6 PÁGINAS

NOISE MODELS AND TRAFFIC MANAGEMENT FOR TOWN - PLANNING ENGINEERING

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ABSTRACT

The control and management of traffic in urban environments are carried out by means of models exclusively created for this end. However, the structure of the state of the traffic in each instant is often directly related to the generated noise. This way, the noise turns out to be a wide source of information about the situation of traffic. In several urban typologies, starting from the measures of the noise, using simple relationships among the traffic parameters and the sequence and levels of noise, it can be monitored the conditions of the traffic giving a useful tool for town planning policies.

1. INTRODUCCION

This study analyzes the prediction, design and administration of the noise of the traffic in highways and urban roads. The global objective of the planning of the traffic is to allow the transport of people and matters to the minimum cost, not only economic but also environmental. This cost should not only include the highway and the vehicle construction, with the operation costs and maintenance, but also the social costs of noise and the air pollution, the characteristics of the pavemented layer, the design of the environment, the antiquity and design of external and internal part of the vehicles and the motor type. The deficiencies in the preventive design have as a consequence later investments in alternative methods to reduce the traffic noise. A simple conclusion is that there are two alternative ways for the reduction of the noise. One is the reduction of the traffic flow and the other one is the employment and preventive strategies (models, legislation) and preventive controls, structures and environmental plans. The bigger or smaller relative importance in these two ways depends on several considerations and on the current situation.

1.1. Aspects of the design and control traffic

It is consequently desirable to analyze the possibilities technical and economic consequences that result on the reduction of the traffic noise before it constitutes an non desirable impact on the

population. As the part of the complete process of design and control of the highway and its environment, the economic damage of noise should can to be evaluated, by means of the improvement of the resources and technologies to get it.

2. METHODOLOGIES TO REDUCE THE TRAFFIC NOISE

The consideration of the design of the traffic roads, with the purpose of reducing the noise requires the study in the ways that is affected by the different characteristics of the layout and traffic volume, design speed, etc. Several characteristics associated with the traffic, the roadway and its environment that give variations of the sound level among $5-10\ dBA$ (this value is chosen as an appropriate rounded number that, nevertheless, is quite big to be reducible, representing a factor of two in the subjective intensity and a factor of ten in the energy. In particular, the actual values can be substantially different depending on the circumstances). These characteristics can be, the multiplication two times of the speed of the automobiles; the multiplication ten times of the intensity of heavy vehicles; the effect of acceleration in slopes to moderate speeds; the multiplication three times of the flow intensity for great traffic fluency; very absorbent pavements in low flows; the insertion of an acoustic barrier at superior heights of $2\ m$; the arboreal bands of great width and frondage (superior to $50\ m$); the multiplication three times of distances which level has been exceeded a 10% part of the time; the multiplication ten times of distances which level has been exceeded a 90% part of the time; the range between the 10% of less noisy automobiles and the 10% of noisier ones in certain conditions, or the difference among the mean levels for automobiles with motor of gasoline and the commercial vehicles with diesel motors.

The difference among the 10% y 90% and the 90% of the levels for the cars and the commercial vehicles include important differences in the design and an unavoidable deterioration for antiquity, and it is hardly difficult that all the vehicles can improve until the level 10% of the less noisy ones, at least at the coming times. However, undoubtedly the noisiest ones present features peculiar of design besides a scarce maintenance that cannot be justified. The installation of normative legal that limits the new levels progressively will have great importance in the task of eliminating them. The measures carried out demonstrate that a great number of commercial vehicles and buses are above enough the limit that imposes the barely restrictive effective legislation. Technical and economic problems exist in the reduction of the noise emitted by the diesel big motors of commercial vehicles, particularly under conditions of low speeds where the motors diesel are particularly noisy compared with the motors of gasoline, without forgetting the remarkable reduction that has taken place in the last years, particularly in slight vehicles. An aggressive legislation should always have present the economic consequences that it takes harnessed. In consequence, it can be more favourable the imposition of political educational and less tolerant with the increase of the current margins, without forgetting the planning and the development of technologies that allow the decrease of the installation cost.

3. TRAFFIC NOISE GENERATION AND MODELS

3.1. Stationary traffics

In the preventive work the models of prediction of the traffic are maybe the clearly most identifiable tool. Difficultly they will be possible political strategies without the development of provident models. On the other hand, the precision of these models is subordinated to the knowledge of the characteristics of the surfaces of the environment, the emission and direction of the sources and other propagation factors. In the fig. 1 offer a classification of the basic models for stationary traffic. Starting from an equivalent reference level, corrective factors are introduced, of emission, of propagation and reception. The last ones generally are joined. The emission parameters can be classified in primary and secondary, offering the first corrections for reference distance, variation of the intensity, the speed, percentage of heavy vehicles (day and night) and motorcycles (traffic parameters). The secondary ones consider the characteristics of the issuing environment, next to

the source, and that they impact over the height of the source, and the rolling surface (road surface). A group of environment parameters, previous to the propagation they are that is to say those that refer to the kind of road, the surfaces in those that are surrounded the issuing focus, (environmental primary parameters) where the environment kind charges great interest, streets in L, or free fields (cannon and facade effects), slope of the roadway, height on the environment, width, number of rails, etc. The parameters that affect to the propagation between source and receiver are due to the existence of constructions, the insert of barriers or limitations of the angle of vision. Lastly they are the factors that affect to the receiver, position regarding the roadway, etc.

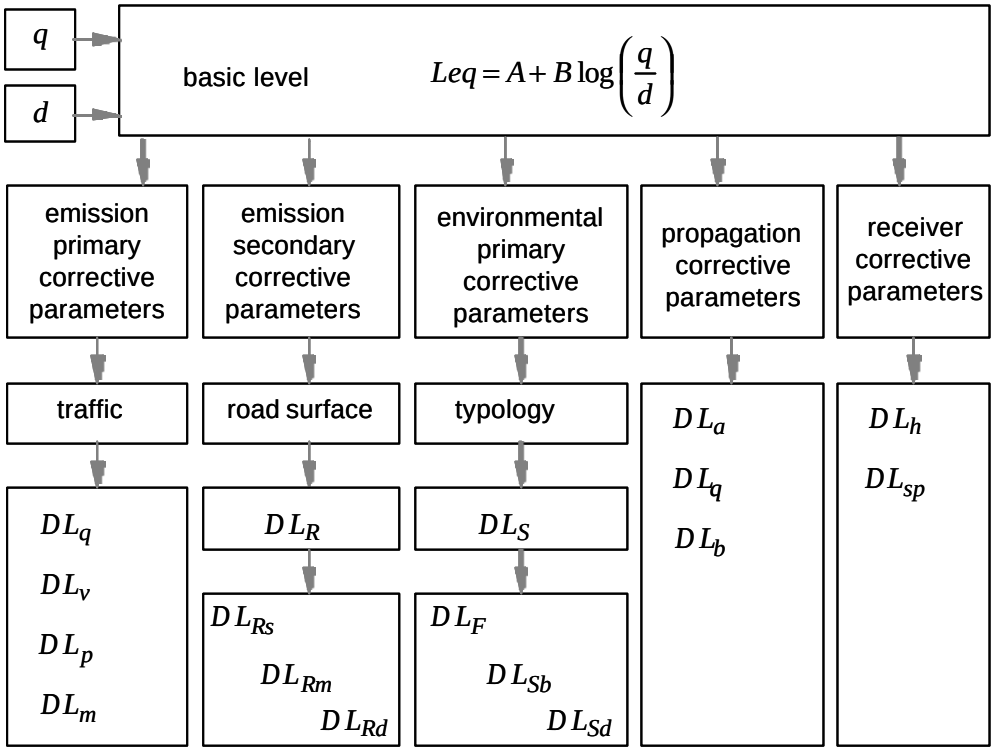

Fig. 1 An outline of the models of prediction of the noise levels can be observed for stationary flows.

These models leave of the reference level generated by a basic configuration of flow that frequently corresponds to a stationary intensity $1000\,veh\,h^{-1}$ of (slight vehicles), at reference distances d of 7.5, 10 or $15\,m$, and mean speed of $50\,km\,h^{-1}$. This level can be corrected in the first place by variation of the reference distance and intensity (basic equivalent level). frequently the basic level is obtained of an expression that includes the primary effects,

$$L_{eq} = A + B\log q + C\log d + D\log v \qquad (1)$$

Models of this type have been proposed by numerous authors and they could be defined as models 2P $q - v$, $q - d$, 3P, $q - d - v$, $q - d - p$ ó 4P $q - d - v - p$.

3.2. Non stationary pulse traffics

The study of the discontinuity of the traffic before the presence of the signalling is based on laws of evolution of the characteristic parameters of the traffic, Intensity, speed, density,…, basing us on the studies of Lighhill and Whitham leans on in the following system of equations,

$$\partial I(D,x)/\partial x + \partial I(D,x)/\partial t = 0 \qquad (2)$$

If the traffic intensity is measured in two sections of the tract of via separated Dx, the excess of density in one of them should be similar to the decrease of vehicles in the tract in question, being obtained,

$$\left(\partial I(D,x)/\partial D\right)\left(\partial D/\partial x\right)-\partial D/\partial t=0 \qquad (3)$$

calling to the wave speed or characteristic speed $c=\partial I(D,x)/\partial D$ and as $I(D,x)=\bar{v}D$,

$$c=\partial I(\bar{v}D)/\partial D=v+D\partial\bar{v}/\partial D \qquad (3)$$

and as $\partial\bar{v}/\partial D<0$, it is that $c<\bar{v}$, (the wave speed is always smaller than the instantaneous mean speed. The diagram that ties different variables is shown in the Fig. 2. the simulation based on this procedure can be applied to urban roads of high intensity.

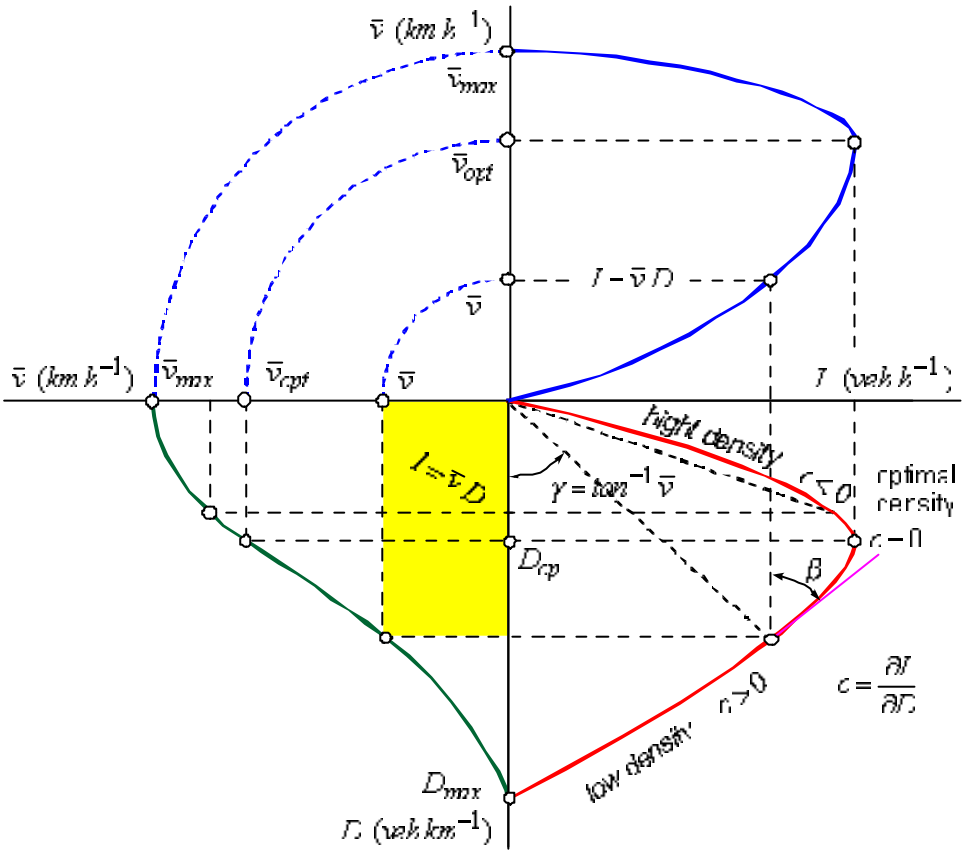

Fig. 2 Fundamental diagram that ties the density with the intensity instantaneous mean speed. Instantaneous density, intensity and mean speed relationship.

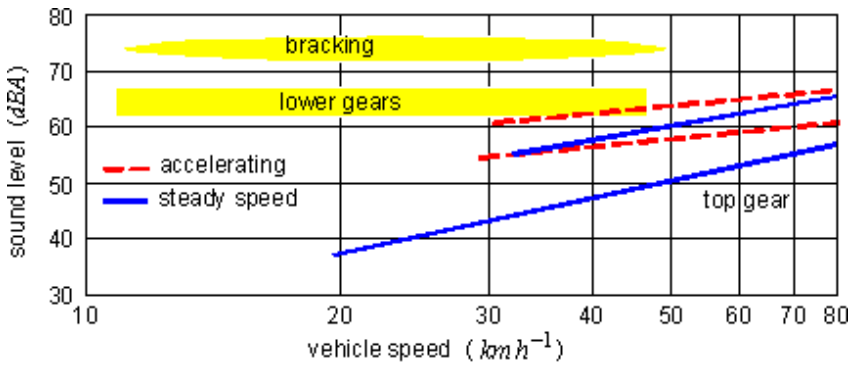

Fig. 3. Noise of representative vehicles. (Diesel and petrol car). - - - - - accelerating; ___ steady speed.

In a high density urban environment, the main sources of noise relative to the nuisance are those produced by traffic and the increase of the background noise that this produces. Because of that the models based on the simulation of different situations of traffic will be preferable in urban nuclei. For a fundamental reason, the instantaneous noise of the traffic in roads of high intensity allows at the same time to reorganize the own traffic avoiding the congestion situations. The growing power of the computers and the elaboration of sonic cadastres by means of the consideration of a reasonably reduced number of parameters will help to this goal. They are numerous the efforts dedicated nowadays to the elaboration of this type of models as it is reflected in the consulted bibliography, great part of which appears at the end. This effort, foregonely, will allow the correction and acoustic rehabilitation of the big population nuclei.

4. THE SOUND LEVEL IN THE PLANS OF ORDINATION OF THE TERRITORY

The current vision of the urban planning differs notably from the established one to principles last century, for reasons of mobility and demand of comfort. This way, the noise constitutes a decisive factor in the ordination plans. The current urbanism requires the relocation of notably noisy activities. The same leisure areas are generating a dense and intense traffic.

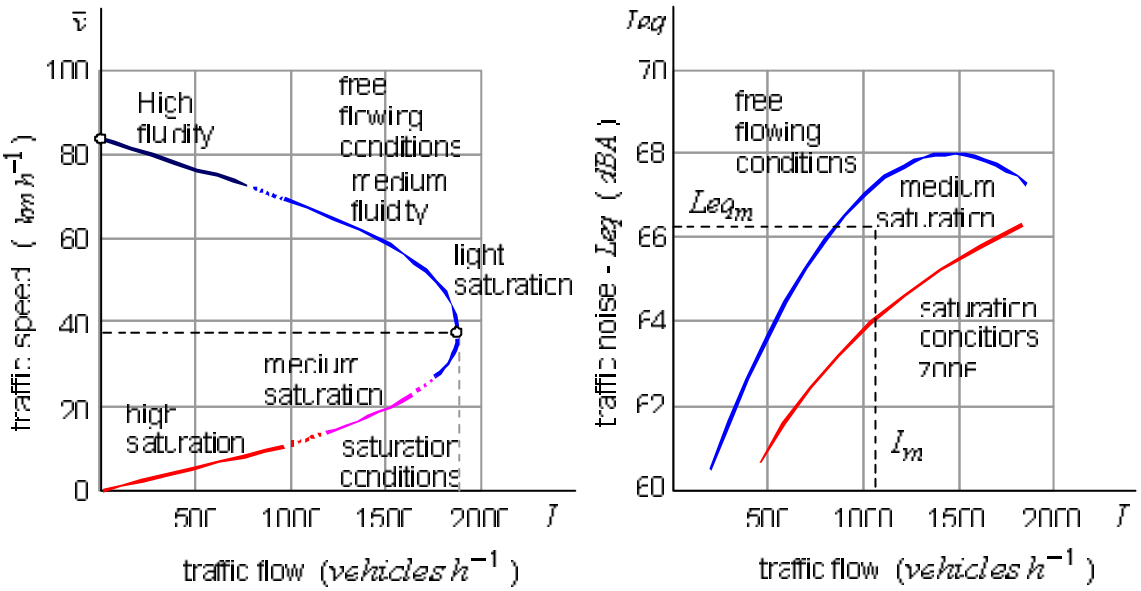

Fig. 4 Speed/flow and Leq/flow relationships. Degree of saturation of traffic.

The design of the roads as a whole is a fundamental preventive performance in the planning. The concept of reticular net where all the roads are simultaneously an access, a way and a distribution pass to local zones is not at the moment the most appropriate solution. Nowadays there is tendency to specialize the roads, of circumvallation, (fundamentally for heavy traffic), of penetration, of distribution, of access. Each class of via is generating different sound levels, with different impermanence and spectral composition. On the other hand the areas acoustically sensitive should only support the traffic generated in the own area, and can be right some actuations as the limitation of the speed, the decrease of intersections and other effects that it causes traffics of the type "stop and go". Support of collective transport (underground if possible) is an appropriate politic to this objective.

5. JURISDICTIONAL RESPONSIBILITIES AND ACTIVITIES ABOUT ENVIRONMENTAL NOISE

The type of jurisdictional action should be approached three levels, Community level indicating the guidelines which should be followed, which are reflected in activities like standard emissions, regulations about manufactured products, equipment, isolation of the construction, etc. Regional, whose activities would be reflected in acts, policies, regulations, guidelines, codes, model by-laws, etc., that deal with planning, building, environment, natural resources, road traffic, health,…, retrofit programs and home improvement programs. Municipal, by means of activities like, municipal laws, noise control and traffic management.

6. CONCLUSIONS

The sound administration of urban environments constitutes one of the disciplines less considered inside the environmental administration. Even more, the strategies generated to handle this problem don't use all their possibilities, in particular the connections with socioeconomic aspects related to the increase or decrease of the sound contamination. Independently of the standard protocols, the sound management suffers of the lack of an effective normative in the prevention and in the supply and support of effective solutions. Thus, without considering that the responsible environmental policies are highly permissive. Certain temporal fashions, such it is the case, i.e. of the acoustic maps that give high popular profitability, have a lack foundation if they aren't considered inside a wider outline. In the case of laws, these are edited following a common structure that is not viable in many cases. The environmental technical personnel lacks of the logistical support of other directly implied social layers and they cannot overcome the economic costs that it supposes an effective administration against the noise. Nevertheless, like in other aspects of the technique, the models of calculation of generated noise by the different sources constitute the first stage in this process and a bigger effort should be dedicated to them.

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