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The "road capacity" of the chilean master plan is it good enough for shaping a sustainable built environment?

La "capacidad vial" del plan regulador chileno, ¿es lo suficientemente buena para dar forma a un entorno edificado sostenible?

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Abstract
The "road capacity" of the Chilean Master Plan is a tool developed to measure the capacity of streets in terms of supporting the size of vehicle flow. This tool considers topics such as land use, population density and street width. The purpose of this technique is to incorporate it to the Master Plan, as a town planning instrument, so as to cope with traffic forecasting and congestion. However, the technique does not embrace any sustainability concept, this is due to a disregard of any district ´s social or environmental needs. Therefore a sustainable urban development would doubtfully be reached. It is argued that some other approaches are required for shaping a sustainable built environment in which it is understood that the streets are a public space for people rather than a platform for moving vehicles only. This means, to promote accessibility as well as mobility. In this paper the author reviews borrowed concepts such as "carrying capacity" and "environmental capacity" from bioregionalist and ecological disciplines using a case study in outskirts of Santiago´s metro area.

Key words
Transport System in Santiago, Chile, traffic forecasting, sustainability, public space.

Resumen
La "capacidad vial" del Plan Regulador chileno es una herramienta desarrollada para medir la capacidad de las calles en términos de apoyar el tamaño del flujo de vehículos. Esta herramienta considera temas como el uso de la tierra, la densidad de población y ancho de la calle. El propósito de esta técnica es su incorporación al Plan Maestro, como un instrumento de planificación de la ciudad, con el fin de hacer frente a la previsión del tráfico y la congestión. Sin embargo, la técnica no incluye ningún concepto de sostenibilidad. Por lo tanto un desarrollo urbano sostenible dudosamente sería alcanzado. Se argumenta que algunos otros enfoques son necesarios para dar forma a un medio ambiente sostenible integrado, en el que se entiende que las calles son un espacio público para las personas en lugar de una plataforma para mover los vehículos solamente. Esto significa, para promover la accesibilidad y la movilidad. En este trabajo la autora revisa conceptos prestados, tales como "la capacidad de carga" y "capacidad ambiental", desde el bioregionalist y disciplinas ecológicas mediante un estudio de caso en las afueras del área metropolitana de Santiago de Chile.

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Palabras clave
Sistema de Transporte en Santiago de Chile, previsión del tráfico, sustentabilidad, espacio público.

Summary

Introduction to the urban transport system in the Great Santiago

Broadly speaking, the Great Santiago has 1.000.000 homes where 4.500.000 inhabitants live on a surface of 50.000 hás. approximately. Density reaches near 90 hab/hás although it differs upon district, e.g. in a low income district such as San Ramón, there are 175 hab/hás while in an upper income district such as Vitacura there are 24 hab/hás. (CTU, 1990). The total number of private vehicles is 400 plus almost 12.000 buses, which means a motor rate of almost 0,1 veh/hab. or 0,4 veh/home. Again there is a dispersion according to the district´s incomes level, e.g. in San Ramón there are 0,19 veh/home while in Vitacura there are 1,71 veh/home. (SECTRA,1992)

The total trips in a work day reach 8.4 million, 36% for working purposes and 31% for studying purposes, yielding a rate of 2,12 trips per person from which 70% are made by public transport means and only 16% by private means. The rest of the trips are made on foot to cover and average distance of 8 to 10 blocks in 15-20 minutes. The average distance by car or bus is 9-10 km, that means 26 minutes by cars and 44 minutes by a public transport means. In other words trip speed average is 22 km/h in a car and 13 km/h in a bus (Fernandez, 1994). Population growth rate in the period 1982-1992 reaches 1,8% while automobile stock growth rate was 2,5% ºand reaches 3,5% in 1992.

Some conclusions arise from these figures: (i) most of the trips are made by public transport means, being walking and private cars a second choice of travelling; (ii) policy and planning should follow this trend to satisfy current travelling needs; (iii) automobile stock growth rate is rising faster than the population growth rate; (iv) private transport demands heavily on road infrastructure due to less trip time; (v) trend shows an increasing number of vehicles per capita which will likely increase road wear; etc. But one of the main points derived from some government institutions is that if those trends continue, and investment on road infrastructure do not increase accordingly, congestion will emerge as an adverse impact on cities. Such is the case of

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the Ministry of Housing and Urbanism (MINVU), the institution in charge of town planning and urban development in Chile. In fact, MINVU´s hypothesis is that the lack of procedures and regulations for urban planning instruments which promote compatibility between activities and road capacity are the major causes of congestion and inefficient management in the cities.

Defining the concept of "road capacity" and its implementation in the Plan Regulador

The "road capacity" of the Plan Regulador is a concept that has been recently introduced by MINVU, in order to incorporate it to the Plan Regulador in terms of procedure and regulation (Bravo, 1997). A methodology has been developed to apply to districts at different sizes such as metropolitan, medium-size and small ones. According to MINVU, road capacity is understood as ..."*the capacity of Plans road network to support vehicles flow with an adequate level of service"...* According to an author, capacity can be understood as *..." the maximum flow that can circulate for a road device, hence capacity is finite"...* (Fernández, op. cit.).

When using capacity concept, the congestion phenomena arises. Road capacity provides a limited traffic flow. Hence flow demand on a road should be less or equal to its capacity. Otherwise such road would reach a degree of saturity, or namely congestion. Solutions to congestion can be tackle from both supply and demand side, e.g. supply side through investment on road infrastructure and demand side from restrictions to travel, such as car licence prohibition, road fares, etc. In this sense, Fernandez argues that solution might be found in traffic management measures which sometimes costs less than any new road infrastructure.

The road capacity of the Plan Regulador attempts to tackle congestion through supply side because this tool develops a methodology to estimate if the road infrastructure proposed for the next 15 years responds to the forescasted flow demand. The criteria for defining capacity is the degree of saturation in an road arc. Methodology analyses the road network proposal in terms of parameters such as connectiveness, road sizes, outline and design. Forecasting are made according to the future scenario proposed by the Plan Regulador and statistical trends in population growth, density and location of activities. A classical transport model, divided in four stages, is used to describe the transport system in the district: trip generation, distribution, modal split and trip allocation. A MUSSA model is used to predict location of activities (MUSSA means land use model for Santiago). Once forecasting is ready, a comparison is made between road proposal and flow prediction to conclude what physical changes are required in the Plan Regulador for avoiding congestion in the future city.

Physical changes in the Plan Regulador mean whether re-classification of road according to its hierarchy or create new roads (increase supply) to support adequate service level of flow. Hierarchy of road is a concept defined by the law as well as urban planning instruments. (Valenzuela, 1984) (Jurídica, 1998) (MINVU, 1994). Criteria of

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hierarchy are based on physical platform size and operational characteristics of transport. A summary of roads classification is shown on **Table 1**.

As it can be seen on Table 1, the criteria to define types of roads is based on traffic functions and to some extent on land use in the urban system, but a relevant concept is still missing in defining hierarchy: the public space. (**Figure 1**)

Figure 1 - COMPARATIVE CONCEPTS APPLIED TO TOWN PLANNING

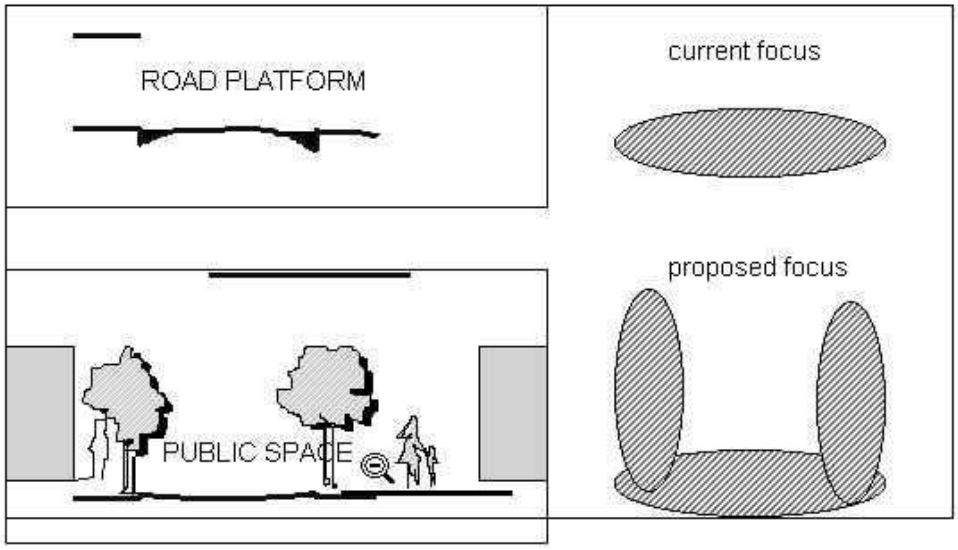

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Table 1
CLASSIFICATION OF ROADS

NAME OF ROADS	FUNCTION	DESIGN STANDARDS			
		SIZE OF THE PLATFORM	OPERATIONAL CHARACTERISTICS		
			SPEED AVERAGE (km/h)	ROAD CAPACITY (veh/h)	MAIN FLOW
EXPRESA	CONNECTION (between urban areas at regional scale)	(estate limit) e.l. 21mt min. highway 50 mt.	80-100	4000	automobile, buses, track
TRONCAL	CONNECTION (between urban areas at district level)	(estate limit) e.l. roadway e.l. 14 mt. min. 30 mt	50-80	2000	automobile, buses, restrictions for animal and human modes of transport
COLECTORA	CORRIDOR (distribution between residence and employment and services)	estate limit e.l. e.l. roadway 13 mt. min. 20 mt.	40 - 50	1500	automobiles, restrictions for animal modes of transport
SERVICIO	ACCESSIBILITY (to the commerce and facilities in the centre)	estate limit e.l. roadway 6.5 mt min. 15 mt.	30 - 40	600	buses, restrictions for animal modes of transport
LOCAL	ACCESSIBILITY (to the residence)	estate limit e.l. 6 mt. min. roadway 10 mt.	20 - 30	low	cars, animal and human modes of transport. exception buses.

Source: *Ley y Ordenanza General de Urbanismo y Construcciones*, 1998. REDEVU, 1984.

The "road capacity" of Plan Regulador is an attempt which certainly means a milestone in the Chilean urban planning. This is because it is the first time to link officially town planning and transport planning, which where traditionally under two different governmental institutions; Ministry of Housing and Urbanism (MINVU) and the Comission of Investment Planning for Transport Infrastructure (SECTRA). Nonetheless a further disturbing question arises:

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The broadening of a viewpoint: from road capacity to environmental capacity

In the seventies the British Colin Buchanan (Buchanan, 1973) stated implicitly the difference between road capacity and environmental capacity and recognised their importance for the design of cities.

Environmental capacity is a broader concept than road capacity because it considers not only circulation but also environmental objectives in the urban planning. In this sense, the concept of environmental capacity is closer to the principles of urban design and life quality in the cities.

The author argues that any urban area should appraise a maximum level of traffic - *maximum capacity* - to consider a street acceptable in terms of environmental objectives such as noise, vibration, pollution, visual intrusion, pedestrian liaison, and obviously take into account the road infrastructure to hold vehicles whether in movement or parked. The road capacity depends to a great extent on spatial organisation of the buildings and access ways to them, what he called "the architecture of traffic". He suggested as convenient to set some minimum standards to control environmental objectives based on parameters such as the number of vehicles, speed, weight, width of sidewalk, etc. Perhaps one of the most remarkable features in his work was to set that functions of a street consider not only the circulation of vehicles but also their access to buildings, air circulation, light and shadows, framework for building and architecture and the fundamental means to deal with people in day to day life.

Other concepts to estimate capacity, although not directly connected with traffic are: *carrying capacity,* developed by a Canadian named Rees (Rees, 1992), and *environmental capacity,* pointed out by Barton (Barton, 1995). Both concepts are borrowed from ecological studies and they are brought to examine the meaning of capacity in terms of environment. Carrying capacity has been applied to a regional scale and he defines it as *the total area of land required to sustain an urban region (its ecological footprint) which is typically at least an order of greater magnitude than that contained within municipal boundaries or the associated built-up area.*
Whilst environmental capacity could be understood as *the capacity of fragile ecosystems to absorb human activity.*

Some preliminary conclusions are: (i) human activity impact on ecosystem; (ii) normally its impact reaches far beyond administrative limits of the specific activity; (iii) if it takes traffic function from ecology to transport, it could be said that it might affect other activities appart from circulation, which occurs in the platform. For example, activities on the sidewalk and buildings.

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Mobility and Accessibility, two principles promoted by the physical planning

Mobility and accessibility are two concepts recently suggested by a Centre for Transport Studies´ s Team in London, as a response to the "developing an integrated transport policy" document. (Brown, 1997), However in Chile governmental programmes still focus on the former.

In fact, the Plan Regulador is the physical planning instrument that attempts to incorporate the road capacity technique to assess vehicles flow according to width of road infrastructure. That purpose looks appropriate even though the principle behind such technique is based on mobility rather than accessibility. But the city is far beyond more than only a space for vehicles. Town planning refers to people and political responsibility to balance competing interest on land for a common good and traffic is a function for helping people and not the other way around. Therefore, it seems to be that the approach started by the government (MINVU) has to be reviewed because it is not sufficiently developed and what is worse, it implies promoting urban sprawl on car-dependence.

A case in point considering governmental programmes bias on mobility might be observed at the borders of metropolitan Santiago, in the district of Maipú. **Figure 2** and **Figure 3** show location of new housing project built in the last decade, and routes for public transport in the district. Housing development takes about 30% of the project surface for building streets. As it can be seen, there are considerable housing areas without any public transport services.

As Newman states, physical planning is in age of urban cynicism due to the government involvement in making cities less automobile dependent but actually designing them on car dependence (Newman, 1995).

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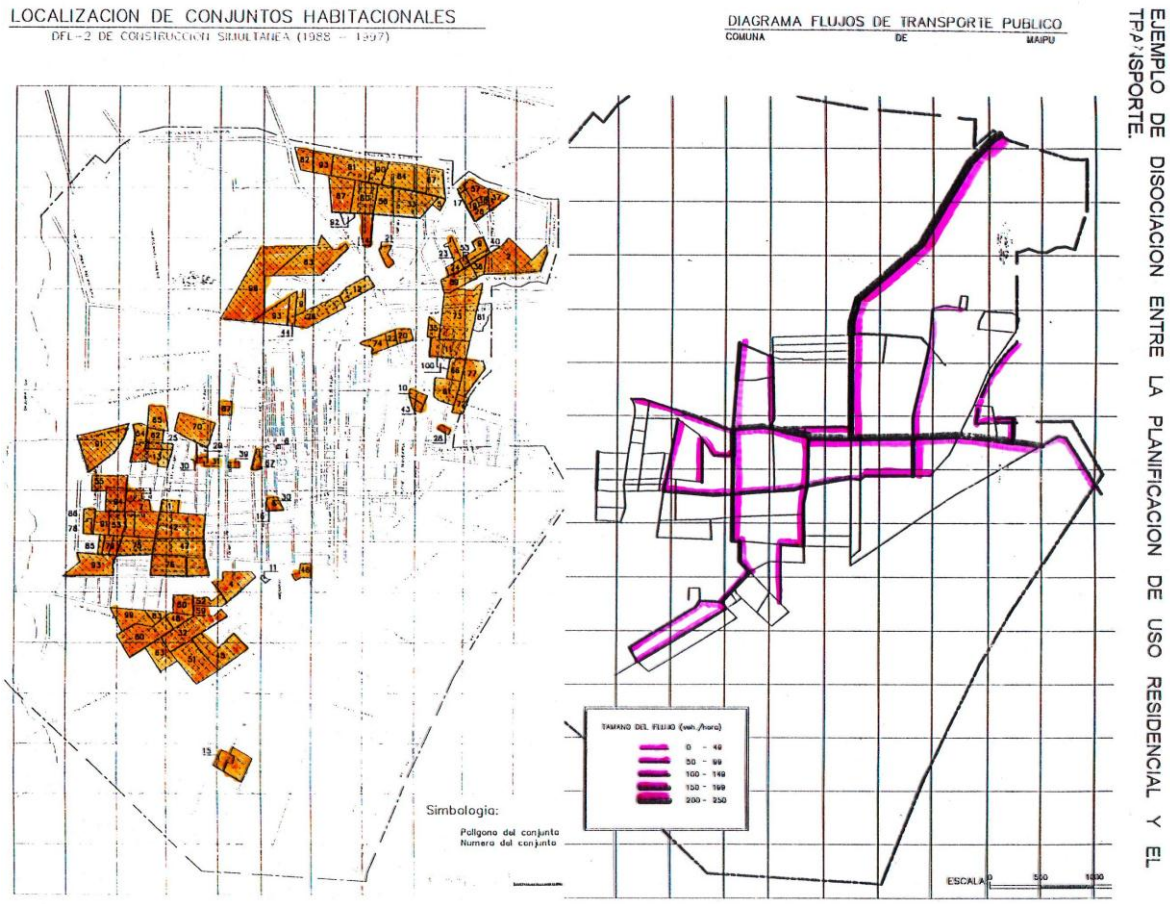

Figuras 3 y 4.-

Recommendations for planning politics

Some reflections and recommendations can be stated from this paper:
(i) If sustainable development is one of the aims mentioned in governmental programmes, it should take into account not only economic growth of any activity nut also equity on society and environment of cities. Applying this to the transport issue, it would mean access to all people (pedestrian and cars) and shaping a built environment (urban space), instead of priority to the economic function of traffic only.

(ii) It is required to think about the built environment type that is being promoted by the physical planning instrument such as the Plan Regulador and the road capacity technique.

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(iii) In this sense, hierarchy is a concept that should be reviewed according to the activities occurring on public space. These activities are connected to land use and building. Consequently it is suggested to consider urban design as well as road traffic needs.

(iv) It should be consider the crucial rol of streets in the design process to structure a neighbourhood according to the principles of the **new urbanism** (Katz, 1994) and control adverse effects of traffic in social day to day relationships on streets. (Elkin, 1991)

(v) All can be said in one word: **moving from road capacity to environmental capacity.**

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