TECHNICAL MEMORANDUM ON NOISE FROM PERCUSSIVE PILING

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TECHNICAL MEMORANDUM ON NOISE
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1. PRELIMINARY

1.1 Citation and Commencement

This Technical Memorandum is issued pursuant to section 9 of the Noise Control Ordinance and may be cited as the Technical Memorandum on Noise from Percussive Piling. **This Technical Memorandum shall replace the existing one that was originally published under section 11(1) of the Noise Control Ordinance in Special Supplement No.5 to Gazette Extraordinary No.38 Vol. CXXX on 7 November 1988 and came into operation on 7 December 1988.** This Technical Memorandum shall come into operation in accordance with section 12 of the Noise Control Ordinance.

1.2 Application and Scope

This Technical Memorandum details the procedures that should generally be adopted by the Authority:

for determining (on the basis of the calculated noise level) ~~the~~ **any** permitted hours of operation for percussive piling;

for the issuing of Construction Noise Permits for percussive piling pursuant to section 8 of the Ordinance; and

for determining whether or not any Construction Noise Permit for percussive piling is being complied with.

1.3 Interpretation

In this Technical Memorandum, unless the context otherwise requires, the following definitions apply:

"Authority" has the same meaning as in the Ordinance;

"Construction Noise Permit" has the same meaning as in the Ordinance;

"diesel hammer" means a device which imparts a percussive force to a pile by means of the downward motion of a ram which causes the compression and ignition of a charge of diesel fuel;

"double acting ~~hammer~~" ~~means~~ **describes the working principle of** a ~~device~~ **piling hammer in** which ~~imparts~~ a percussive force **is imparted** to a pile by means of the direct or indirect impact of a **ram or** piston ~~in a cylinder~~ falling under the force of gravity with an additional downward force being exerted by ~~means of the injection of~~ a fluid at high pressure ~~into the cylinder above the piston~~, the **ram or** piston being raised by means of ~~the injection of~~ **a force imparted by** a fluid at high pressure ~~into the cylinder beneath the piston~~;

"drop hammer" means a device which imparts a percussive force to a

pile by means of the direct or indirect impact of a mass falling under the force of gravity alone, the mass being raised by means of a crane or winch;

"hydraulic hammer" means a device which imparts a percussive force to a pile by means of the downward motion of a ram or piston which follows the single or double acting principle and is powered by hydraulic fluid at high pressure;

"internal drop hammer" means a drop hammer used in such a manner that the point of impact is at or near the bottom of the pile casing, the casing being a hollow steel tube within which the action of the hammer takes place;

"Ordinance" means the Noise Control Ordinance;

"percussive piling" has the same meaning as in the Ordinance;

"pile" has the same meaning as in the Ordinance;

"piling" has the same meaning as in the Ordinance;

"piling zone" means an area within which percussive piling may take place, as specified in a Construction Noise Permit;

"pneumatic or steam hammer" means a device which imparts a percussive force to a pile by means of the downward motion of a ram or piston which follows the single or double acting principle and is powered by air or steam at high pressure;

"Secretary" has the same meaning as in the Ordinance; and

"single acting ~~hammer~~" ~~means~~ **describes the working principle of** a device **piling hammer in** which ~~imparts~~ a percussive force **is imparted** to a pile by means of the direct or indirect impact of a ram **or piston** falling under the force of gravity alone, the ram **or piston** being raised by means of a force imparted by a fluid at high pressure.

Standard acoustical terminology is used throughout this Technical Memorandum. Other terms are as defined in the Ordinance or in the text of this Technical Memorandum.

1.4 General Introduction to the Procedures

For the purpose of determining if a Construction Noise Permit for percussive piling should include restrictions on the hours during which percussive piling may take place (referred to in this Technical Memorandum as the permitted hours of operation) the Authority shall act in accordance with the following general procedures which are detailed in subsequent sections. The Authority shall:

(a) identify the most affected Noise Sensitive Receiver and determine the appropriate Acceptable Noise Level (in accordance with Sections 2.1 and 2.2);

(b) calculate the Corrected Noise Level which will be generated by the percussive piling at the Noise Sensitive Receiver (in accordance with Sections 2.3 to 2.8); and

(c) determine the appropriate permitted hours of operation for the percussive piling by comparing the Corrected Noise Level with the Acceptable Noise Level (in accordance with Sections 2.9 and 2.10).

The Construction Noise Permit issued by the Authority shall include the permitted hours of operation as a condition, and may include such other conditions as the Authority considers appropriate, such as the permissible piling methods and pile types which may be used, the area within which percussive piling may take place (referred to in this Technical Memorandum as the piling zone), the dates of commencement and expiry of the Construction Noise Permit and any special noise control measures that must be adopted. **In particular, a more stringent criterion shall be applied to the use of diesel, pneumatic and steam hammer pile drivers.**

A Construction Noise Permit may be issued for an initial period of such duration as the Authority considers appropriate, and may be renewed before or after the date of expiry for such further period or periods and subject to such alterations or new conditions as the Authority considers appropriate.

Construction Noise Permits for the carrying out of non-percussive piling are only required between 1900 and 0700 hours or at any time on a general holiday, including Sunday, and may only be issued in accordance with the Technical Memorandum on Noise from Construction Work other than Percussive Piling.

2. DETERMINATION OF THE PERMITTED HOURS OF OPERATION FOR PERCUSSIVE PILING

2.1 Step 1--Location of the Most Affected Noise Sensitive Receiver (NSR)

The NSR which will be most affected by noise from the percussive piling shall be identified.

For the purpose of this Technical Memorandum any domestic premises, hotel, hostel, temporary housing accommodation, hospital, medical clinic, educational institution, place of public worship, library, court of law, performing arts centre or office building shall be considered to be a NSR. Any other premises or place, not being in the nature of industrial premises, which is considered by the Authority to have a similar sensitivity to noise as the premises and places above shall also be considered to be a NSR. Any premises or place shall, however, be considered to be a NSR only when it is in use for its intended purpose.

2.2 Step 2--Determination of the Acceptable Noise Level (ANL) for the Noise Sensitive Receiver (NSR)

The Authority shall determine the appropriate ANL for the NSR under consideration from Table 1. If Table 1 is not directly applicable to the NSR under consideration the Authority may make use of such ANL as it considers appropriate.

If in the opinion of the Authority the NSR will be materially affected by noise from percussive piling associated with more than one CNP, the Authority may make such correction to the ANL

as it considers appropriate having regard to standard acoustical principles and practices.

2.3 Step 3--Sound Power Levels for Percussive Piling

The sound power level of each of the percussive piling units included in the CNP application shall be obtained from Table 2 having regard to the piling method and pile type combination. If any piling method and pile type combination included in the CNP application does not appear in Table 2 the Authority may make use of such sound power level as it considers appropriate.

2.4 Step 4--Summation of Noise Levels

The sound power levels obtained in Step 3 shall be summed logarithmically in accordance with Table 3 to obtain a total sound power level.

2.5 Step 5--Distance Attenuation

The plan distance or, where appropriate, the slant distance between the NSR and the pile location nearest to the NSR shall be determined.

The position of the pile location nearest to the NSR shall be selected having regard to any pile layout drawing supplied by the CNP applicant. If no such drawing is supplied to the Authority the position shall be taken to be the position on the piling zone boundary nearest to the NSR.

The appropriate correction factor for distance attenuation shall be obtained from Table 4. This correction factor shall be subtracted from the total sound power level obtained in Step 4 to give the Predicted Noise Level (PNL) at the NSR.

2.6 Step 6--Corrections for the Effect of Barriers

In cases where the Authority considers that all of the percussive piling will be totally screened by a substantial barrier **such that none will be visible** when viewed from **any window, door or other opening in any facade of** the NSR, a negative correction of 10 dB(A) shall be applied to the PNL obtained in Step 5.

Substantial barriers shall be taken to be large solid objects, such as buildings or topographical features, which will act as effective acoustic screens. Barriers which are small, lightweight, incomplete or temporary, such as site fences or hoardings, are not to be considered.

In cases where the NSR is a building directly adjacent to the construction site such that none of the percussive piling will be visible when viewed from any window, door or other opening in any facade of the NSR, the NSR shall be considered to be partially screened and a negative correction of 5 dB(A) shall be applied to the PNL obtained in Step 5. ~~Where, in similar cases, the NSR is separated from the construction site by another building such that none of the percussive piling will be visible when viewed from any window, door or other opening in any facade of the NSR, the NSR shall be considered to be totally screened.~~

2.7 Step 7--Correction for Acoustic Reflections

In cases where the NSR is a building, a positive correction of 3 dB(A) shall be applied to the PNL obtained in Step 5.

An additional positive correction of 3 dB(A) may be applied to the PNL in cases where the Authority considers that noise levels at the NSR will be increased due to the confined or reverberant nature of the immediate locality of the construction site or the NSR.

2.8 Step 8--Corrected Noise Level (CNL) at the Noise Sensitive Receiver (NSR)

The corrections obtained in Steps 6 and 7 shall be applied to the PNL obtained in Step 5 to give the CNL at the NSR.

2.9 Step 9--Determination of the Permitted Hours of Operation

The CNL at the NSR obtained in Step 8 shall be compared with the ANL obtained in Step 2 and the appropriate permitted hours of operation, **if applicable,** shall be determined from Table 5**A or 5B**.

The Authority may vary the timing (but not the total duration) of the permitted hours of operation if it considers that such variation would be justified by the nature or requirements of any NSR which may be affected or of the percussive piling under consideration.

The timing and total duration of the permitted hours of operation may be varied if the application is a special case as defined in Section 3. The procedures detailed in Section 3 shall then be followed.

2.10 Step 10--Construction Noise Permit (CNP) Issuing Procedure

Each CNP issued by the Authority shall include as a condition the permitted hours of operation and may also include such other conditions as the Authority considers appropriate. **When there is no permitted hours of operation for the use of diesel, pneumatic and/or steam hammers pursuant to Section 1.2 above, a CNP shall not be issued.**

When giving consideration to the renewal of CNPs pursuant to section 8 of the Ordinance the Authority may impose additional conditions or time restrictions having regard to complaints received and other relevant factors, notwithstanding the procedures and guidelines detailed in Steps 1 to 9.

3. PROVISIONS FOR SPECIAL CASES

3.1 Quiet Working Methods or Other Special Factors

Applications which contain sufficient details of any particularly quiet percussive piling methods or any special noise control measures which the CNP applicant proposes to employ, or any other special factors or exceptional circumstances which the applicant considers relevant, may be given special consideration by

the Authority. In considering such special cases the Authority may make allowances, adjustments or corrections to any of the factors in Section 2 and appropriate calculation procedures may be adopted by the Authority having regard to standard acoustical principles and practices.

Any CNP issued under this provision may include conditions such as details of the special noise control measures to be employed, acoustic performance specifications for such measures or for particularly quiet percussive piling methods to be used, maximum noise levels at the NSR or at any other positions and any other conditions which may be considered to be appropriate by the Authority.

3.2 Percussive Piling Having Important Social Implications

Where in the opinion of the Authority a CNP application is for percussive piling in connection with a project which, by virtue of its magnitude or purpose, may have significant social implications or where restrictions on the permitted hours of operation may not be in the public interest or where the carrying out of percussive piling during the permitted hours of operation might arouse considerable public concern, the Authority shall refer the matter for advice to the Secretary. In giving such advice the Secretary shall give due considerations to these factors. In such cases the Authority shall abide by any advice received from the Secretary.

3.3 Geologically Difficult Sites

The Authority shall consider a CNP application to use diesel hammers for a particular site as a special case if that site is situated in areas as designated in Scheduled Areas no. 2 and 4 in the Fifth Schedule of the Buildings Ordinance (Chapter 123). For any CNP issued under this provision, the appropriate permitted hours of operation shall be determined from Table 5A in Section 2.9.

4. TESTING FOR COMPLIANCE WITH CONSTRUCTION NOISE PERMIT CONDITIONS RELATING TO MAXIMUM NOISE LEVELS

In case where a maximum noise level has been specified as a condition of a CNP, any measurements which are taken to determine if this condition is being complied with should generally be carried out in accordance with the procedures and guidelines given in the Annex.

Table 1--Acceptable Noise Levels (ANLs)

NSR Window Type or Means of Ventilation	ANL (dB(A))
(i) NSR (or part of NSR) with no windows or other openings	100
(ii) NSR with central air conditioning system	90
(iii) NSR with windows or other openings but without central air conditioning system	85

10 dB(A) shall be subtracted from the ANLs shown above for NSRs which are hospitals, medical clinics, educational institutions, courts of law or other NSRs which are considered by the Authority to be particularly sensitive to noise.

Table 2--~~Source~~ Sound Power Levels for Percussive Piling

Piling Method* and Pile Type	Sound Power Level (dB(A))
Diesel hammer driving pre-stressed concrete pile	128
Diesel hammer driving steel pile	132
Diesel hammer driving ~~sheet~~ steel **sheet** pile	132
Drop hammer driving concrete pile	116
Drop hammer driving steel pile	126
Drop hammer driving ~~sheet~~ steel **sheet** pile	129
Hydraulic hammer (double acting) driving pre-stressed concrete pile	**126**
Hydraulic hammer (double acting) driving steel pile	**129**
Hydraulic hammer (double acting) driving steel sheet pile	**129**
Hydraulic hammer (single acting) driving pre-stressed concrete pile	**122**
Hydraulic hammer (single acting) driving steel pile	**126**
Hydraulic hammer (single acting) driving steel sheet pile	**126**
Internal drop hammer	113
Pneumatic or steam hammer (dDouble acting ~~hammer (pneumatic or steam)~~ driving ~~sheet~~ steel sheet pile	135
Pneumatic or Steam hammer (sSingle acting ~~hammer (pneumatic or steam)~~ driving steel pile	130

* These terms are defined in Section 1.3

Table 3--Summation of Noise Levels

Difference in dB(A) between two noise levels being summed	Amount in dB(A) to add to the higher noise level
0 to 0.5	3.0
1.0 to 1.5	2.5
2.0 to 3.0	2.0
3.5 to 4.5	1.5
5.0 to 7.0	1.0
7.5 to 12.0	0.5
more than 12.0	0

When using Table 3 noise levels should be summed in a pairwise fashion and the final total rounded to the nearest whole dB(A) with values of 0.5 or more being rounded upwards.

Table 4--Correction Factors to Obtain the Predicted Noise Level from ~~the Total~~ Sound Power Level at Given Distances

distance (m)	correction (dB(A))	distance (m)	correction (dB(A))
0	17	44 to 48	44
1	17	49 to 53	45
2	20	54 to 59	46
3	21	60 to 65	47
4	23	66 to 72	48
5	24	73 to 79	49
6	24	80 to 87	50
7	25	88 to 96	51
8	26	97 to 107	52
9	27	108 to 118	53
10	29	119 to 130	54
11	30	131 to 144	55
12	30	145 to 159	56
13	31	160 to 175	57
14	32	176 to 193	58
15	33	194 to 214	59
16	33	215 to 236	60
17	34	237 to 260	61
18	34	261 to 288	62
19	35	289 to ~~300~~317	63
20 to 21	36	**318 to 351**	**64**
22 to 24	37	**352 to 387**	**65**
25 to 26	38	**388 to 427**	**66**
27 to 29	39	**428 to 472**	**67**
30 to 32	40	**473 to 521**	**68**
33 to 36	41	**522 to 575**	**69**
37 to 39	42	**576 to 635**	**70**
40 to 43	43	**636 to 700**	**71**

For the purpose of determining the correction to be used for converting from ~~the total~~ sound power level at the source to the PNL at the NSR, the distance from the source position to the NSR shall be determined to the nearest whole metre, with values of 0.5 or more being rounded upwards.

This table is only valid for distances of up to ~~300~~ 700 m. For distances greater than ~~300~~ 700 m the Authority shall calculate appropriate correction factors having regard to standard acoustical principles and practices.

Table 5A--Permitted Hours of Operation for the Carrying Out of Piling Work Not Involving the Use of Diesel, Pneumatic and/or Steam Hammers

Amount by which Corrected Noise Level (CNL) exceeds Acceptable Noise Level (ANL), *CNL - ANL*	Permitted hours of operation on any day not being a general holiday
~~more than 10 dB(A)~~ 10 dB(A) < *CNL-ANL*	0800 to 0900 AND 1230 to 1330 AND 1700 to 1800
~~between 1 dB(A) and 10 dB(A)~~ 0 dB(A) < *CNL-ANL* ≤ 10 dB(A)	0800 to 0930 AND 1200 to 1400 AND 1630 to 1800
~~no exceedance~~ *CNL-ANL* ≤ 0 dB(A)	0700 to 1900

Table 5A is also applicable to the piling work involving the use of diesel hammers permitted under Section 3.3.

Table 5B--Permitted Hours of Operation for the Carrying Out of Piling Work Involving the Use of Diesel, Pneumatic and/or Steam Hammers

(i) Effective for percussive piling work to be conducted until 31.3.98

Amount by which Corrected Noise Level (CNL) exceeds Acceptable Noise Level (ANL), *CNL - ANL*	Permitted hours of operation on any day not being a general holiday
10 dB(A) < *CNL-ANL*	0800 to 0900 AND 1230 to 1330 AND 1700 to 1800
0 dB(A) < *CNL-ANL* ≤ 10 dB(A)	0800 to 0930 AND 1200 to 1400 AND 1630 to 1800
CNL-ANL ≤ 0 dB(A)	0700 to 1900

(ii) Effective for percussive piling work to be conducted between 1.4.98 and 30.9.98 (Stage 1)

Amount by which Corrected Noise Level (CNL) exceeds Acceptable Noise Level (ANL), *CNL - ANL*	Permitted hours of operation on any day not being a general holiday
20 dB(A) < *CNL-ANL*	Nil
10 dB(A) < *CNL-ANL* ≤ 20 dB(A)	0800 to 0900 AND 1230 to 1330 AND 1700 to 1800
0 dB(A) < *CNL-ANL* ≤ 10 dB(A)	0800 to 0930 AND 1200 to 1400 AND 1630 to 1800
CNL-ANL ≤ 0 dB(A)	0700 to 1900

(iii) Effective for percussive piling work to be conducted between 1.10.98 and 31.3.99 (Stage 2)

Amount by which Corrected Noise Level (CNL) exceeds Acceptable Noise Level (ANL), *CNL - ANL*	Permitted hours of operation on any day not being a general holiday
10 dB(A) < *CNL-ANL*	Nil
0 dB(A) < *CNL-ANL* ≤ 10 dB(A)	0800 to 0930 AND 1200 to 1400 AND 1630 to 1800
CNL-ANL ≤ 0 dB(A)	0700 to 1900

(iv) Effective for percussive piling work to be conducted between 1.4.99 and 30.9.99 (Stage 3)

Amount by which Corrected Noise Level (CNL) exceeds Acceptable Noise Level (ANL), *CNL - ANL*	Permitted hours of operation on any day not being a general holiday
0 dB(A) < *CNL-ANL*	Nil
CNL-ANL ≤ 0 dB(A)	0700 to 1900

(v) Effective for percussive piling work to be conducted on or after 1.10.99 (Stage 4)

Amount by which Corrected Noise Level (CNL) exceeds Acceptable Noise Level (ANL), *CNL - ANL*	Permitted hours of operation on any day not being a general holiday
-10 dB(A) < *CNL-ANL*	Nil
CNL-ANL ≤ -10 dB(A)	0700 to 1900

ANNEX--GENERAL CALIBRATION AND MEASUREMENT PROCEDURES

1. Instrumentation

For the purpose of this Technical Memorandum sound level meters shall comply with International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1), and other noise measuring and analysis instrumentation shall be of a comparable professional quality. Standard acoustical principles and practices shall be followed in the measurement and analysis of the noise under investigation.

2. Calibration Procedures

Immediately prior to and following each noise measurement the accuracy of the sound level meter shall be checked using an acoustic calibrator generating a known sound pressure level at a known frequency. Measurements may be accepted as valid only if the calibration levels from before and after the noise measurement agree to within 1.0 dB.

3. Measurement Procedures

3.1 Assessment Point

Noise level shall be determined by carrying out measurements at the assessment point. Where a measurement is to be carried out at a building, the assessment point shall normally be at a position 1 m from the exterior of the building facade but may be at any other point considered to be appropriate by the Authority. Where a measurement is to be made of noise being received at a place other than a building, the assessment point shall be at a position 1.2 m above the ground, at a particular point considered appropriate by the Authority.

3.2 Noise Units and Descriptors

Any noise measurement shall be made in terms of the A-weighted equivalent continuous sound pressure level (Leq) measured with an integrating sound level meter. Such measurement shall be made over any 5 minute period.

3.3 Rounding of Noise Levels

All noise measurements shall be rounded to the nearest whole dB(A), with values of 0.5 or more being rounded upwards.

3.4 Weather Conditions

Noise measurements should ~~not~~ be made in ~~the presence of fog, rain, wind with a steady speed exceeding 5 m/s, or wind with gusts exceeding 10 m/s~~ **accordance with standard acoustical principles and practices in relation to weather conditions.**