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NOISE CONTROL FOR QUALITY OF LIFE

Construction noise: overview of regulations of different countries

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ABSTRACT

Regulations for the control of construction noise to the environment are often based on a balance between the interests of those who want to build and possible annoyance by neighbors near the building site. The value of these building activities for society is commonly recognized. However, people exposed to the involved noise emission expect a responsible approach from local authorities and builders. To minimize the annoyance of such activities an integral approach is necessary, taking into account practicable mitigating measures and acoustical optimization of location and period of time, especially for loud construction activities and equipment. This paper gives an overview of the way different countries regulate construction noise. Specific considerations for noise limits are described.

1. INTRODUCTION

Construction noise is an inevitable part of our society. Noise immission levels can be high depending on specific demolition and building equipment c.q. the distance to surrounding dwellings. Different countries deal in a different way with this item, addressed in laws or in general accepted guidelines. In most cases higher construction noise levels at dwellings are accepted, mostly with specific restrictions regarding duration, periods and sound reducing measures. Some regulations or guidelines also present information ways to reduce these noise levels. How the noise emission can be monitored in practice will be discussed. This paper also describes some practicable ways to reduce the noise due to building activities.

2. REGULATIONS REGARDING CONSTRUCTION NOISE IN DIFFERENT COUNTRIES

2.1 Australia

In the “Environment Protection (Noise) Policy 2007” (version 31-03-2008) under the Environment Protection Act 1993 of South Australia part 6, Division 1 deals with construction noise.

Construction activity in this division includes:

- demolition work, site preparation work and building maintenance or repair work;
- the operation of vehicles within, or entering or leaving, a construction site;
- any activities, at or within the immediate vicinity of a construction site, of persons who

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perform work at the site, or work connected with the work at the site.

Construction activity resulting in noise with an adverse impact on amenity must not occur on Sunday or other public holiday, and on any other day except between 07.00 and 19.00 hours. Exception of those rules is possible to avoid an unreasonable interruption of vehicle or pedestrian traffic movement, or if other grounds exist that authority determines to be sufficient.

All reasonable and practicable measures must be taken to minimize noise resulting from the activity and to minimize the impact, including (without limitation):

- commencing any particularly noisy part of the activity after 09.00 hours;
- locating noisy equipment or processes so that their impact on neighboring premises is minimized (maximizing the distance, create barriers etcetera);
- shutting or throttling down machinery whenever it is not in actual use;
- ensuring that noise reduction devices such as mufflers are fitted and operating effectively;
- ensuring that equipment is not operated if maintenance or repairs would eliminate or significantly reduce a characteristic of noise resulting from its operation that is audible at noise-affected premises;
- operating equipment and handling materials as to minimize impact noise;
- using off-site or other alternative processes that eliminate or lessen resulting noise.

Construction activity results in noise with an adverse impact on amenity if measurements show that the source noise level (continuous) exceeds 45 dB(A) or (maximum) exceeds 60 dB(A). However, if measurements of ambient noise at the noise-affected premises show that the ambient noise level (continuous) exceeds 45 dB(A), the construction activity does not result in noise with an adverse impact on amenity unless the source noise level (continuous) exceeds the ambient noise level; the same principle relates to maximum noise levels.

The “Noise environment protection Policy” (Environment Protection Authority) of January 2010 describes in paragraph 9.4 noise regulations. Subject to time restrictions outlined below, noise from building work is permitted to exceed the noise standard provided the work is carried out in accordance with AS 2436 (“Guide to Noise Control on Construction Maintenance and Demolition Sites”).

Distinction is made between building works requiring and not requiring building approval. If a building approval is required, time restriction apply upon the length and duration of the work approval:

- In industrial areas, city center and town centers, noise from building work can only exceed the noise standard between 07.00 and 20.00 hours from Monday to Saturday and between 08.00 and 20.00 hours on Sunday and public holidays;
- Noise from work which takes longer than two weeks to finish (for the entire project) can only exceed the noise standard between 07.00 and 18.00 hours on Monday to Saturday, excluding public holidays, also during the first two weeks of the project. The aim of this is to prevent exceeding the noise standard on Sundays and public holidays so that people have some respite from the noise by the building project.

If no building approval is required, the noise standard can only be exceeded for less than 40 hours in an 8 week period between 07.00 and 20.00 hours from Monday to Saturday and between 08.00 and 20.00 hours on Sunday and public holidays.

2.2 Canada

Municipal regulations, which are enacted through bylaws, generally cover noise emissions. Some regulations limit the noise levels at the property lines of the emitters, while others limit the noise at the point of perception, which for example, may be inside a residential bedroom or on a deck or balcony of a residence.

2.3 France

Regarding environmental noise caused by building activities “La code de la sante publique” describes that according to article R 1334-36 attention to the environment is characterized by one of the following circumstances:

- if the prescriptions in a building permit is not respected;
- if precautions for limiting the noise emission is insufficient;

- in case of high noise emission.

The end user of the building project and the constructor are responsible for respecting the environment. Some local regulations contain additional prescriptions regarding working hours, which may be included in the building permit. As example: in Paris building activities are not allowed on working days between 22.00 and 07.00 hours, on Saturdays between 22.00 and 08.00 hours and on Sundays and general feast-days without prior authorization by the authorities. There are no general applicable noise limits.

2.4 Germany

Regulations to control construction noise can be based “Gesetz zum Schutz vor schädlichen Umwelteinwirkungen durch Luftverunreinigungen, Geräusche, Erschütterungen und ähnliche Vorgänge” – Bundes-Immissionsschutzgesetz – BImSchG of 26th of September 2002 (version 23-10-2007). According to this law building sites do not need an environmental permit. Building noise can be assessed according to the regulations in “Allgemeine Verwaltungsvorschrift zum Schutz gegen Baulärm – Geräuschimmissionen” of the 19th of August 1970 (shortly “AVV-Baulärm”), Vorschriftensammlung der Staatlichen Gewerbeaufsicht Baden-Württemberg. Table 1 shows the noise limit according to this AVV-Baulärm.

Table 1 – Noise limits according to AVV-Baulärm

Week day	Assessment period	Duration	WR	WA	MI	GE	GI
Working day	07 – 20 hrs	13 hours	50	55	60	65	70
	20 -7 hrs	11 hours	35	40	45	50	
Sunday/ Feast-day	7 – 20 hrs	13 hours	50	55	60	65	70
	20 – 7 hrs	11 hours	35	40	45	50	

The last five columns refer to different types of areas:

WR = only dwellings

WA = mostly dwellings

MI = mixture of dwellings and industry

GE = mostly industry

GI = only industry

Corrections to the noise limits of table 1 should be applied according to specified resting hours as shown in table 2.

Table 2 – Time corrections related to average duration of building activities

Average duration of building activities		Time correction [dB(A)]
Daytime 07.00 – 20.00 hours	Nighttime 20.00 – 07.00 hours	
Up to 2 ½ hours	Up to 2 hours	10
From 2 ½ to 8 hours	From 2 to 6 hours	5
Above 8 hours	Above 6 hours	0

Noise reduction measures are obliged according to AVV-Baulärm if an exceeding occurs above 5 dB. For that purpose AVV-Baulärm describes measures to reduce construction noise regarding the organization of the building site, provisions regarding building equipment, application of low noise equipment, application of low noise ways of working, limiting the working hours of especially noisy equipment. Noise reducing measures are not obliged if ambient noise is so high that the contribution of building noise as expected does not increase the noise impact, so such a reduction is not effective for the noise immission levels.

2.5 Netherlands

In 2010 a new governmental guideline with recommendations regarding construction noise to the environment was published (“Circulaire bouwlawaai”). This is no law but a recommendation to local authorities. Since the so called ”Bouwbesluit 2012” (Building Regulations 2012) came into force, the noise limits in that guideline became legally obliged for building and demolition activities. Relatively high noise levels are allowed but with a limited duration time. Table 3 shows these noise limits during working days (Saturday is not considered as normal working day) between 07.00 and 19.00 hour at the facade of dwellings.

Table 3 – Legal noise limits for construction noise during daytime conform “Building regulations 2012”

Day value	Up to 60 dB(A)	Above 60 dB(A)	Above 65 dB(A)	Above 70 dB(A)	Above 75 dB(A)	Above 80 dB(A)
Maximal exposure duration in days	No limit in days	Not more than 50 days	Not more than 30 days	Not more than 15 days	Not more than 5 days	0 days

As part of the application of the building permit it might be necessary to prove that the noise limits of table 3 are met, or that an official dispensation is required. For working in evening and or night time and in the weekend (including Saturday) such a special dispensation is needed at all times, unless noise levels are expected not higher than 60 dB(A). Part of a dispensation is the application of best available techniques regarding noise abatement. Formal dispensation is necessary in the following situations if the noise levels during daytime exceeds 80 dB(A) on working days between 07.00 and 19.00 hours, the noise levels do not comply with the criteria for allowable days (see table 3), if during evening or night time, or during weekends (including Saturday) construction activities are necessary with noise levels higher than 60 dB(A). Dispensation has to be granted by the local authority (or not), and may be combined with additional obligations such as specific noise limits for these exceptional construction activities, specific resting hours after a period of exceptional noise (levels or period), obligations to communicate to involved people nearby the building site. If construction noise complies with regulations of local authorities regarding building activities, no formal dispensation is required.

Table 4 shows examples of the average sound power of different equipment and activities as well as the average distance at which the noise limits of table 3 are met, assuming a working day of 8 hours.

From table 4 it appears that especially for demolition and foundation activities only at relatively large distances the noise limits can be met. Figure 1 shows average noise levels depending on distance and applicable noise limit.

For example, figure 1 shows that pile driving at a distance shorter 60 m exceeds the maximal limit of 80 dB(A). Only at greater distances than approximately 400 m the limit of 60 dB(A) is met. Pile driving without limitations in duration of that activity is not possible if dwellings are present at shorter distances than 400 m. This can cause serious problems in urban situations, and formal dispensation is needed.

Table 4 – Overview of soundpower levels of building equipment and activities with necessary average distance to dwellings

Building phase; equipment/activity	Soundpower [PWL in dB(A)]	Distance [m] at which day limit [$L_{Ar,LT}$ in dB(A)] is met				
		60 dB(A)	65 dB(A)	70 dB(A)	75 dB(A)	80 dB(A)
Demolition						
Demolition crane with scissors	108	45	25	15	10	5
Demolition crane with hydraulic breaker	125	80 - 200	55 - 125	30 - 80	20 - 55	10 - 30
Hydraulic breaker (hand-held)	112	60	40	25	15	5
Shovel 20 tons	107	40	25	15	5	5
Mobile crusher	115	85	60	30	20	10
Mobile crusher	120	130	85	60	30	20
Site preparation						
Crawler crane 20 tons	107	40	25	15	5	5
Dumper/truck	106	35	20	10	5	5
Foundation work						
Hydraulic pile driver prefab concrete piles	120 - 126	240 - 415	160 - 260	100 - 175	60 - 115	30 - 65
Pile driver steel piles	130	650	400	265	185	105
Pile driver prefab concrete piles	130	650	400	265	185	105
Bored piles (Tubex of Terr-Econ)	102	25	15	5	5	<5
Sheet piles with vibrating hammer	125	225	145	105	60	30
Sheet piles with vibrating hammer (quiet)	118	130	80	45	25	15
Completion						
Concrete mixer	107	40	25	15	5	5
Concrete pump	110	50	30	20	10	5
Concrete pump +2 trucks	111	55	35	20	10	5

Day value due to construction activities at various distances

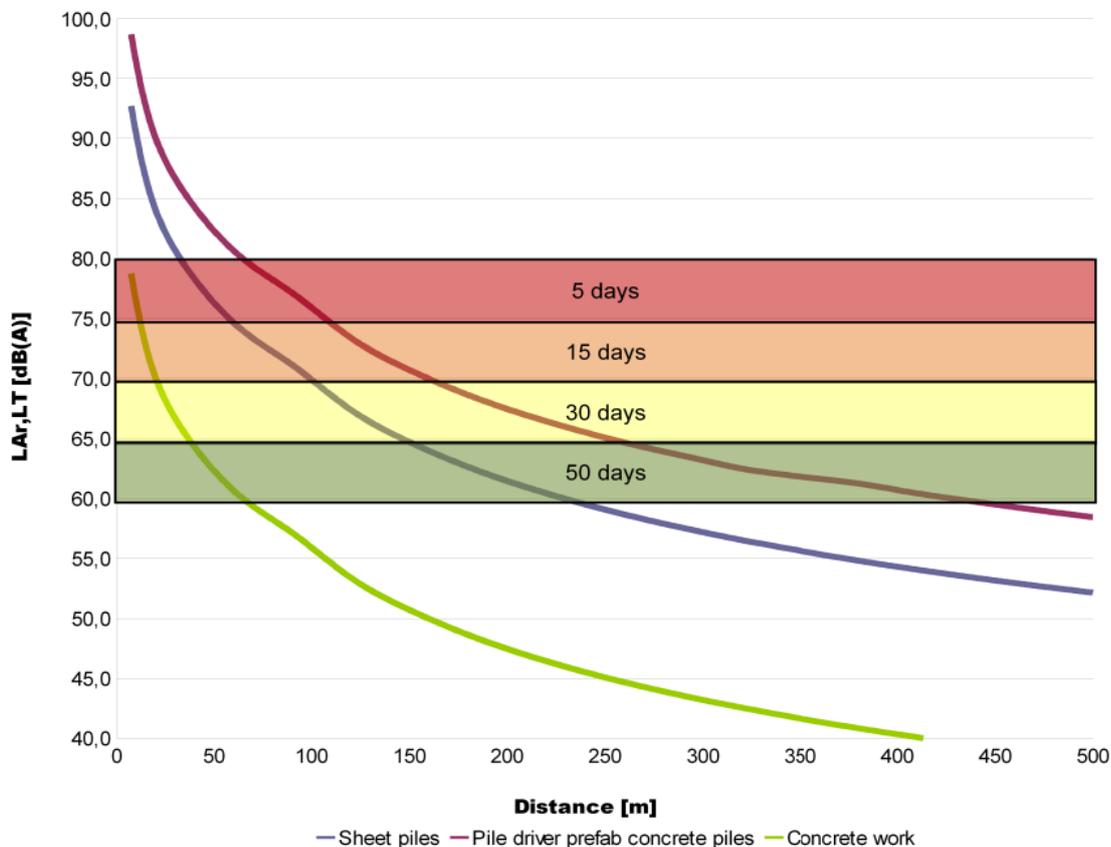


Figure 1 – Occurring noise levels due to different building activities (pile driving concrete piles, vibrating sheet piles, concrete activities) in relation to distance

2.6 Norway

Norway has a specific guideline for construction noise (“Retningslinje for behandling av støy i arealplanlegging”, T-1442/2012; guidelines for limiting noise from building and civil engineering). It is meant to provide guidance for local authorities regarding regulations and conditions in the framework of permits under the Planning and Building Act. It also provides a template for noise requirements that can be applied in contracts, tender documents and environmental monitoring programs. A distinction is made between major and minor works.

For major works the noise limits are as follows. Construction activities with a total duration no longer than 6 weeks should not exceed the limits in table 5. If operation time exceeds 6 weeks, stricter limits for day and night apply as shown in table 6. All limits concern equivalent sound levels, incident sound pressure level at the outside of rooms with noise sensitive applications.

Table 5 – Recommended basic outdoor noise limits for construction activities

Building type	Noise level day period ($L_{pAeq12h}$ 07-19)	Noise level evening period ($L_{pAeq12h}$ 19-23); Sundays, feast days ($L_{pAeq12h}$ 07-23)	Noise level night period ($L_{pAeq12h}$ 23-07)
Homes, cottages, hospitals, health care centers	65	60	45
Schools, daycare	60 during times of use		

Table 6 – Correction for construction or operational phase of period length (rounded to whole weeks / months). Stricter noise limits from table 4 for operations that provide noise pollution for longer time than 6 weeks

The length of the building period	Correction of noise limits of table 4
0 – 6 weeks	0 dB
6 weeks to 6 months	3 dB
More than 6 months	5 dB

If several construction projects are affecting the same neighborhood at the same time or shortly after each other in time, it must be treated as a continuous work operation, provided that the break between two operations period of is no longer than one month.

There are special regulations for working at night. Noisy operations and activities should normally not occur at night. If, in exceptional cases deviation from this is permitted, and the noise limits in table 5 are exceeded, deviations should only be allowed if night work has a short duration. Noise limit can then be raised from 45 to 50 dB(A) if it takes less than two weeks of operation and to 55 dB(A) if it takes less than one week. Maximum noise level, L_{AFmax} , during night time should not exceed the equivalent level with more than 15 dB.

In some situations it may be appropriate to require limits to the indoor noise levels as specified in table 7, for example when working in the building structure or where a high outdoor noise can only be reduced with sound insulation measures. The recommended limits in table 7 are not to be adjusted for long term work. For tunnel works, underground installations in case of clearly hearable drilling and hammering noise the values in table 7 are 5 dB lower.

Table 7 – Recommended indoor noise limits for construction activities

Building type	Noise level dayperiod ($L_{pAeq12h}$ 07-19)	Noise level evening period ($L_{pAeq12h}$ 19-23); Sundays, feastsdays ($L_{pAeq12h}$ 07-23)	Noise level night period ($L_{pAeq12h}$ 23-07)
Homes, cottages, hospitals, health care centers	40	35	30
Noise sensitive working stations	45 during times of use		

If the noise limits in table 7 in special cases can not be met, a special rule of notification is applicable. Deviations should only be allowed for short term operation up to two weeks, and noise limits should not be raised by more than 5 dB. If the sound in or near residential areas with noise sensitive application have an impulse or pure tone character, the noise limits mentioned above have to be sharpened by 5 dB. This is not needed for rare or atypical events.

For operations where it is not possible to comply with the limits, operating restrictions should be used and any alternative residence for those who are affected should be offered. For minor works, noise requirements as described above, do not have to be applied. As minor works are considered activities that only take place during day time (07.00 – 19.00 hours), weekdays, that do not affect any other objects than neighboring homes, accommodation or jobs, have as noisy phase a duration of maximal two weeks of L_{pAeq} less than 70 dB(A) every day, or a period of maximal one week with L_{pAeq} less than 75 dB(A) every day, the scope of the operation is not greater than the corresponding construction of two detached houses, drilling / jack hammering / sheet piling / pile driving activity and the corresponding dominant activity takes not more than two days and spaced at least 30 m from the nearest building, neighbors are notified in a specific way as directed.

Both major and minor construction work should be notified to neighbors and others exposed to significant noise. Notification should always include notices at the construction site, and personal information to the most affected neighbors. Information to larger number of households and the use of local newspaper should be considered when the size of the project dictates this. For large projects, such as lasting more than half a year, night mode or with particularly noisy activities, information sessions for affected residents should be held also. This notification should include at least reference to the regulations, the nature and the reason why the noisy works are necessary, stipulated period for noisy activities (calendar days), daily working hours and type of activity, who is responsible (telephone and address of workplace).

In addition it should inform about what is done to reduce the noise (e.g. choice of noisy methods / machines, any shielding, any reduction in operating time, etcetera). Public information about major and / or noisy activities should be given as a normal part of the planning process, so that the affected neighbors have the opportunity to take precautions. When the operation to be started concerns particularly noisy activities such as blasting, sheet piling / pile driving, work at night people should be notified separately and no later than one week before work starts. For less severe work people should be notified 1-2 days before and no later than when the work begins. Other noisy activity should be notified no later than 3 working days before the start of the operations.

2.7 USA; New York City

How to deal with construction noise provides the city of New York in the “NYC DEP Noise Code and Construction Noise Regulation”. The following information is extracted from plenary session paper at Internoise 2012.

Part of it is that contractors will need to develop, and post conspicuously for inspection and review, a suitable Noise Mitigation Plan detailing the steps and mitigation measures they will use to control construction noise. Alternative noise mitigation plans can be allowed for special purposes. It contains required general noise mitigation measures. Contractors will certify that all the equipment used on site will comply with specific noise emission limits for generic types of equipment. If noise complaints are received, NYC DEP inspectors will measure and evaluate noise emissions from the contractor’s equipment to ensure compliance with the guidelines. It specifies mitigation provisions, such as:

- All devices must be equipped with appropriate mufflers and silencers.

- Housing doors on equipment will be shut during operations, and the equipment will operate at the lowest possible power level.
- Portable small equipment, such as generators, pumps, and compressors, will be covered with a noise enclosure.
- A 15-foot tall noise barrier or curtain system will be used around the perimeter of the job site when the site is within 200 feet of a receptor.
- Normal hours for construction will be 07.00 to 18.00 hours, unless the contractor's Noise Mitigation Plan for after-hours operations is accepted.
- Specific noise mitigation requirements and suggested additional mitigation options are provided for five general categories of particularly noisy construction equipment, including impact devices (e.g. pile drivers, jackhammers, hoe rams, and blasting), earth moving equipment (e.g. vacuum excavators), trucks and vehicles (e.g. dump trucks), stationary equipment (e.g. cranes, auger drill rigs, street plates, backup alarms), manually operated equipment (e.g. concrete saws).

3. SOME GENERAL OBSERVATIONS FROM NATIONAL REGULATIONS

In different countries no legislation or regulations on a national level exist regarding construction noise. It is mostly regulated on a local level. Some countries have general accepted guidelines that provide recommendations for local authorities. In general specific noise levels and periods of time have to be respected. These noise limits are sometimes depending on the kind of area where building activities take place (city center or industrial area versus rather quiet urban areas, or on the ambient noise), and / or on the duration of the noisy activities: the longer they take, the more severe the noise limits. Mostly only noisy building activities during normal working days (sometimes also excluding Saturdays) during daytime are allowed. Daytime is between 07.00 and 19.00 hours or 20.00 hours, sometimes varying with the kind of week day (normal working day versus Sunday or feast day). In many cases building activities during evening and night time are not allowed.

Dispensation from those general rules is possible if there are specific arguments for that and mostly only if all possible mitigation measures are applied. Also communication to the public may be obliged.

4. MITIGATION MEASURES

Mitigation measures might concern:

- low noise equipment;
- additional sound reducing devices at the source or in the transmission way;
- specific organization of the building activities regarding location of stationary noisy equipment (largest possible distance to dwellings) respectively mobile equipment, routes for lorries, working hours.

5. PROGNOSIS AND NOISE MONITORING

In many cases no obligation regarding a prognosis prior to the start of the building project or the monitoring during the building process is prescribed. An adequate prognosis can show that reasonable noise limit can be met, or special dispensation has to be granted. The effect of sound reducing measures can be taken into account. However these calculations are based on assumptions that can be different from real practice afterward, because it may be necessary during execution of the building project that working periods or locations have to be changed due to unforeseen circumstances. For that reason it may be obligatory to do noise monitoring during the project by the local authority and it might be also a way to obtain confidence from inhabitants of dwellings surrounding the building site. By noise monitoring the building company is able to prove that noise limits were met (or not ...). It also provides the possibility to interfere in the building process if exceeding of noise limits is likely to take place without adjusted continuation. Noise monitoring has to be done at adequate locations, not too far from the building site to prevent the influence of changing wind conditions and disturbing ambient noise. Figure 2 shows equipment developed by Peutz for long term noise monitor.

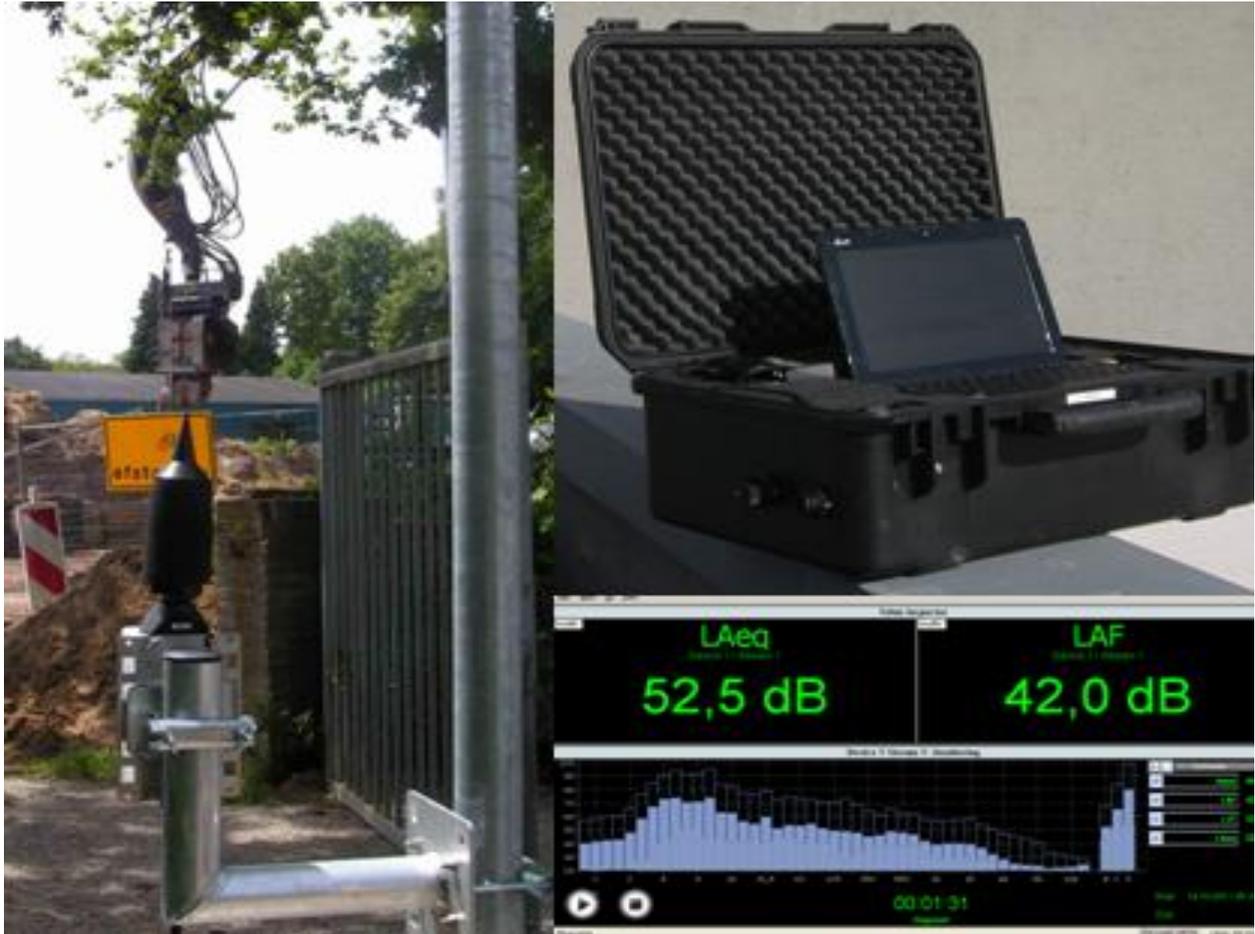


Figure 2 – Noise monitoring system by Peutz

6. COMMUNICATION

Communication in time about noisy construction activities (kind of activity, duration, part of the day) appears to be crucial to prevent severe complaints from the neighborhood due to relatively noisy activities. This is especially true for activities during night time.

7. CONCLUSIONS

It is recommended to investigate whether reasonable noise limits can be met prior to the start of the building project. Noise monitoring is sometimes recommendable to control during the building process whether the noise limits tend to be exceeded, so that noise levels can be reduced. Also mitigation measures can be part of the permit.

In general noise limits relate to L_{Aeq} -values for a defined period of the day. Sometimes additionally high peak levels that might be experienced as extra annoying are prescribed with specific limits. Clear communication with the neighborhood is recommendable also.