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# Urban and Building Acoustics management in the next decades: a matter of prevention, simplification and education

João Baring

Univ. of São Paulo - Facty. of Archt. and Urban., Rua Rafael Clark 85, 05526 - 010 São Paulo, Brazil
jbaring@uol.com.br

In Brazil, in cities like São Paulo and Rio de Janeiro, noise pollution control has been carried out mainly in the form of repression. In the seventies and eighties, people joined together to fight against noisy government projects, and government fought noisy industries and commercial establishments. Since then, people became quite aware of their rights, but learned little about their own commitments on the matter. The author researched this process in order to find a better way for the future and concluded that prevention must be enforced through noise codes, standards must include easier survey measurement methods and low cost devices for sound control must be available. Most important, education must be improved in all levels, to make every citizen a partner of noise control at home, at work and elsewhere in the cities. This paper points to some ways of dealing with this process.

# 1 Introduction

Policies for the acoustic control of the urban environment, at several of major cities in the world, are in a transitional stage, between cycles of mobilization against noise pollution, involving different profiles of law enforcement, technical development and education. In São Paulo, Brazil, the focus of this paper, the previous cycle took place over approximately 30 years, with best achievements between 1975 and 1995. The basis for a new cycle must be urgently prepared. With a population over 13 million people, noise pollution in São Paulo will be absolutely out of control in the near future, if controlled only by repression, without a goal of education and collaboration on the prevention of excessive noise, involving every citizen in the city, as far as possible.

# 2 Passive learning about the need for noise control

Ethnic and cultural miscegenation has made most Brazilians, in many circumstances, receptive to loud environments. But sometimes authorities overestimate their tolerance to noise. This happened in São Paulo where, in 1971, an elevated expressway, nick-named "Minhocão", was built threading between buildings on São João Avenue, in the downtown area, a traditional place to live and to make real estate investments during the first half of the century. By the seventies, people had come to prefer roaring cars, as symbols of power. Driving them at high speed, in a dense traffic through the "canyon" between buildings, caused a tremendous noise impact, over 85 dB(A) in average, on ground level, during rush hours.

Complaints were reported and broadcasted insistently. Reporters covered the drama of families having to move out and selling their apartments. Buyers were interested in taking advantage of people with temporary jobs in the area, desperately dependent on rental opportunities. Both owner and tenant were not much interested in keeping the properties in good condition. So, in a few years the degradation of the buildings was notorious, as seen in Figure 1.

The successive local governments were astonished by the magnitude of the social problem, but only decided to do something about it after being sued by several owners resistant to the devaluation of their properties. From 1986 to 1992, government commissions studied the errors that had been committed and the alternatives to mitigate the situation. The author of this paper participated of those commissions, representing, as a planner, the Faculty of Architecture and Urbanism of University of São Paulo, and as a technician, the Institute for Technological Research of the State of São Paulo.


Fig. 1 The elevated expressway Presidente Arthur da Costa e Silva, in 1986, fifteen years after its construction. Called "Minhocão", meaning "Big Earthworm", caused accelerated urban degradation, mainly by noise.

The first error

The economical, political and social importance of the State of São Paulo, couldn't be conceived dissociated from the importance of the City of São Paulo, whose population was close to 10 million people, at the time the elevated expressway was built. Such a megalopolis deserved a collaborative planning between state and city governments, especially on the subject of transport infrastructure. The Engineer Francisco Prestes Maia, Mayor of São Paulo from 1938 to 1945, was a visionary in that sense and planned for two level viaducts along important avenues, the upper level for the traffic, a municipal matter, and the lower for a future subway, a state government responsibility. It didn't work, even as a suggestion, but it should have, because both, the "Minhocão" and the East-West line of the subway, had approximately the same path and were planned and constructed with little difference in time. For political reasons, planners worked apart and couldn't find a joint solution that would certainly have been much better for the city.

The second error

By the time the "Minhocão" was built, United States had started to face popular reactions against community disturbance caused by expressways, including noise. The phenomenon is known as "Freeway and expressway

revolts" [1}. This should have been a warning for the Brazilian planners, but they decided to bet on the innate tolerance of the population. The facts showed they were seriously wrong.

Alternatives for correction or mitigation

With respect to the first error, there was no mitigation. But the members of the commissions came to the conclusion that the best solution would be the collaborative and simultaneous construction of the "Minhocão" and the East-West line of the subway, both underground. Ironically the "Big Earthworm" would be in its right place, beneath the earth. This was no longer possible, because of high costs.

The second error could be repaired by demolition, as done in the United States, in some similar cases. But the "Minhocão" became essential for a traffic flow of about 80 thousands vehicles daily. The number is more impressive when it is considered that the elevated expressway stays closed, by popular demand, for 9 hours in the night, and on Sundays and holidays. So, the only alternative is to make it quiet by confinement of noise. This was suggested 15 years ago, but only recently was taken into consideration. Pushed by successive waves of complaints, and lately, by a Non Government Organization and a public prosecutor, the municipal administration promoted a project competition to pose ideas on what might be done with the elevated way. The winner solution is shown in Figures 2 and 3.

Fig. 2 and 3 Solutions for the "Minhocão", proposed in 2003 by two architects, Juliana Corradini and José Alves, graduates from Faculty of Architecture and Urbanism of the University of São Paulo. Noise confinement is just one benefit. Annexed garage buildings, galleries, and a 60,000 $m^2$ traffic-free area on top, for pedestrians and leisure, are other inputs for urban revitalization downtown.

# 3 Learning by law enforcement

The big mistake of "Minhocão", as an issue of noise pollution, became a stimulus for acoustic knowledge acquisition among engineers. People in general learned also, but on level of simple information, because of the hundreds of newspaper articles, telling them about health and behavioural problems caused by noise and about real state devaluation.

In 1972, one year after the construction of "Minhocão", the Institute for Technological Research of the State of São Paulo, invited the author of this paper, an architect and a professor of Acoustics at the Faculty of Architecture and Urbanism, to help organize a research group on Acoustics, with special attention to requirements of buildings and nearby environments. Soon, in 1974, the city of São Paulo got its first successful law on noise pollution control, with the participation of the Institute. Citizens realized they could do something about noisy neighbours, mainly industries and commercial establishments, and government, seeking political benefits, gave them support. A specialized department was created to enforce the law and the Institute was asked to evaluate industrial projects in terms of the potential impact of noise beyond their boundaries.

Finally prevention was on the way, despite limited to industries, exactly where the most expressive learning of Acoustics could be observed, pushing the development of the market for acoustic materials and devices. This has been the good way of learning by law enforcement and the results prove it. Practically there are no more complaints in São Paulo, about external industrial noise.

With respect to commercial establishments, especially small ones, the results have been quite different. Owners are conditioned to take opportunities, not to make plans and projects, as industrial engineers usually do. After setting up, they resist attempts to lower sound levels, especially where people gather together for fun, and where music is part of it. In addition, São Paulo, for most of the year, is a typical tropical city, and the small establishments prefer open places, with tables and chairs on the sidewalks. If the owners are forced to make any acoustic treatment, they normally try the easier and less expensive ways. Simple application of acoustic absorbing materials in partially open places is their preferred alternative and this has created a distortion in the popular culture about the correct use of materials for noise isolation. Some of the very informal establishments started a mania of cardboard egg packages as acoustic treatment, something which has spread to an uncountable number of rooms, where youngsters rehearse their bands. This has been the bad way of learning by law enforcement

São Paulo must invert this situation. Thousands of commercial establishments for musical leisure must be converted into good examples of sound problem management for their hundreds of thousands clients, thus making the law observance a means for educating the population on noise pollution control. The big establishments that already meet the law and make satisfactory acoustic treatments must now manage better the disturbance caused by their clients before entering and after leaving the rooms. Those interested in running a commercial establishment must take a brief course on noise prevention before applying for a licence. This must be

mandatory and included in the future city noise legislation. It will not be arbitrary, but similar to the requirement for a defensive driving course, now required in Brazil for emission or renewal of a driver's licence. One deals with safety of a few persons that could be involved in an accident and the other with quality of life and emotional equilibrium of hundreds of people living nearby a noisy establishment.

For industrial engineers, learning Acoustics to prevent excessive noise to neighbours has not been the main concern, but certainly was the precursor. Industrial workers unions in Brazil succeeded in having regulations on hearing loss prevention approved 7 years after the repercussion of the "Minhocão" noise problems and 4 years after the "Silence Law" of the city of São Paulo. Since then, industrial engineers have been taking courses in acoustics spontaneously, because of their double commitment to external and internal noise control. But civil engineers and architects haven't done so to the same extent, because the law neglected them for a long period.

The "Minhocão" showed dramatically the aspect of noise emission control as an obligation, but also posed discussions on the responsibilities of engineers and architects to take the chance of their projects to provide protection against compulsory external noise, at least for multi-pavement buildings for residential use and for offices, hospitals and schools. The discussions started in a 1992 government commission, and finally resulted in the Law no. 11780, in 1995 [2], which principles are the following:

First principle

A big city is an assembly of different areas that, by natural vocation or regulation, are exclusively or partly residential, industrial, for business, commerce, leisure and so on. Some are calm, others have noisy surroundings. The government must regulate occupancy and share the responsibility of preventing conflicts caused by excessive noise, to the point of altering the normal operation of an airport, for example. Architects and civil engineers must find external indicators for the future buildings and consider all possibilities for noise protection in their projects, if needed. Unless they run their own business, architects and civil engineers really work for those who make decisions for the building construction companies that contract them. The responsibility is of the incorporation investors and also theirs, at a sublevel.

Second principle

Some noise increase can be expected, even in calm areas, as a consequence of essential urban interventions, like widening avenues and constructing traffic overpasses. But the "Minhocão", definitely was not supposed to over-impact the area with noise. Prosecutions were based on the evidences of absurd noise levels. But in 1981 a single citizen sued the municipal administration for indemnification because his house was devalued by the construction, in 1977, of another overpass, 15m in front of the façade of the house. Noise pollution wasn't the only argument, but was the most consistent. He lost in all instances but finally got a successful verdict in the Federal Superior Tribunal, in1992. Worried, the municipal government decided to include in the noise law under discussion a numerical limit for noise level increases in similar situations, that couldn't be contested, being based on scientific research. The author of this paper had a possible answer, because a few years before he had studied the acoustic performance of several common windows tested by the Institute for Technological Research, in laboratory and in the field, as part of the research for getting his PhD. They were all composed of simple 3mm monolithic glass, and the Rw results varied from 7 to 31 dB. If the proposal of Beranek et al. [3] of 40 dB(A), is considered a medium term reference for noise level tolerance in bedrooms, living rooms and private offices, then, the best windows tested, with Rw 31 dB, would provide a satisfactory isolation for an external noise level of up to 71 dB(A), even at positions in the rooms close to the façades, assuming that the windows are their weakest components, in terms of acoustic performance. The 71 dB(A) was approved by the commission as the maximum level to which the noise may increase as a result from a government intervention in the city. This concept is based on the assumption that, for that condition, there will be a satisfactory means of protection, easily found in commerce, not just a special and expensive one. The limit was practically equal to the 70 dB(A) adopted in Japan, at that time, another reliable reference.

The Law no. 11780 became just a warning, because, once approved, the regimental 60 days for deadline to submit a regulatory decree, wasn't long enough to be able to decide all technical procedures involved. Instead of hurrying controversial decisions, it was considered better to propose a 5 years testing period. This period happened to be much longer, basically because the national standards needed for certification haven't yet been completely revised, and only in 2003 the use of an external noise pollution indicator was approved by the municipal administration, a quantity that also requires a definition. In the meantime, however, at least one big building construction company has formally involved its quality department in preparing ways for meeting of the requirements of the law. The civil engineers are interested in survey measurement methods and simple procedures to pre-test solution alternatives, before making a decision and asking for certification. Other companies are expected to do the same.

# 4 Prevention through the education of children

Ideally, parents should teach their baby children to avoid persistent noise excesses in home and teachers should complement the task, doing the same in elementary schools. But in Brazil, for ethnic and cultural reasons, a significant percentage of adults, not only accept sound disturbances as an inherent part of living in a community, but also behave in a manner that is an education to the contrary for their children. In consequence, students between 7 and 14 years old, mainly in public schools, very often transform classrooms in acoustic purgatories for their teachers, resulting in voice impairment for many of them. The author of this paper briefly investigated the situation and, as expected, found out serious implications for the children's learning and wage losses for the teachers, when committed to extra jobs in other schools. The numbers were surprising, up to 15 cases of sick leave for reason of voice impairment, in a single school.

Reacting to the situation, a few teachers have decided to do something about it, by means of simple tools, like traffic lights painted on cardboards, called "the noise

semaphores", operated by the students themselves, to signal noise excesses in classrooms [4]. The experiment has become a national reference, after being published by an important magazine about education. It started when the school was chosen as a sample to run a municipal program on student education about environment quality conservation in parks, "the park experience", including noise measurements. It is hoped that this will end as a government educational program on noise control, run directly for students and indirectly for their parents.

Simple sound level meters, just reading in dB(A), provided for teachers of elementary schools, can make a real difference. They can reproduce the "park experiment", first in a quiet spot, asking the students to listen to the amazing diversity of ambient sounds, and after taking them to a noisy area, by the parkway, demonstrating how difficult is even to speak and understand what is spoken, under noise levels up to 80 dB(A). In classrooms, sound level meters may serve as calibration devices for the "noise semaphores", and remembering the "park experience", the students will know when their noisy behaviour can be not only inconsequential fun, but also cause harm. Finally, all this can be extended to their parents and relatives, if the students are asked to do homework, which consists of a simple intelligibility test, in presence of loud sounds from a TV set, or mini-system. Under such conditions, the student must read to somebody, as in normal conversation, a certain number or words from a list provided by the school, and ask the person to repeat, reporting the number of correct answers. The accuracy is not relevant. The intention is to provoke a second participation of the student in the education process, also as an agent, spreading noise prevention concepts at home.

## 5 Conclusions

Correctly oriented practical solutions are the best tools to educate the population about noise control, especially when these solutions are simple and cheap. Figure 4 shows an example.

Fig. 4: Residences transformed into office buildings, in a highly noisy street. The cheapest solution was to move windows to the back and make a wall façade in front. The blue building gave the idea and the white one copied it.

It is the sensorial education that matters: one experiences the disturbance, and afterwards the relief. If convinced of the advantages, that person spreads the news. It happened with cars in Brazil. Some people preferred them roaring in the seventies, but in the eighties they changed their minds after experiencing air-conditioned cars with good stereo sound. Even with the sound off, they also could enjoy comfortable conversations, leaving urban noise outside, among other advantages. But sensorial education is based on impressions and sometimes they mislead us, as in the case of the cardboard egg package mania, mentioned before in this paper. People experienced mainly reverberation relief, and thought it meant significant sound reduction for the neighbours. The owners of the establishments for leisure, where the mania started, should be made aware of that, in order to avoid the propagation of the mistake. These owners need another level of education, directed to their needs, because they interact closely with population and must show correct solutions to their clients.

Sensorial education is also captivating civil engineers in the buildings they are constructing, when they feel the sensation of noise abatement, closing windows, and can measure the difference, using simple survey procedures. Industrial engineer where captivated before, with the relative simplicity of noise dosimetry. Starting with children's education in schools and making the practice of noise control more available, hundreds of thousands of people can be captivated also, in the next decades. The more acquainted with noise control people are, the greater the development for acoustics as a whole, can be expected.

## References

[1] Wikipedia's "Freeway and expressway revolts": http://en.wikipedia.org/wiki/Freeway_revolt

[2] The City of São Paulo Law 11780 (1995).

[3] L. L. Beranek, W. E. Blazier, J. J. Figwer: Preferred noise criteria curves and their application. Personal communication (1971).

[4] T. Kuniyoshi, R. P. da C. Oliveira: "The experience of the 'Noise Project' at the Desembargador Amorim Lima Elementary School". FAPESP Report on "Awareness for noise diminishing in schools: a concern of public administration about the auditory health of children and the improvement of their learning acquisition". Foundation for Research Support of the State of São Paulo - FAPESP (2000), Annex 3, Document 1.