movements generated by the freight transport or migration of people.

5 Heading towards a sustainable future

The development of the S.A.T. Project (taking it only as a new 'tool') appears to provide the answer to existing limitations found in present urban settlements. For instance, the increase in height-limits found in present buildings and the tendency to maintain this trend in the future, makes the elevator (its inner mean of transportation) likely to become obsolete to fulfil its requirements. Also, time lost periods are generated in our cities, due to non-effective transportation, seen at neuralgic-overcrowded centres at inner-cores, generating a decrease in economical benefits, non-optimisation of natural resources, risks to health, chaotic 'construction' of our urban environment, etc). The S.A.T. project also responds to an increase in transportation security standards, implemented under two main parameters: a private and a public one. In natural or manmade catastrophes and accidents, we find inexistent emergency pathways or even an inefficient evacuation network. Deficient connection is shown between public services (firemen-ambulances-policemen, etc) and private property (dwelling/office buildings, corporation-blocks or commercial centres). Inefficiency is caused by relying on daily urban transit flow (special reserved lanes, so called, but with no special features, depending on probable obstructed arteries, on contact with other means of transportation, on climate influence, etc.), far from guaranteeing a free-flow, connecting a specific spot to the corresponding emergency services (hospital / fire-department, etc). Other limitations correspond to the fact of not being able to find today public means of transport that could compete with the freedom and reliability (time, comfort, scale) provided by private transportation (car).

If S.A.T. is to be installed in cities, architectural mutations will definitely occur breaking up the vertical functioning-dependency that is present in today's city medullar-structure. A new freedom will be achieved by the promotion of social-equity by creating public-transport systems that will flow through the city nourishing public-spaces, green areas, and private sectors. Public routes will connect different buildings transporting either passengers or freight. These prolongations (pathways) will go from buildings towards public networks that do not act as simple virtual channels, but create spaces as habitable as the ones working on ordinary plan levels. These pathways and their morphology will become not only possible structural entities towards other buildings or to the urban environment, but create optional evacuation pathways, to encourage the migration of residents from a building to its neighbours, or to specific secure spots in the public network. Interrelations are generated between different zone

areas according to their densities, creating sectors of higher or lower compactness in its structure. Acting as a system, it transforms the existing means of transport towards not self-sufficient services, but inter-dependent (in relation to others) forcing them to act also under this systemic-organization. The transportation structure shows its complexity when trying to manage the overlapping functions generated in city-cores. Incompatibilities manifest themselves between public, private and freight-transportation.

Its implementation acts as a catalytic tool forcing unconnected isolated elements to plug-into the network (system). This is its methodology. Regulations determining this plugging-in and out, or inner-relations, responds to its dynamic and organic structure as expressed previously. S.A.T. promotes then, a tetra-dimensional structure, forcing the city to work based on in its three-dimensions, heading towards sustainability. The concept of intranet-internet appears as an example from which to explain the conformation of S.A.T. as a private-public transportation system. This interrelation will be generated between possible private-convoys, corresponding to industrial complexes or multinational enterprises (i.e. public, private or freight transportation), that will upon plugging-into the network, promote the opening of their domain over public realms. For instance, they could reach massive transport terminals or convey employees to parking lots in urban peripheries. Therefore, private convoys will travel through the city showing their distinctive logo. These relationships will contribute to economical benefits promoting cooperation between private and public sectors. This will show the dynamic configuration of circuits, switching from private to public domain, according to temporal periods. Dynamic terminals will determine the relationships and connections between public, semi-public, private and semi-private routes, each one maintaining its attributes, or interconnecting them. S.A.T., as a public-transportation system, will be in charge of creating new connections home/work or generate tours around the city, probably proposing new perspectives from which to recognize the urban scenery (aerial views, crossing lakes, or sea-shores, etc.). Due to its high safety standards (no possible physical contact with other means of transportation or invulnerability regarding climate phenomena) and its security measures, promotes social equity towards elderly or disabled passengers. Freight transportation, for instance in the City of Buenos Aires, is carried out when the city is asleep, having therefore a limited time to develop its duties. This is owing to the fact that it shares the same area as public and private transportation. Therefore, S.A.T. as a freight-transportation system will allow a continuous feeding-net, with no interruptions. Dangerous or fragile materials could be handled, without requiring human contact. The functional-stratification in levels (connecting underground with different aerial ones) could be appreciated, interacting with each other, but behaving individually at the same time.

We could define main and secondary routes within the network (without worrying about their direction of movement, horizontal, vertical or sloped). The main ones could develop, for instance, between airport and industrial areas or downtown areas, financial sectors, corporation settlements or cultural centres. We could find also 'alternative or secondary' routes, which due to transfer stops, could deliver us to residential areas, in fact, arriving even at our specific floor-

level (home). Therefore, in a few words, the airport (as an example) could be connected (plugged-in) to different attraction centres, without any interruption generated at ground zero, transforming it, consequently, into man's domain. If we focus on the interior of buildings, as it does not depend on cables, we do not have height limits. Several vehicles or convoys could simultaneously function under one same channel, promoting optimisation in travel-time-periods and flexibility of use. We could define also, resting-secondary channels, were several units could be waiting to be coupled to the system, when they are needed; or under the by-pass function, to detour high-speed units, in rush hours or emergencies.

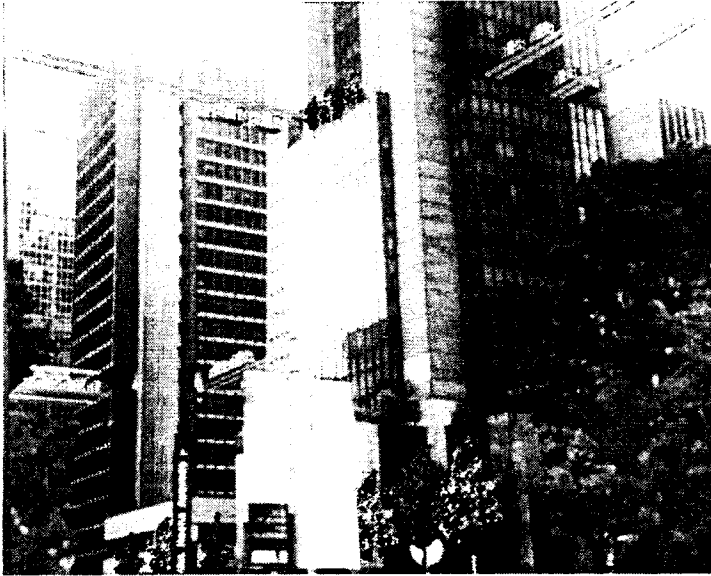


Figure 6: S.A.T. implementation in the city.

Spatial-relationships will become efficient, were upon concentration generate an abrupt growth, decreasing or absorbing urban sprawl, producing a re-organization and re-structuring of the obsolete concept of presently verticalism. Consequently, we discover a new-morphological-spatial conception, promoting an increase in height and based on a 3D-interrelation, in terms of space and fluidity, what we define as interactive-verticalism.

6 S.A.T.'s implementation in cities, will allow us to:

- Return man's pedestrian freedom in present-day saturated cities.
- Decrease life's rhythm, reducing the pace of urban life.
- Decrease urban pollution (such as air, visual, vibrations, sound contamination).
- Generate an increase in open green public spaces.
- Transform, all current means of ground transportation.
- Increase urban traffic average speed.

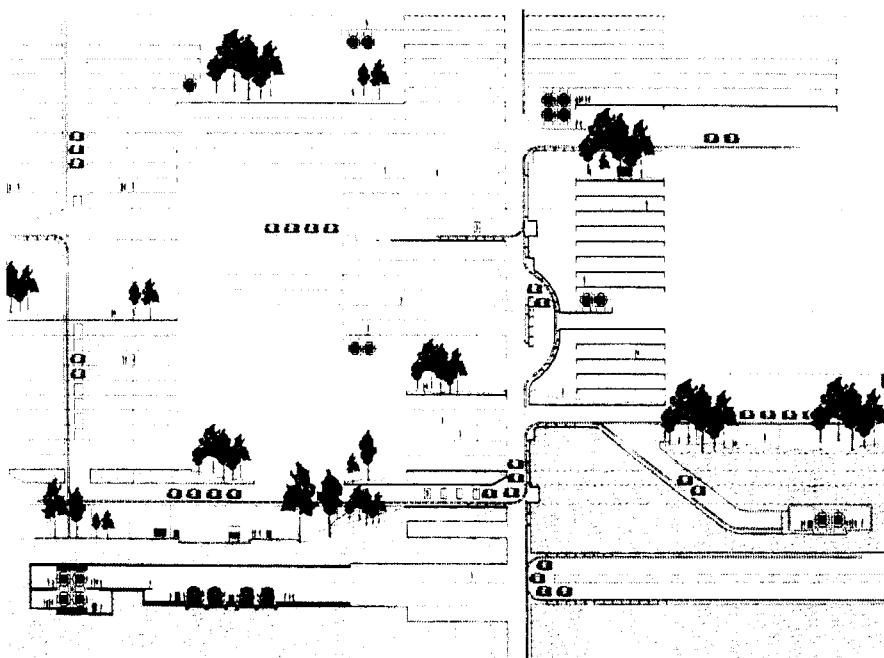


Figure 7: Tetra-dimension of Urban Space

- Promote optimisation of time, regarding time lost due to traffic and transport bottlenecks.
- Allow the recovery of creative leisure time.
- Tetra-dimensional use of our space, not creating barriers for man's mobility.
- Be a catalyst towards systemic.
- Hierarchy Individual scales in a massive media.
- Improve public health.
- Not only, avoid creating wounds in the urban-grid, but healing of existing ones.
- Re-generation of residual-urban spaces.
- Promote an efficient use of economical resources.
- Generate 'architectural mutations', breaking up the 'vertical-functioning dependency' of present buildings + spaces, due to the plurality of directions, the infinite combination of possible routes, crosses and gradients created under immeasurable options of degrees and directions that it will create.
- Create new connections between already built volumes (not depending or relying on the ground level where all public/private connections are generated), translating this into economic benefits, due to optimisation of time travel, transportation wages, etc
- Generate a city with an ecological concern.

The tetra-re-dimensioning (3D+Time) generated by S.A.T. proposes to draw a trend towards the conformation of sustainable cities, promoting man to become the reference-pattern in our contemporary and future urban landscapes.