

## PROBLEMATIC OF ACOUSTICS WARNING SIGNALS ACCIDENTAL INFLUENCE IN EXTERIOR ENVIRONMENT

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**Abstract:** Article deals with evaluation of accidental noise sources in exterior environment, mainly acoustic warning and information signals related with medical activities. Impact of first aid ambulance cars from the noise load in environment point of view is often disturbing and it can be predicted hardly during drafting phase of noise prediction. This paper describes evaluation of noise level increase from warning signals to the total noise level from the traffic in urban environment. Furthermore determination of some factors increasing the noise level of acoustic signals from first aid ambulance cars are presented.

### 1 Introduction

There are several factors that influence perception of the sound by society – people:

- Discrete (interrupted) sound level. High-pitched noise is more unpleasant than interrupted noise if its level is higher than clear tone sound. [1].
- Repetitiveness or fluctuation in sound level. Clear sound change outside rivets on this direct source. On the other hand – people have tendency to get acclimatize to steady marginal sources of sound.
- People are sensitive to sleep interruption caused by noise.
- Background noise is also important, because it masks other sound sources very often.
- Impulsive or startling noises.
- Visibility of the noise source. People are more tolerant to noise if they don't see its source.
- People are preferring sounds from the nature (beside bolt) in general, than sound from anthropogenic activities.[2]
- Noise as unpleasant information. Sound from siren, horn adumbrates information that e.g. fire truck, police car or first aid car is passing through. Often even acoustic signal is not needed – noise itself e.g. from helicopter is an example of warning noise.

Environmental noise is diverse and its influence to the society – people differs by various level of the tolerance. Protection of the health is very important role for the society. On the one hand is effort of keeping allowable sound levels in exterior environment and on the other hand very often first aid ambulance cars are influencing these levels. Often it is not possible to predict number or frequency of first aid ambulance cars rides per hour and even time of acoustic signals operation, which is dependent also on traffic situation on the particular road.

## 2 Legislative conditions of evaluation

Noise evaluation in environment is legislatively given by allowable sound levels for different characters of noise sources in two values:

- Allowable equivalent noise level for filter A :  $L_{Aeq,p}$ .
- Maximal allowable equivalent noise level for filter A :  $L_{Amax,p}$ .

Slovak Republic legislative for special warning sound signals in Government of SR regulation 40/2002 allows max.  $L_A = 130$  dB, in current valid regulation MZ SR 549/2007 is in the areas of possible stay of people  $L_{Amax,p} = 118$  dB. Unpleasant noise sources from air traffic were regulated in previous Regulation of SR Government 339/2006 to the limit  $L_{Amax,p}$  for each reference times. In current valid Regulation MZ SR 549/2007 it have been reduced just to the night.

## 3 Calculation conditions of evaluation

Overall equivalent noise level e.g. from traffic in prediction:

$$L_{Aeq,p} = 10 \log 1/\Sigma t_i [ t_1 \cdot 10^{0,1L_1} + t_2 \cdot 10^{0,1L_2} + \dots t_i \cdot 10^{0,1L_i} ] \quad (1)$$

, where  $t_1, t_2, \dots, t_i$  is exposition time of each noise sources from the traffic,

$L_1, L_2, \dots, L_i$  is noise level for each noise sources from traffic,

After simplification

$$L_{Aeq,p} = 10 \log 1/\Sigma t_i [ t_1 \cdot 10^{0,1L_1} + t_2 \cdot 10^{0,1L_{2AS}} ] \quad (2)$$

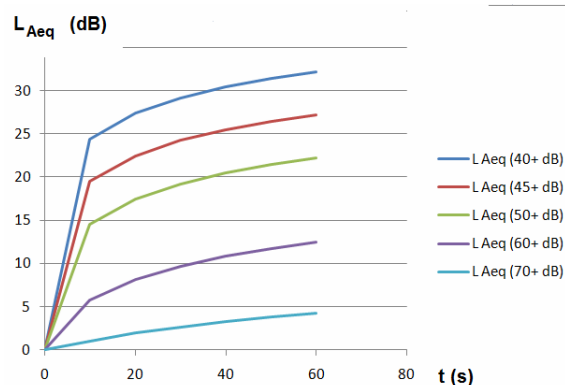
, where  $t_1, t_2$  is exposition time of noise from the traffic – calculated e.g. by software of noise study and exposition time from warning acoustic signals (AS),

$L_1, L_{2AS}$  is affection of each noise sources from the traffic and noise from warning signals e.g. first aid ambulance car warning signals.

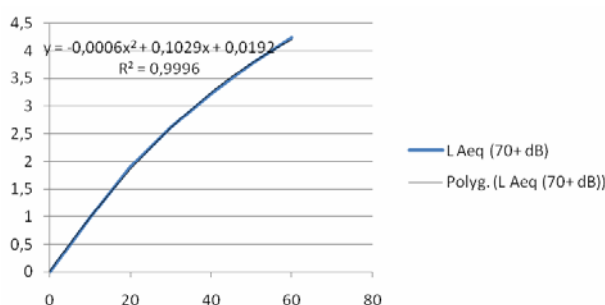
Calculation of equivalent sound level in 1 hour for acoustic warning signal at assumed level  $L_{2AS} = 90$  dB is solved for exposition time with 10 seconds increments as showed on Figure 1. Also allowed levels for each area categories are shown on Figure 1 from 40 to 70 dB together with increments of allowed noise levels and consequently shown regression equations in Table 1. [3]

**Table 1.** Noise level growth for given noise level e.g. from traffic at various exposition times  $t$  (s), if in evaluated point is  $L_{2AS} = 90$  dB with help of calculation formula

$L_{Aeq} = 40 + 3,674 \ln(t) + 16,733$	$R^2 = 0,99$
$L_{Aeq} = 45 + 3,0733 \ln(t) + 13,815$	$R^2 = 0,99$
$L_{Aeq} = 50 + 2,4774 \ln(t) + 10,917$	$R^2 = 0,97$
$L_{Aeq} = 60 - 0,105 t^3 - 1,6555 t^2 + 9,3267 t - 7,5929$	$R^2 = 0,99$
$L_{Aeq} = 70 - 0,000 t^2 + 0,1029 t + 0,0192$	$R^2 = 0,99$



**Figure 1.** Sound increments to acceptable sound levels in the area caused by accidental acoustic warning signals.



**Figure 2.** Determination of regression equations

**Table 2.** Noise level growth in various place of affection with variable  $L_{2AS}$  values and constant exposition time  $t = 20$  s.

$L_{Aeq} / L_{2AS} \rightarrow$	80 dB	90 dB	100 dB	110 dB
40 dB	57,45	67,45	77,44	87,44
45 dB	57,68	67,47	77,44	87,44
50 dB	58,1	67,52	77,45	87,44
60 dB	61,9	68,1	77,52	87,45
70 dB	70,21	71,9	78,16	87,52

Problematics of noise growth in environment during warning acoustic signal exposition from the means of transport has the following aspects:

- In some calculation simulations of traffic noise in urban environment are as inputs information about character and traffic intensity, but without ability to count with acoustic warning signals.
- During exposition of acoustic warning signals allowed noise values in environment are overload, but this sounds are accepted by people, because it is for their protection and safety.

## 4 Conclusion

Sound level growths – noise in environment from fluctuated noise sources – warning acoustic signals are influencing following matters:

- Type of acoustic warning signal – character of the sound.
- Time of warning signal exposition also depend on speed and direction of the means of transport.
- Absorbability factor of acoustic power of surfaces on surrounding buildings and terrain.
- Distance and location of evaluated point in relationship with sound source transport line.

Sound level growth has influence also on heat flow density in constructions [4].

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