

Noise from Parking Lots and Delivery by Trucks

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The parking lot object type  can be used to calculate the sound power level from an area hosting a parking lot. The handbook states that the accompanying propagation calculation must be done according to ISO 9613 or the German RLS 90. This limitation is no longer true. Also General Prediction Method can be used to calculate the propagation, meaning that the parking lot object type has become relevant for Nordic customers.

Area object type

Up to now the regular area object type  together with emission record 'Personbil, parkeringsoperation' (# 17 in the Danish system library of SoundPLAN version 7.0 or older and # 23 in version 7.1, identical with record # 358 in the English library) has been used widely to model the emission from parking lots. The time histogram to attach to the source naturally depends on local conditions; on the index card 'General' of the record mentioned above, a duration of 30 seconds for one single movement is suggested (this time estimate has been accepted by Danish authorities in projects where accuracy is not known to be improved by using another duration).

The A-weighted sound power level of a single parking movement is 84,8 dB according to record # 17/23/358. If 40 cars arrive and leave the area during the time slice in question, the total active time of the area source is 40 minutes if based on the recommended duration of 30 sec per movement.

Please be aware that arrival is one movement and departure is a second.

The area source input mask will look like shown in Fig 1 assuming 80 movements take place during daytime.

As for the maximum sound power level only few values can be found in literature. The stated value is the author's guess.

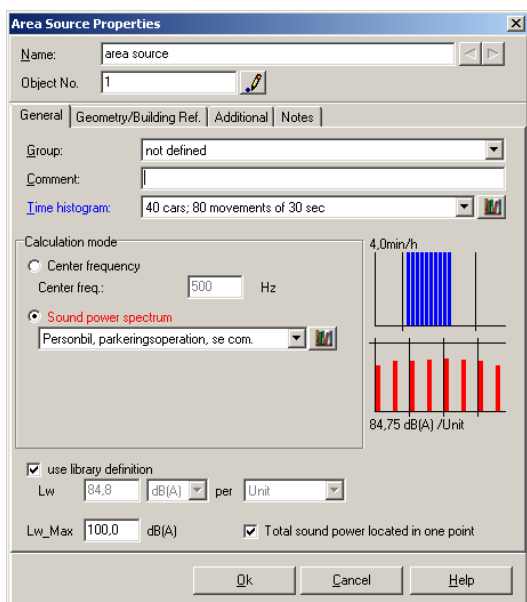


Fig 1 Input mask for area source

Parking Lot object type

This object type is an implementation of a rather extended study on noise from parking lots published by Bayerisches Landesamt für Umwelt. The study was first carried out in 1997, but has been revised in 2003 and again in 2007. All

three methods for calculating the emission are available in SoundPLAN, but for new projects it is recommended to select the youngest. An English translation of the report on the study from 2007 accompanies this Net Info. If you intend to use the Parking lot object type it might be necessary to look up additional information in the report. This Net Info is only a short introduction to the implementation in SoundPLAN.

Definitions and terms in the Bavarian report:

Vehicle motion = parking movement = one arrival OR one departure. A full event consisting of arrival and departure is in this way 2 motions/movements.

A parking procedure includes both arrival and departure, thus 2 motions.

The motion includes any possible shunting inside the parking bay, door and boot shutting, start of engine etc.

Carport = parking bay = area for one single car.

Occupancy of parking area is the total number of carports on the area.

B0 is the unit of the reference value. In most cases the unit is 1 carport. However, the report states guidelines as how to handle noise from specific parking lots as for example parking lots connected to discotheques, consumer markets, self-service department stores, discounting markets, hotels and restaurants, and in these cases the number of carports might not be the most convenient unit. In these cases 1 m² of selling area can be used, except for hotels where the unit is 1 bed, see Table 3 on page 17 in the report.

Base B is the reference value. For a regular parking lot B is equal to the number of carports; in case of shops it is the total area of the shop or the number of carports depending on your choice of B0. In case of a hotel it is the number of beds.

L_{wTeg} is the sound power levels per car motion stated as a dose referenced to 1 hour, see for example Table 18 page 49 in the report (L_{wTeg} includes a surcharge for impulses according to German guidelines which is not relevant for users within our region).

KD surcharge for passaging traffic: noise from parking lots can in general be split into two contributions, one from cars driving inside the area looking for a free carport or heading for the exit, and another from cars shunting inside the carport, shutting doors and boot, starting engine etc. The first mentioned contribution can be taken into account by adding KD to the other contribution, see formula (3) page 61 in the report. If this feature is not used, you need to calculate the contribution from passaging traffic separately by modelling line sources or use the road object type ('Separate Method').

KI surcharge for impulsiveness of the noise (not relevant for Nordic standards).

KStr0 surcharge for road surface

How to use the Parking Lot object type in SoundPLAN

Basically Parking Lot is an area object type. From your input data SoundPLAN calculates the emission and next the immission according to the chosen standard.

The object elevation should be set equal to the ground elevation. SoundPLAN automatically adds 0,5 m during the propagation calculation in order to lift the source above ground.

First select the parking lot type from the drop down list. P+R (Park and Ride) is a 'neutral' parking lot. Once the type has been selected the unit B0 is shown. For P+R the reference unit B0 is 1 carport, but for shops you can select between 1 m² of shop area or 1 carport. Additionally f – the number of carports per unit of the reference value – is shown.

Next state Base B, the size of the parking lot. For P+R areas the size is always stated in terms of the number of carports, whereas for shops you can choose between the number of carports or the size of the shop in m². Remember to define the time histogram according to your choice, see below.

From yet another drop down list you can select the type of surface of the parking lot.

If you have chosen a parking lot type from the shop categories and at the same time have selected Road surface: 'natural stone paving' it will have an effect to tick for 'low noise shopping trolley'. According to the Bavarian study the basic sound power level per motion is 2 dB lower with low noise trolleys on that surface (see Table 31).

The time histogram you attach to the source should state the number of movements per B0 per hour. Use the unit [U/h]. If your client is not able to give you specific data for how frequently the carports are being used there might be some help to get from Table 33 in the Bavarian report. In this table you can see some data for number of motions per carport per hour or motions per 1 m² selling area per hour for different types of parking lots.

If you tick for 'use typical spectrum' the propagation calculation will be based on the spectrum 'Record #60' shown in Fig 3. This spectrum is identical with the current record #60 in the English system lib. If you leave out the tick mark the calculation will be done with the overall sound power level and the propagation parameters only at 500 Hz.

The input mask might end up looking something like shown in Fig 2, in which the parking lot can host up to 40 cars and each carport is in average visited by one car (one arrival + one departure) during the time slice 07 to 17. That makes all together $40 \times 2 = 80$ movements or 0,2 movements per hour per carport.

The screenshot shows the 'Parking lot Properties' dialog box on the left and a time histogram table on the right.

Parking lot Properties Dialog:

- Name: parking lot
- Object No.: 2
- LFU Bayern 2007
- Parking lot type: P+R
- low noise shopping trolley: ☐
- Unit B0: 1 parking lot
- Base B: 40
- Road surface: Asphaltic lanes
- Time histogram: parking lot, 2 movements
- Attention: Time histogram is referring to one park movement per unit B0 and hour [U/h]
- use typical spectrum: ☒
- separated method (without KD): ☐
- Austrian method (without KI): ☒
- Max. level: 100,0
- Graph: A small bar chart showing a peak at 07-17.
- Table:

K_PA	0,00
K_I	0,00
K_D	3,73
K_Stro	0,00
Ref. Lw	82,75

Time Histogram Table:

hour	U/h
00-01	0,00
01-02	0,00
02-03	0,00
03-04	0,00
04-05	0,00
05-06	0,00
06-07	0,00
07-08	0,20
08-09	0,20
09-10	0,20
10-11	0,20
11-12	0,20
12-13	0,20
13-14	0,20
14-15	0,20
15-16	0,20
16-17	0,20
17-18	0,00
18-19	0,00
19-20	0,00
20-21	0,00
21-22	0,00
22-23	0,00
23-24	0,00

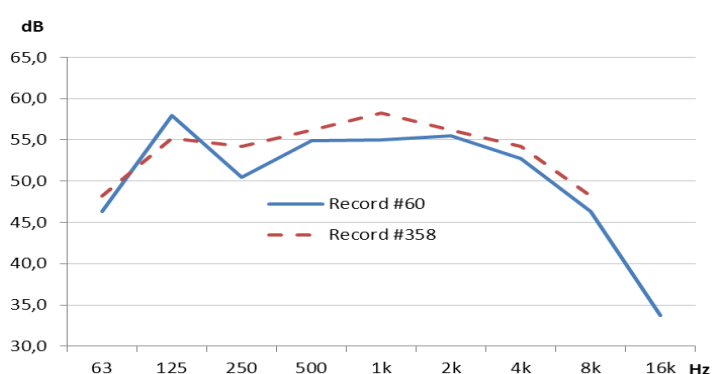
Fig 2 Input mask for parking lot object type including time histogram

If the vehicles visiting the parking lot is a mix between different categories (cars, motorbikes, lorries) you must define one area per category and select the relevant category from the drop down list under 'Parking lot type'.

Differences between the Parking lot object type and the area object type

The basic sound power level from the emission records mentioned above are pretty much the same. In Fig 3 the spectra are shown. In this figure the sound power level per motion is referenced to 1 hour. The German spectrum (#60) is a bit more frequency dependant and furthermore contains data at 16 kHz. If you believe more in the German measurements, which are considerably younger than the Danish ones, you can of course use these data together with the regular area object type (whereas the Parking lot object type is locked to the data (record #60) shown below and can only be replaced by the producer in future versions of the program).

For small parking lots with room only for few cars the outcome is more or less the same whatever object type you use. But the bigger parking lot the bigger differences due to the KD factor used by Parking lot object type. With the input data used in Fig 2 the contribution from passing traffic gives KD = 3,73 dB.



Octave [Hz]	63	125	250	500	1k	2k	4k	8k	16k	SUM
Record #60, [dB]	46,3	57,9	50,4	54,9	55,0	55,4	52,7	46,3	33,7	63,0
Record #358, [dB]	48,2	55,2	54,2	56,2	58,2	56,2	54,2	48,2		64,0

Fig 3 A-weighted sound power level per parking motion referenced to 1 hour

Noise from Delivery by Trucks

The Danish Environmental Protection Agency in 2001 financed an investigation on noise from delivery of everyday goods to shopping centres. It was performed by the Danish consultancy Carl Bro – Acoustica, now Grontmij. The report is accompanying this Net Info. Below you will find a summary of the most important findings.

Contributions to the total noise are generated partly from the truck driving to and from the platform, where the unload/load takes place, and partly from handling the goods when the truck is parked at the platform.

Sound power levels from handling the goods are stated in Table 1 below. (In Table 5.1 page 21 in the report from Grontmij the handling is further split into handling of pallets/trolleys with and without goods; please check with the report in case you have information that detailed). Typical duration from 10 to 60 minutes per delivery. If you have no specific information a duration of 30 minutes in average is a fair guess.

	Duration [%]	LwA [dB]	Frequency spectrum
Preparing for delivery/departure	10	88	1
Handling pallets and delivery trolleys on truck body	35	90	4
Handling pallets and delivery trolleys on terrain/platform	40	94	7
Lift, raise	10	82	8
Lift, lower	5		
Entire activity	100	91	9

Table 1 Duration and A-weighted sound power levels for activities during unload. Frequency spectrum refers to Table 3.

As for the driving to and from the platform an equivalent, A-weighted sound power level L_{WA} of **101,5 dB** and speed **2,5 km/h** is proposed. Frequency spectrum 10, see Table 3.

Maximum A-weighted sound power levels with time weighting 'F' is found in Table 2 on the next page.

	Maximum L_{WA} [dB]	Frequency spectrum
Handling pallets on truck body	106	12
Handling pallets on platform	112	13
Preparing for delivery/departure	106	14
Outlet of compressed air	105	15
Shutting door	99	16
Driving to and from platform	105	10
Entire activity	112	11

Table 2 Maximum, A-weighted sound power levels. Frequency spectrum refers to Table 3.

Frekvens-spekter nr.	Frekvens, Hz							
	63	125	250	500	1000	2000	4000	8000
1	-11	-11	-10	-8	-7	-6	-9	-17
2	-14	-7	-5	-6	-12	-12	-13	-21
3	-20	-10	-4	-5	-10	-14	-18	-28
4	-19	-9	-5	-5	-9	-12	-17	-26
5	-33	-18	-6	-3	-7	-13	-20	-31
6	-35	-20	-8	-4	-6	-10	-13	-23
7	-26	-17	-6	-4	-7	-11	-15	-25
8	-16	-16	-11	-2	-9	-12	-17	-25
9	-22	-14	-6	-4	-7	-11	-15	-25
10	-20	-17	-11	-8	-4	-7	-13	-21
11	-22	-14	-6	-4	-7	-11	-15	-25
12	-25	-11	-7	-6	-5	-8	-14	-25
13	-22	-14	-6	-4	-7	-11	-15	-25
14	-24	-20	-13	-9	-7	-6	-3	-19
15	-31	-22	-16	-8	-6	-6	-6	-12
16	-22	-17	-10	-7	-5	-6	-11	-19

Table 3 Frequency spectra referenced to a sum of 0 dB