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The Theoretical Models Of Ambient Noise Of Streets With Intensive Moving

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We will begin with the most simple models of an ambient noise of the street with intensive moving, when the street is uniformly filled with transport (without care of sound attenuation).

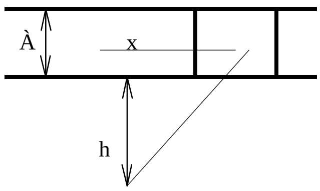

illustration 1

Let`s imagine an infinitely long and quite remote street by width A. We are looking for the noise of this street from the distance h. A unit of the length of the street gives the noise with the power W_e.

What is the noise of the whole street ? W_p — is the resulting noise of the whole street. In according with illustration 1 :

$$(1)\quad W_p = 2W_e \int_0^\infty \frac{dx}{x^2+h^2} = 2W_e\, 1/h\, \mathrm{arctg}\,(x/h)\Big|_0^\infty = 2W_e\, 1/h\, (\pi/2 - 0)$$

So,

$$(2)\quad W_p = \frac{W_e\pi}{h}$$

It means, that the noise of the remote street is inverse proportional to the distanse.

If $À \approx h_1$, that is a big street (avenue) is situated not so far, we can divide it to separate moving rows (it is done in reality). Then we can define the endowment of each narrow row with the help of formula (2) , where W_s is now the power of the noise of the street`s area`s unit (see illustration 2).

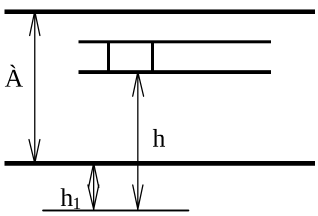

illustration 2

$$(3)\quad W_p = \int_{h1}^{h1+À} \frac{W_s\pi}{h} = W_s\pi \ln h\Big|_{h1}^{h1+À} = W_s\pi\, [\ln(h_1+a) - \ln h_1] = W_s\pi \ln\frac{h_1+À}{h_1}$$

If $À >> h_1$ è $h_1=1$ —

(4) $W_p = W_s \pi \ln À$.

The formulas (2—4) completely describe the noise of such streets.

It would be easy to begin the analysis with the situation, when the street is completely filled with the transport. Then we can say, that the unit of length or the unit of area lets out a noise, equal to the noise of one car (this value can be taken from Russian State Standards of the car`s noise, but real cars are mush noisy). Then we can calculate the noise of half-filled street, quater-filled street and so on.

The distance to the street can be taken into account with the help of formulas (2—3), and the width of the street (the quantity of rows) — by the formulas (3—4).

The results of calculations are in the table.

It must be noticed, that the maximal noise of the streets is bigger than the noise of one car by 10—15 db.

Our values of noise are a little bit bigger, than the values of other authors [1,2]. This is because we consider the fact of more intensive transport`s moving, that is nearly to reality.

The table of the street`s transport noise
(calculated with the help of “completely filled street” model)

1.	The extend of street`s filling	completely	1/2	1/4	1/16	1/32	1/64
	Correction, db.	0	-3	-6	-12	-15	-18
2.	The distance to the remote street,m. (h ≥ 30 m.)	30	50	100	300	500	1000
	Correction, db.	-15	-17	-20	-25	-27	-30
3.	The quantity of the rows(h≈ 1ì.)	1	2	4	8	10	16
	Correction, db.	0	+3	+6	+9	+10	+12
4.	The crossing of some identical equiremoting streets	1	2	4	—	—	—
	Correction, db.	0	+ 3	+ 6	—	—	—

The initial value of averaging car`s noise must be equivalent to the noise of one car, fixed in the State Standard plus 5 db., that is 85—95 db., or approximately 90 db.

Of course, such oa easy models can`t take into account all the factors. When there are an intensive moving and an intensive street`s noise we would have multiply reflection and scattering by surrounding buildings. In this case a car is not only a source, but also a scatterer of the noise. It is quite a complicated process.

The energy radiation theory is the most appropriate for solving such a complicated noise problem. This theory works with angular solidity of power`s stream in the point with beam intensity I of noise field. The source of the noise — the car — has the beam intensity of radiation field J.

The describing of the most general model is huge and it will not go in this report. But we must notice, that in the most general case we will get the integro-differential equations. So we`ll do only the calculation of noise field, scattering frequently on noising cars in the case of a narrow street without buildings (it corresponds to the first problem).

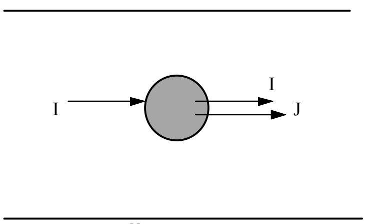

illustration 3

Let`s imaginesome established selfcoordinated field with beam intensity I, which spreads along the street. This field doesn`t depend of distance along the street because of its uniformity.

So, the beam intensity I is falling on the car (illustration 3). The same beam intensity I goes from the car, but this leaving beam intensity is equal J+I(1-4πm), where I(1-4πm) — is that we have from I after scattering in all directions on this car (m — is the scattering coefficient. We consider, that the scattering is undirectional).

(5) So, $I = J + I\,(1-4\pi m)$

(6) and $I = J/\,4\pi m$.

It means, that along the street the frequently scattering field runs (6). This field is not usually taken into account, and it must be added to the field (1,2), that increases the resulting noise of the street and changes its descriptions.

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R E F E R E N C E S

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