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NOISE CONTROL OF OUTDOOR MUSIC FESTIVALS - LEGISLATION AND ELECTRONICALLY AMPLIFIED MUSIC.

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1 INTRODUCTION

Flanders is a small but vibrant region with a high population density and comparable density of industrial and recreational activities, which require an even amount of mobility. For the last decades we have been experiencing an increasing number of large scale festivals and outdoor music concerts. As the number of festivals and the scale of them increased, the number of complaints of noise annoyance have increased as well.
Next to this, other remarkable observations were noticed, after we had been talking to people that really love the ambiance of music festivals.
Often the remark was made that they liked very much the bands, the music, and the music programme of the festival, but that after some time they had to leave the concert because the sound level was too high. The music was far too loud and caused more pain and annoyance than enjoyment. Although the people who made these testimonies, were real music and festival lovers, they didn't seem to be able to find the real ambiance at the concert.

2 FLEMISH AND BELGIAN LEGISLATION – A BRIEF REVIEW.

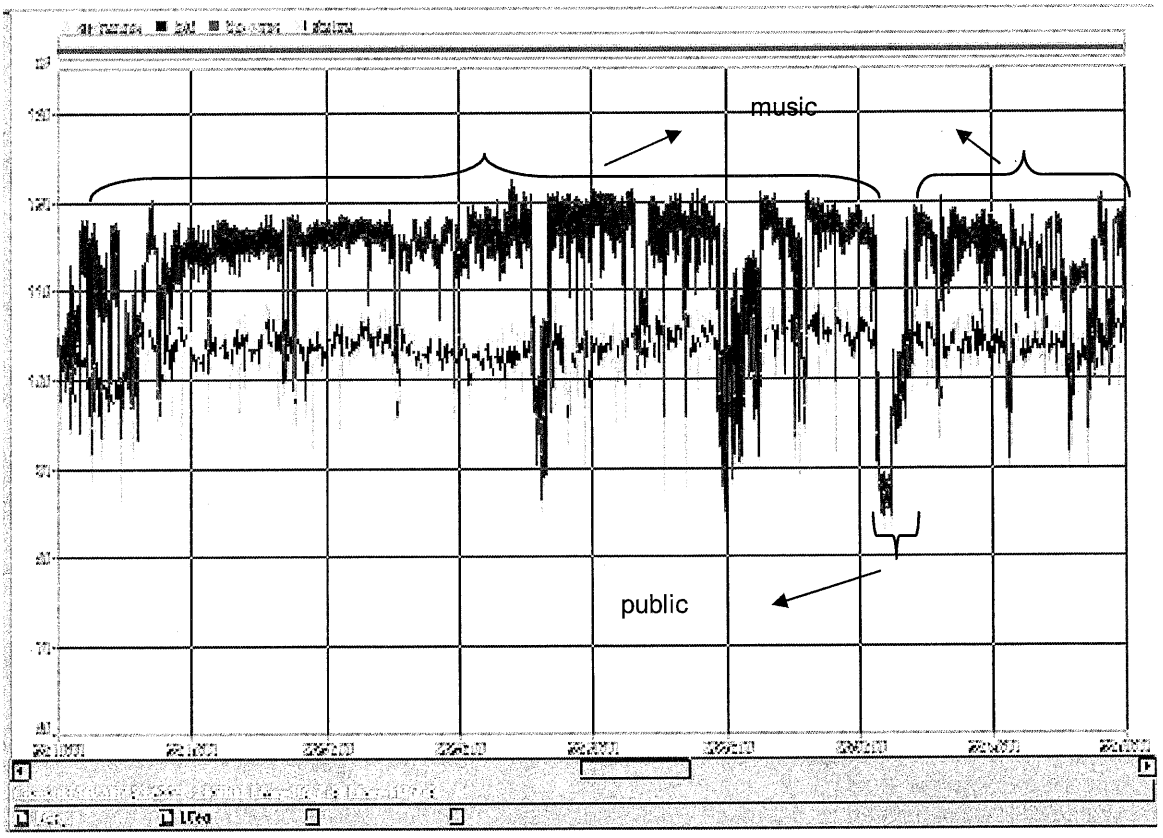
Science makes simplifying models to understand better the way natural mechanisms work. This gives birth to theories by which we can make predictions in situations where these theories apply and can control reality. In this way legislation can be seen as a juridical model with which we can control events, for example music festivals.
However, the existing legislation was rather old-fashioned and out of date.
A brief historical review of the legislation:
1/ Royal Decree from 24th of February of 1977 - Defining Surveillance of noise levels of music in public and private establishments. (1)
2/ VLAREM-2: Decree of the Flemish Government concerning general and sectoral provisions relating to environmental protection.
Chapter 4.5. Noise nuisance control.
Chapter 6.7. Non-classified music activities. (2)
3/ Local – municipal and police - regulations.

3 LEGISLATION IN DETAIL. (3)

3.1 Royal Decree from 24th of February of 1977 - Defining surveillance of noise levels of music in public and private establishments.

The sound level has to be measured in dB(A)-SLOW.
The maximum sound pressure level at emission location is limited to 90 dB(A)-SLOW. Emission location is defined by every position accessible to the public. So people can be standing close to the speakers and subsequently the measurements can be done at the same distance.
Inside the neighbouring houses, the sound pressure level due to the music has to be limited to 5 dB(A) above the background level.
Background level is defined as the minimum sound pressure level (in dB(A)-SLOW) in the absence of music noise measured over 5 minutes.
The sound pressure level due to the occurrence of music, means the instantaneous measured maximum sound pressure level caused by the music. All parameters have to be read directly from the display of the sound level meter.
This regulation was applied at first from 24 February1977 and was meant mostly for small scale music events, for example in pubs, small dancing halls, occasional music events or parties in parish halls and so on … . An example of a realistic case study will elucidate the regulation, which is still applicable.

In the bedroom of a house, a maximum level of 39 dB(A) (L_{ASmax}) was measured caused by electronically amplified music produced in the adjacent pub. In the absence of music, a background level of 19 dB(A) L_{Asmin} was measured. The difference between the two levels is 20 dB(A). According to the legislation mentioned above, the difference is limited to 5 dB(A). This means a violation of the standard of 15 dB(A). In second order a maximum level in the pub was measured: 89 dB(A). This value didn't exceed the maximum limit of 90 dB(A) and the emission limit was not violated. This legislation has worked well for more than 30 years.
The emission limit works well for protecting against hearing loss and the limit at the neighbouring homes works well to avoid noise annoyance. After dealing with many noise complaints we experienced the limits to be satisfying, at least for small cases.
With the increasing number of large music events such as festivals and open air concerts the regulation brought about problems. First of all the scale is much larger, which caused several problems when measuring the sound pressure level.
In modern music a lot more of low frequency noise is produced than thirty years ago. The A-weighting was not satisfying anymore.
Where did we have to measure the emission levels? The difference between the level near the speakers and the level at the far end of the festival site is significant, and in some cases can reach values of more than 20 dB.
In the absence of music the instantaneous sound pressure levels produced by the audience can reach values of 85 to 95 dB(A), or in the case of shouting and applauding, 100 or 105 dB(A).
The graph underneath shows the sound pressure levels in dB(A) and dB(C) measured as $L_{eq,1s}$ parameters at the PA (Public Address, the location where the music amplification is controlled), during and between the performance of two music bands.



During the gig the difference between the A-weighted and C-weighted level is remarkable, due to the fact that the music spectrum contains a large amount of low frequency noise. The noise of the audience contains sound with frequencies mainly between 300 and 4000 Hz. In this frequency domain the A- and C-weighting don't differ very much and from this point of view it is very understandable that the difference between those measured sound pressure levels is minimal. This graph is typical of the time evolution of noise levels at large scale music festivals. It shows that the old legislation can't be

applied in an appropriate way for large scale events. If the maximum level is limited to 90 dB(A) and the audience is producing 90 dB(A) or more, then a problem arises.
Chapter 6.7. of the newer VLAREM [4] legislation allows us to make an exception on this emission limit of 90 dB(A). But then we risk to have a lack of hearing protection.

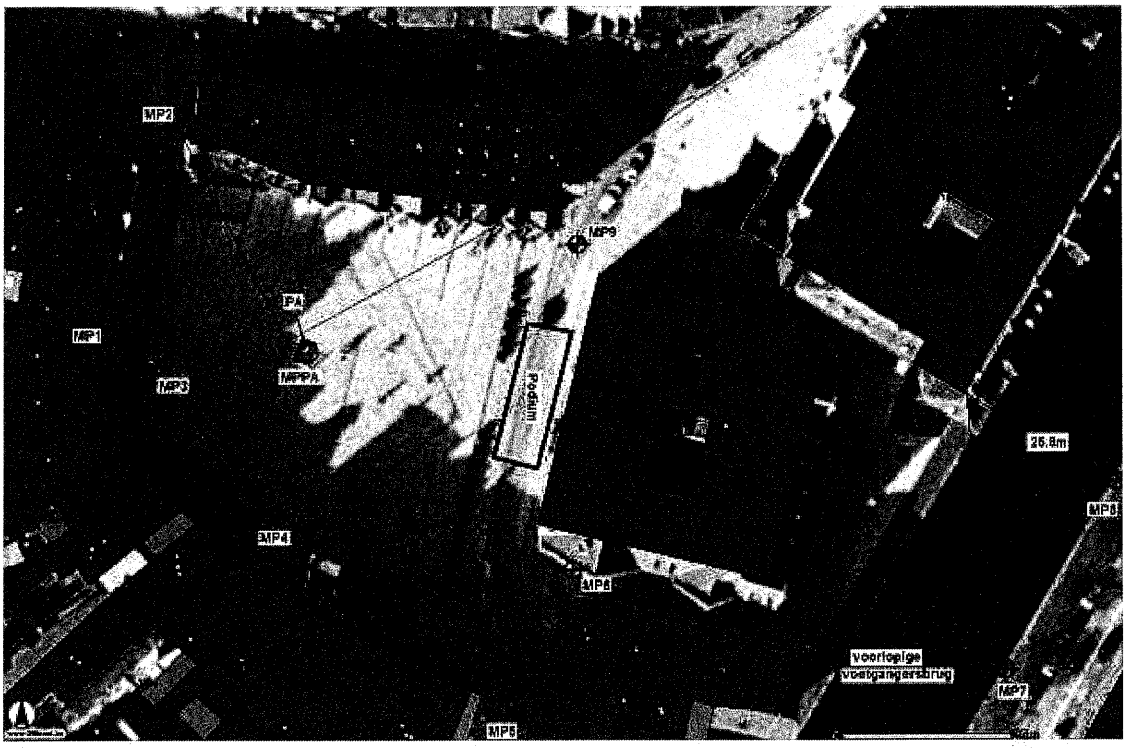
3.2 VLAREM-2 – Decree of the Flemish Government concerning general and sectoral provisions relating to environmental protection.

3.2.1 Chapter 4.5. Noise control.

This decree gives a list of so-called "environmentally classified activities" which are potentially harmful and have to meet certain regulations and limits. One of these activities are dance halls (of which the area accessible to public is equal to or exceeds 100 m² and which are used for parties on a regular basis). Chapter 4.5 states the noise regulations and limits of industrial establishments which have to be met.
The noise limits for these kind of activities depend on four different elements:
-The location of the activity (dance hall) according to the laws of planning and urbanism.
-The time of occurrence, i.e. day, evening or night. Logically the night requires the most restrictive limits.
-The specifications for new and existing activities, which are more stringent for the new ones.
Classified music activities according to the "VLAREM" legislation are defined by the following elements:
-area of rooms accessible to the public must be equal to or exceed 100 m²;
-dance facility
Special occasions such as music festivals which occur once or twice a year on the same site are not incorporated in this.
Starting from January of 1999 a new part of legislation in the "VLAREM"[4] was established: chapter 6.7.

3.2.2 Chapter 6.7. Non-classified music activities.

This chapter stipulates that the municipal administration is entitled to make an exception to the earlier mentioned legislation of the Royal Decree for music of 24 February of 1977. In case the exception is made, the noise limits aren't applicable anymore. Instead the local authority can impose new limits.
At this point our institute worked out a new noise limit accompanied with a new measuring method.
At a perimeter of 85 m around the PA (Public Address, which is located at a distance of about 35 m to the speakers) the specific sound level of the music, defined as a $L_{Ceq,T}$ measured over a period T equal to 3 to 5 minutes, has to be limited to 95 dB(C).
In other cases, for instance, with enclosed squares, measurement locations at smaller distances are chosen in the vicinity of facades of houses or apartments.
A example is given in the next figure.



MP: measurement points

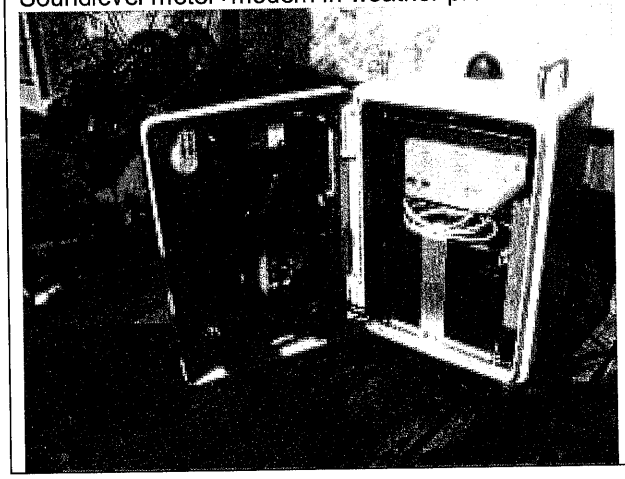
: stage location

We learned from experience that the emission spectra at PA location with which the above mentioned level of 95 dB(C) can be fulfilled have to be restricted to the following values:

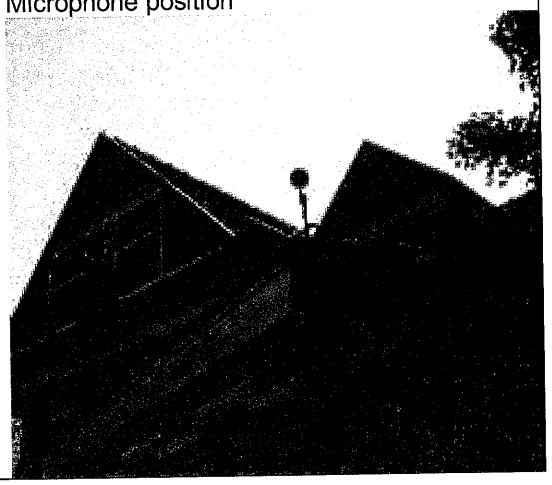
f (Hz)	1/3-oct	f (Hz)	1/3-oct
25	47	25	50
31,5	57	31,5	60
40	67	40	70
50	92	50	95
63	102	63	105
80	107	80	110
100	102	100	105
125	99	125	102
160	96	160	99
200	94	200	97
250	94	250	97
315	90	315	93
400	89	400	92
500	93	500	96
630	93	630	96
800	89	800	92
1000	85	1000	88
1250	86	1250	89
1600	90	1600	93
2000	90	2000	93
2500	87	2500	90
3150	86	3150	89
4000	83	4000	86
5000	85	5000	88
6300	82	6300	85
8000	77	8000	80
10000	72	10000	75
L	110	L	113
A	100	A	103
C	110	C	113

As the success of regulation is linked to the way enforcement is established, we wanted to develop a measurement method that is simple and effective.
The modern sound level meters on the one hand and the information and communication technologies on the other hand give us a huge range of possibilities for real-time measurements and control of the produced sound pressure levels at music concerts.
A class-1 sound level meter, coupled to a GPRS modem, is positioned at a measurement location at the afore mentioned 85 m from the PA and will measure continuously the sound pressure level. The next pictures show an example of a measurement configuration.

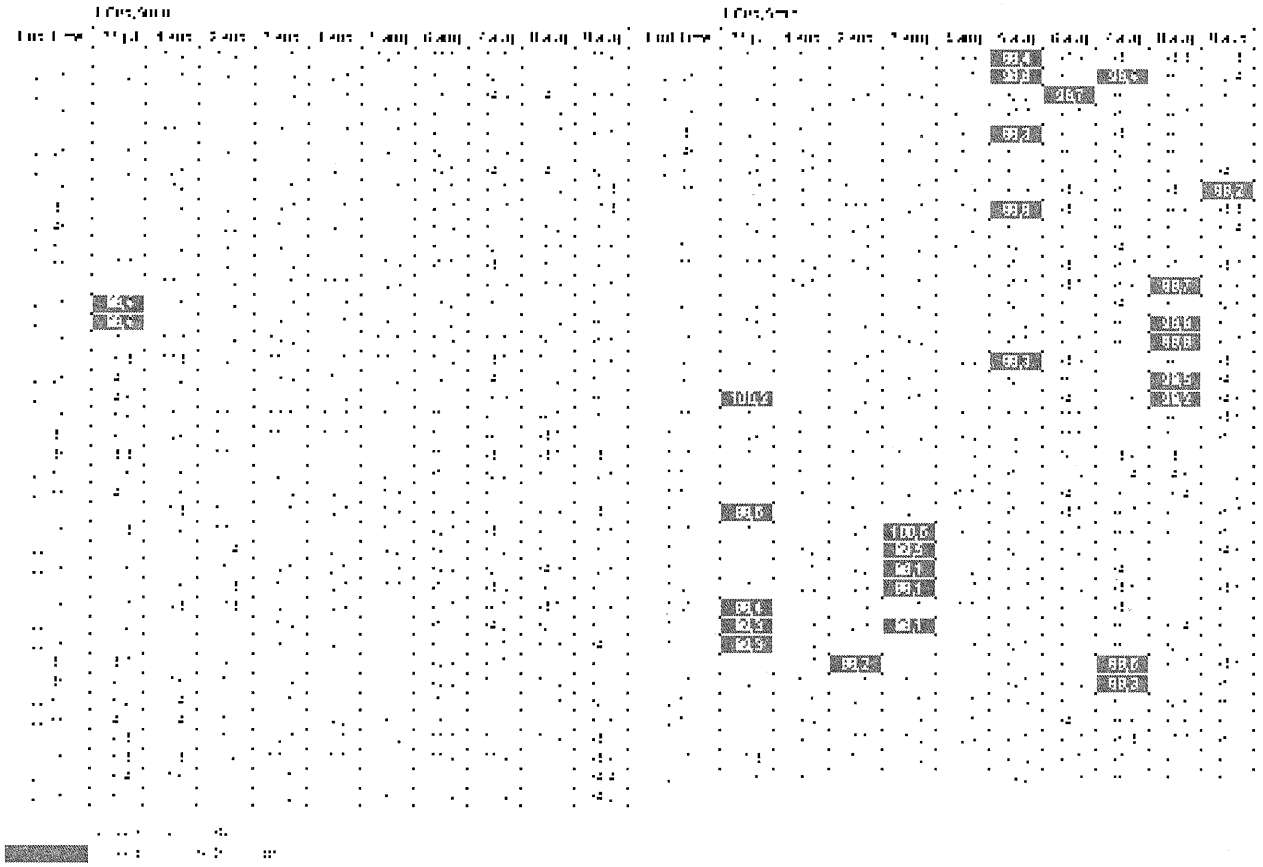
Soundlevel meter+modem in weather protected box



Microphone position



The measurement location has been discussed and approved by all parties involved in the organisation (municipal administration, police administration, organising committees, sound engineers ...). On this base the sound level meter will calculate each 5 minutes a $L_{Ceq,5min}$. The modem sends this value to a communication address that is coupled to a website application. The supervising authorities (police or environmental officers) and even the PA technicians can see the level at the approved measurement location.
In this way the emission level can be adapted when a violation of the limit at the measurement point is observed.
Afterwards, when the evaluation of the whole festival or concert is to be made, a list of $L_{Ceq,5min}$ values is available and a comparison with the noise limit can be made.
In the table below an example of an assessment of a festival in a Flemish city during 2009 is given:



It shows that 80 % of the time-blocks fulfils the regulations. 16 % exceeds the limit by 0 to 3 dB(C) and 4 % exceeds the limits by 3 to 6 dB(C). No exceedances of more than 6 dB(C) were observed.
Real efforts by the PA technicians had to be made to achieve this result.
Comparison of the log books with notifications of the telephonic complaints of noise annoyance and the exceeding of the above mentioned limit of 95 dB(C) at 85 m showed that this limit works well to reduce the amount of noise annoyance.
At concerts without limits, the $L_{Ceq,5min}$ level sometimes rises far above 120 dB(C). Due to the imposed limits and as mentioned before, the sound pressure levels at the festival site will fluctuate between 110 and 113 dB(C). At these levels the risk of hearing damage is still present but is already reduced, compared to situations without limits. When the organisers are willing to promote and dispense personal hearing protection, like ear plugs, a additional reduction of risk can be obtained. Using high quality ear plugs in an appropriate way, will lead to extra sound level reductions of 15 to 25 dB.
Even if the sound pressure level increases to about 118 dB(C), the level for the individual visitor can in this way be reduced to values of less than 98 dB(C), which produces a far more acceptable risk of hearing damage.
At the same time the sound quality and ambiance of a large scale music concert can be assured.

3.3 *Local - municipal and police - regulations*

It is important to mention that the new limit and measurement method, discussed before is not yet generalised in a Royal or Flemish Decree.
As the Flemish legislation (Chapter 6.7. of 'VLAREM-2') allows local administrations only to make exceptions of the limits in the old Royal Decree (of 1977), the new limit discussed earlier can be applied in municipal and police regulations, especially tailor-made for each festival. Extra provisions, for instance about time restrictions, can be stipulated in this kind of regulations. Enforcement has to be done by local police and environmental authorities.

4 CONCLUSIONS:

Large scale festivals require modern noise limits which are less stringent than old legislation for small scaled music producing activities.
Noise limits require appropriate methods for continuous enforcement.
Modern powerful sound level meters with communication extensions give possibilities for continuous measuring sound pressure levels and advertising it on a web application.
The chosen sound pressure level which suits very well for controlling a large scale music festival is the $L_{Ceq,5min}$.
The C-weighting is appropriate for assessing loud music noise especially when it contains a large amount of low frequency noise. In this way a "one-number-characterization" can be done.
Experiences tell us that the suggested limit of 95 dB(C) at a distance of 85 m of the PA (located at about 35 m of the speakers) is a realistic limit. Although it demands an effort of the PA-technicians to diminish the emission levels at the PA. Especially excesses in the lowest frequency bands (subwoofer region) must be reduced, but in a way that a qualitative concert can still be held.
As a result of these limit and assessment methods, the annoyance in a large area around the festival is significantly reduced. Nevertheless the sound quality and ambiance at the festival site can still be guaranteed.

5 REFERENCES

1. Belgian legislation – K.B. 24-02-1977 - "Geluidsnormen voor muziek in openbare en private inrichtingen".
2. Flemish legislation – VLAREM-2:
Hoofdstuk 4.5. – "Beheersing van geluidshinder".
Hoofdstuk 6.7. – "Niet-ingedeelde muziekactiviteiten".
3. Website Flemish government: Navigator Legislation, Environment, Nature and Energy:
http://navigator.emis.vito.be/milnav-consult/
4. Flemish legislation – VLAREM: "Besluit van de Vlaamse regering van 6 februari 1991 houdende vaststelling van het vlaams reglement betreffende de milieuvergunning"