SoundPLAN Nord ApS, Bakkevej 26A, DK-5210 Odense NV, Denmark
phone: +45 2946 1030
www.soundplan.dk
support@soundplan.dk
CVR no.: 27 92 34 88

Mean Propagation **SP Net info 91**

Uploaded: 13.04.2011
Latest revision: 02.02.2015

In the Result Tables you can look up figures for 'mean propagation' in industry noise projects. Emission data are frequency dependant and so are screening, ground effect, air absorption etc. So how are these mean figures derived?

During calculation each line and area source is dissected in a number of sub sources. For each of those sub sources the propagation loss due to spreading, air absorption, ground effect, etc. is calculated per frequency band. If the sound power level of each sub source is denoted as $L_w,i(f)$ then the contribution to the total level $L_p,i(f)$ of this sub source per frequency band is

$$L_p, i(f) = L_w, i(f) - dL_1, i(f) - dL_2, i(f) - dL_3, i(f) - .. - dL_n, i(f) \qquad (1)$$

where $dL_1,i(f)$, $dL_2,i(f)$ … $dL_n,i(f)$ are the frequency dependant propagation losses.

The energetically sum over all sub sources and frequencies gives the unassessed contribution level of the source:

$$L_p = 10\log(\sum_{f,i} 10^{0.1*Lp,i(f)}) \qquad (2)$$

The mean propagation losses should fulfil this condition, anything else would not make sense:

$$L_p = L_w - dL_1 mean - dL_2 mean - dL_3 mean - .. - dL_n mean \qquad (3)$$

where L_w is the total sound power level of the source and dL_nmean the overall average propagation losses. In order to obtain this the following approach has been selected by the producer:

First of all mean values are only calculated for the direct sound field, meaning not for reflections.

During calculation the following intermediate values are calculated:

$$P_w = \sum_{i,f} 10^{0.1*L_w i(f)}$$

$$P_1 = \sum_{i,f} 10^{0.1*(L_w i(f) - dL_1 i(f))}$$

$$P_2 = \sum_{i,f} 10^{0.1*(L_w i(f) - dL_1 i(f) - dL_2 i(f))}$$

.

$$P_n = \sum_{i,f} 10^{0.1*(L_w i(f) - dL_1 i(f) - dL_2 i(f) - ... - dL_n i(f))}$$

which leads to:

$$dL_1 mean = 10\log(P_w) - 10\log(P_1)$$

$$dL_2 mean = 10\log(P_2) - 10\log(P_1)$$

.

.

$$dL_n mean = 10\log(P_n) - 10\log(P_{n-1})$$

Eksample:

Below the calculations are illustrated in a very simple case, a single sub source (or point source) and data in 8 octave bands. The total sound power level is 102,40 dB with the octave levels in column B, followed by the regular spreading, ground effect, screening and air absorption as a function of frequency. This gives the total sound pressure level 24,94 dB with distribution as shown in column G:

	A	B	C	D	E	F	G
1	octave	emission	spreading	ground eff	screening	air abs	immission
2							=B-C-D-E-F
3	63	83,00	61,43	-4,14	6,24	0	19,47
4	125	88,80	61,43	5,51	7,45	0	14,41
5	250	92,10	61,43	5,96	9,16	0,33	15,22
6	500	93,20	61,43	0,14	11,33	0,67	19,63
7	1000	93,80	61,43	0	13,84	1,33	17,20
8	2000	92,10	61,43	0	16,58	2,33	11,76
9	4000	89,70	61,43	0	19,45	5,65	3,17
10	8000	98,90	61,43	0	20	18,63	-1,16
11	**Total**	**102,40**					**24,94**

From these data the intermediate values Pw, P1, P2, P3 and P4 and the mean values can be calculated as shown below.

	H	I	J	K	L	M
1		Pw	P1	P2	P3	P4
2		=10^(0,1*B)	=10^(0,1*(B-C))	=10^(0,1*(B-C-D))	=10^(0,1*(B-C-D-E))	=10^(0,1*(B-C-D-E-F))
3		199526231,50	143,55	372,39	88,51	88,51
4		758577575,03	545,76	153,46	27,61	27,61
5		1621810097,36	1166,81	295,80	35,89	33,27
6		2089296130,85	1503,14	1455,46	107,15	91,83
7		2398832919,02	1725,84	1725,84	71,29	52,48
8		1621810097,36	1166,81	1166,81	25,64	15,00
9		933254300,80	671,43	671,43	7,62	2,07
10		7762471166,29	5584,70	5584,70	55,85	0,77
11	**sum**	**17385578518,20**	**12508,04**	**11425,89**	**419,56**	**311,53**
12						
13			**mean spreading**	**mean ground eff**	**mean screening**	**mean air abs**
14			=10*LOG(I11)-10*LOG(J11)	=10*LOG(J11)-10*LOG(K11)	=10*LOG(K11)-10*LOG(L11)	=10*LOG(L11)-10*LOG(M11)
15			**61,43**	**0,39**	**14,35**	**1,29**

According to (3):

Lp = Lw –dL(mean spreading) – dL(mean ground eff) – dL(screening) – dL(air abs)

= 102,40 - 61,43 - 0,39 - 14,35 - 1,29

= 24,94 dB

If you really want to study the propagation losses it is recommended to print the protocol with frequency dependant data. The mean values discussed here can be rather confusing. For example you might experience that the air absorption changes if you put up a barrier between source and receiver.