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SOUND PRESSURE LEVEL EVALUATION FROM TOILET FLUSHES

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INTRODUCTION

Plumbing noise is not only restricted within the sanitary environment. It can annoy the occupants of the neighbouring rooms, and even of the neighbouring apartments, generating embarassment and invasion of privacy.
The verticalization and concentration of buildings in the urban space, besides the use of light material partitions, has respectively as a consequence, the increase of service pressures of plumbing installations, and a reduction of sound transmission loss of partitions, evidencing even more the noise generated at plumbing fixtures.
A good noise control work practice recommend first the possibility of reducing noise at its origin. Towards this goal, a survey of the most critical noise sources in hydraulic installations for residential buildings points, among others, to elbows, bends, valves and appliances, due primarily to the turbulence intensity generated at abrupt changes in flow direction and flow restrictions. Although the piping system is generally designed for maximum flow velocities of the order 3 m/s, this value can be a few orders of magnitude higher at restrictions provided by appliances and valves. This is specially true with appliances that operate with high flow rates, such as the toilet flushing .

NATURE OF THE PROBLEM

To study this problem, simulations of the flow in a typical sanitary environment were made, using a water-closed with flush-valve as one of the representative plumbing noise sources, in the hydraulic tower of the Plumbing Installation Laboratory of the Polytechnic School at the University of São Paulo.
In Brazil, because of typical hydraulic installations in apartment buildings, the static supply pressure to such appliances can be as high as 50 meters of column of water. In such circunstances, in the case of flushing valve, the user must throttle

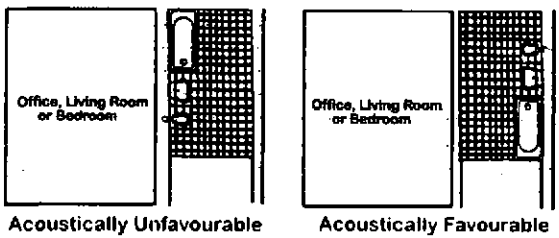
the supply control valve, normally coupled to such devices, in order to adequately regulate the flow rate to the toilet, with substantial increase in noise levels generated at the valve restriction. Furthermore, due to the typical operational characteristics of the flushing valve, the flow rate varies from zero to a maximum value during opening, and from the maximum value again to zero during the closing process. This variable flow restriction is capable of generating high noise levels, specially at the initial stages of the process.

EXPERIMENTAL RESULTS

In this work presentations will be made of the correlations of A-weighted sound pressure levels with supply pressure , for simple toilet with flush valve.

Laboratory Measurements

The bathroom layout, and particularly the plumbing layout, in relation to the sensitive areas in the same apartment or other apartments in the building, determines the sound transmission path between the noise source and the receiver. The modeling of this path is very complex because of different designs, geometries, and materials involved. Flanking transmission add to the problem. The first phase of the present study is being concentrated on the so called acoustically favourable and unfavourable layouts shown on figure below; for more details please refer to DIN 4109.



Acoustically Unfavourable Acoustically Favourable

In the laboratory, the partitions that devide the source and the receiving rooms are made of a material with a value of surface density of 100 kg/m^2 . Both rooms are in the same floor. We believe that these layouts represent the most critical situations from a noise annoyance point of view.

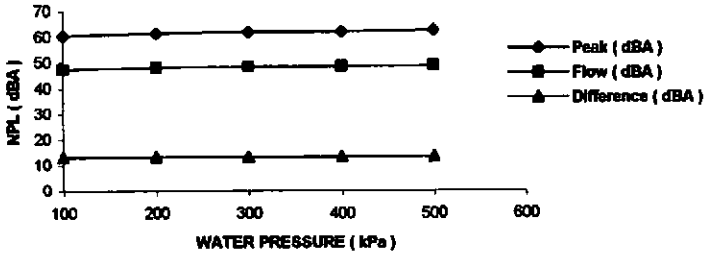
Field Measurements

The standard DIN 52219 - Measurement of noise emission from water supply installations in buildings, shows what the noise level is the composition of many partial noise of plumbing, and it does how to do the test.

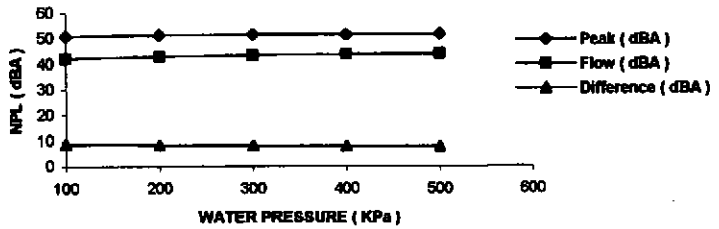
The field measurements was done based DIN 52219, using toilet with flush valve. The results below were determined by linear regression using the experimental data points.

Acustical Conditions	Static Pressure (KPa)	Toilet Flush Peak (dBA)	Toilet Flush Flow (dBA)	Peak & Flow Difference (dBA)
Unfavorable	100	60,5	47,5	13,0
Unfavorable	200	61,4	48,1	13,2
Unfavorable	300	61,9	48,5	13,3
Unfavorable	400	62,2	48,8	13,4
Unfavorable	500	62,5	49,0	13,5
Favorable	100	50,9	42,2	8,7
Favorable	200	51,3	43,0	8,2
Favorable	300	51,5	43,5	8,0
Favorable	400	51,6	43,8	7,8
Favorable	500	51,7	44,1	7,6

UNFAVOURABLE ACUSTICAL CONDITIONS



FAVOURABLE ACUSTICAL CONDITIONS



SUMMARY

In tipical house installation, it did measure Noise Pressure Level (NPL) from toilet flushes with acoustically favourable and unfavourable layouts on neighbouring roons. The datas obtains indicate there are a significant peak of noise pressure level in comparison with the noise during water flush.

REFERENCE

DEUTSCHES INSTITUT FÜR NORMUNG. Noise control in buildings. Sheet 1- Terminology. Sheet 2 - Requirements. Sheet 3 - Examples of construction. Sheet 4 - Floating screeds on concrete floors. Directives for constructings. Sheet 5 - Comments. 1962/1963. (DIN 4109).

DEUTSCHES INSTITUT FÜR NORMUNG. Messung von geräuschen der wasserinnstallation am bau. 1972. (DIN 52219/1972).