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Construction Noise Database (Phase 3).

Database of noise emissions from equipment used on construction and open sites.

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1 INTRODUCTION

- 1.1 Hepworth Acoustics Ltd was commissioned by the Department for Environment, Food and Rural Affairs (Defra) to update a database of noise emissions from equipment used on construction and open sites. The existing construction plant noise database is contained in Annex C, Part 1 of British Standard 5228 'Noise and vibration control on construction and open sites'.
- 1.2 This report forms Phase 3 of the study. The objective of the Phase 3 study is to obtain measurements of noise from typical construction-type plant that is currently used on quarries in the UK and to prepare a database of the information. The database is to include octave band noise levels.

2 BACKGROUND TO THE STUDY

- 2.1 It is often necessary to evaluate the potential impact of noise from proposed construction and open sites in order to assess potential environmental impact and evaluate requirements for noise mitigation.
- 2.2 In the UK the likely noise levels must be calculated in accordance with the guidance set out in BS 5228 'Noise and vibration control on construction and open sites' which is a code of practice approved by the Secretary of State under the Control of Pollution Act.
- 2.3 Part 1 of BS 5228 includes best practice guidelines for minimising noise impact and describes methods of calculating noise levels from construction and open sites. To assist in the calculations, the standard includes tables of noise emission data for a wide range of construction plant and activities in Annex C. However the majority of the plant noise data in Annex C of BS 5228 is based on research commissioned by the Construction Industry Research and Information Association that was published in 1977. Therefore the majority of information in the current database relates to 1970s machinery and working practices.
- 2.4 Moreover, although Part 5 of BS 5228 deals with quarries, there is no specific data on noise emissions of construction-type machines used in quarries within the Annex C database.
- 2.5 Hence there is a need to obtain noise measurement data in respect of typical construction plant that is currently deployed on quarry sites.

3 NOISE MEASUREMENTS & DATA ANALYSIS

Approach

- 3.1 In Phase 1 of the study it was concluded that data was required for plant in actual use on construction and open sites rather than results from standardised type testing under Schedule 6 of the Noise Emission in the Environment by Equipment for use Outdoor Regulations. This would obtain real life noise levels and would include all noise sources such as horns, reversing sirens, rattling of excavator buckets, impact noises, etc. A method statement for carrying out the noise measurements and data analysis was agreed with the Defra project manager prior to implementation.

Surveys

- 3.2 The surveys for Phase 3 of the project were carried out by Hepworth Acoustics in February and March 2006. The plant noise measurements were undertaken on a number of quarries, mainly in Cheshire, Derbyshire, and North Wales.

Results

- 3.3 The results of the noise measurements are presented in Appendix II. The results of the sound pressure readings, which were taken at various distances (generally between 10 – 30 metres), have been normalised to a distance of 10 metres, as was done for the existing database in Annex C of BS 5228.
- 3.4 The results are presented as un-weighted octave band sound pressure levels together with overall A-weighted activity sound pressure values. As in the current database in Annex C of BS 5228, L_{eq} data was used for stationary or quasi-stationary plant/activities and L_{max} values were used for pass-bys of vehicles.
- 3.5 During the Phase 3 study approximately 300 individual plant noise measurements were taken. However, the aim has been to minimise the number of individual data entries within the database as far as possible. Thus, where appropriate and following discussion with Defra, multiple results for individual plant items have been presented as (log) average L_{eqs} for quasi-stationary plant and (log) average L_{max} values for plant on haul routes.

- 3.6 The results have been separated in to hard rock quarries [Table 1(a)], other quarries [Table 1(b)] and general activities (lorry movements, water pumps) [Table1(c)].
- 3.7 As in the current database in Annex C of BS 5228, machines are identified by engine power and weight only. It should be noted that engine power is quoted in kW not bhp. Weights for machines, relate to the usual weight references used in the quarrying industry i.e. weights for machines such as excavators, wheeled loaders, etc are the actual weights of the machines whereas weights for dump trucks are the load capacity weights.

4.0 COMMENTS AND OBSERVATIONS

4.1 Our observations and comments on the findings of the study are set out below.

Hard Rock Quarries

4.2 Our definition of hard rock quarries is quarries where blasting is required. The data was obtained from a number of quarries, mainly limestone quarries in Derbyshire and North Wales. The data has been presented in a logical order in Table 1(a) commencing with drilling of shot firing holes.

4.3 There may still be some old, open drill rigs in use at some quarries but there has been a general move towards the use of modern enclosed mobile drilling rigs with a cabin for the driver/operator. The latter type were in use at the quarries we visited. The drill rigs are used to drill holes for shot firing (blasting). Typical hole diameters are 100-150mm with depths typically of 10-15 metres.

4.4 The blasted rock is then transported to the crushing plant. On large sites this involves a large hydraulic tracked face shovel, or wheeled loader, loading large capacity (>50t) rigid bodied dump trucks. On smaller sites articulated dump trucks may be used.

4.5 On some sites, oversized rocks may have to be broken up near to the face by a rock breaker mounted on to a hydraulic tracked excavator. Alternatively a tracked semi-mobile crusher may be used.

4.6 The rock is then loaded by the dump trucks into the feed system of the fixed processing plant. The fixed processing plant does not form part of this study but may involve just crushing and screening (grading) of stone, or the manufacture of 'added value products' involving lime processing, asphalt coating plant, mortar plant, cement manufacturing, block works, etc.

4.7 The crushed stone, or processed material, is then loaded on to road lorries. Some noise measurements of road lorries leaving the weighbridge are included in Table 1(c). These are generally at low speed because speeds limits are usually in place on quarry access roads.

Other Quarries

- 4.8 'Other quarries' comprise quarries or pits where blasting is not necessary and the mineral is simply dug out of the ground such as sand, gravel, clay, etc. Our measurement data was obtained from a number of pits (primarily sand and gravel workings) in Cheshire and North Wales and the results are shown in Table 1(b).
- 4.9 Sand/gravel workings involve the extraction of the material followed by transport to the loading area or fixed processing plant. Within the industry there has been a general move away from dredging of sands and gravel to dry working. Once any top soils have been removed, this simply involves the use of one, or more, face shovels (wheeled loaders) extracting material from the toe of the working face. At some sand and gravel workings a semi-mobile vibrating screen/stockpiler may be used near to the quarry face.
- 4.10 The excavated material is then transported to the processing/lorry loading area usually by a field conveyor system. The conveyor belts themselves do not generate any significant noise (as long as the rollers are greased regularly) but there may be some localised noise from conveyor drive units.
- 4.11 At some workings (e.g. sand, gravel, clay for construction works) the excavated material may simply be loaded in to road lorries and taken away. At others there may be some fixed processing plant which varies greatly between quarries (in terms of size, age, purpose, design). Fixed processing plant does not form part of this study but may involve washing, screening (grading), drying, of the material for foundry use, glass industry, etc.
- 4.12 During our surveys there were generally no soil stripping operations taking place (this is typically undertaken by contractors in the summer) but there is adequate noise data for small excavators, bulldozers, etc, undertaking preparatory earthworks in the results for the Phase 2 study.

5.0 SUMMARY AND CONCLUSIONS

- 5.1 Hepworth Acoustics have produced a database for construction-type equipment used on quarries. The database was obtained from measurements undertaken on a number of hard rock and other quarries. The database includes octave band noise data.
- 5.2 In our judgement (and as recommended in Part 1 of BS 5228) when calculating noise from proposed open sites (such as new quarries or extensions to existing quarries) the best approach is to actually measure noise emissions from the exact type of plant that is to be used. However, in many cases it may not be practical to do so and in such circumstances use of the new database for environmental noise calculations will give greater accuracy than relying on 'type test' noise emission data quoted by plant manufacturers.

APPENDIX 1 – DATA TABLES

Table 1(a) – Hard Rock Quarries												
Ref no.	Equipment	Power rating, kW	Equipment size, weight (mass), capacity	Octave band sound pressure levels, @ 10m (Hz)								A-weighted sound pressure level, L_{Aeq} , dB @ 10m
				63	125	250	500	1k	2k	4k	8k	
Drilling blast holes												
1	Tracked mobile drilling rig	317	20 t / 125 mm dia.	86	92	85	88	84	83	78	77	90
2	Tracked mobile drilling rig	270	23 t / 110 mm dia.	94	95	90	91	87	85	80	73	92
3	Tracked mobile drilling rig	186	16 t	77	83	82	84	85	85	84	79	91
4	Tracked mobile drilling rig	321	—	83	84	79	85	82	79	75	71	87
Face shovel loading dump trucks												
5	Tracked hydraulic excavator (mainly engine noise)	400	82 t	90	85	79	80	78	75	70	62	83
6	Tracked hydraulic excavator	235	47 t	95	93	89	89	86	82	76	74	91
7	Wheeled loader	597	94 t	88	88	87	85	86	83	77	70	90
7	Wheeled loader	466	82 t	88	93	84	84	83	81	79	69	88
8	Wheeled loader	370	50 t	89	87	84	82	81	81	72	65	86
9	Wheeled loader	364	56 t	91	94	90	86	86	83	77	69	91
10	Wheeled loader	325	58 t	89	87	85	83	84	80	75	71	88
Breaking boulders/oversized material												
11	Excavator mounted rock breaker	125	29 t	91	89	85	89	87	87	84	80	93
12	Excavator mounted rock breaker	102	23 t	86	86	83	78	80	78	76	71	85
13	Excavator mounted rock breaker	100	22 t	85	88	85	89	92	88	86	81	95
14	Tracked semi-mobile crusher	310	90 t	91	91	88	87	85	83	78	68	90
15	Tracked semi-mobile crusher	250	38 t	98	98	97	94	91	88	82	72	96
Dump trucks on haul roads												
16	Rigid dump truck ж	699	90 t	86	89	88	88	86	83	76	70	91ж
17	Rigid dump truck ж	567	64 t	99	95	87	86	84	83	77	73	90ж
18	Rigid dump truck ж	544	60 t	95	97	89	85	83	83	76	75	90ж
19	Rigid dump truck ж	517	63 t	90	91	88	85	83	82	77	73	89ж
20	Rigid dump truck ж	517	60 t	96	97	90	84	84	84	74	76	90ж
21	Rigid dump truck ж	362	41 t	92	91	86	85	84	85	77	77	90ж
22	Articulated dump truck ж	309	40 t	100	97	88	84	82	80	77	68	89ж

Table 1(a) – Hard Rock Quarries												
Ref no.	Equipment	Power rating, kW	Equipment size, weight (mass), capacity	Octave band sound pressure levels, @ 10m (Hz)								A-weighted sound pressure level, L_{Aeq} , dB @ 10m
				63	125	250	500	1k	2k	4k	8k	
Dump truck discharging into hopper												
23	Rigid dump truck	544	60 t	88	82	77	79	80	79	73	67	85
24	Rigid dump truck	362	40 t	89	84	80	82	80	78	72	64	85
Lorries being loaded from silo												
25	Lorry	310 to 350	32 t to 36 t	80	79	74	76	76	76	73	65	82
Loading chippings into dump trucks												
26	Wheeled loader	320	45 t	89	90	86	82	83	77	75	64	87
27	Wheeled loader	221	30 t	91	81	73	71	71	72	62	59	77

* Drive-by maximum sound pressure level in L_{max} (octave bands) and L_{Amax} (overall level)

Table 1(b) – Other Quarries (i.e. sand and gravel)												
Ref no.	Equipment	Power rating, kW	Equipment size, weight (mass), capacity	Octave band sound pressure levels @ 10m (Hz)								A-weighted sound pressure level, L_{Aeq} , dB @ 10m
				63	125	250	500	1k	2k	4k	8k	
Face shovel extracting/loading dump trucks												
1	Tracked hydraulic excavator	184	37 t	82	87	82	77	72	70	66	59	80
2	Tracked hydraulic excavator	74	19 t	82	75	72	73	71	70	66	58	76
3	Wheeled loader	198	29 t	88	84	81	84	76	70	68	61	83
4	Wheeled loader	193	31 t	87	87	85	75	76	74	69	62	82
Face shovel loading hopper												
5	Wheeled loader	232	39 t	84	88	81	74	74	71	66	65	80
General wheeled loader operations												
6	Loading sand to lorry	221	30 t	93	78	73	72	76	83	71	57	85
7	Loading sand to lorry	198	29 t	81	79	75	77	71	65	61	53	77
8	Loading sand to lorry	193	23 t	85	83	76	76	75	72	72	61	80
9	Loading sand to lorry	180	21 t	90	79	71	69	71	67	61	55	75
10	Loading gravel to lorry	193	23 t	89	86	87	77	78	77	73	68	85
11	Loading dump truck with pebbles	232	39 t	92	84	84	80	79	78	75	72	85
12	Loading dump truck with pebbles	184	23 t	87	84	82	77	76	74	70	65	82
13	Picking up sand from stockpile	175	23 t	89	80	82	73	70	69	64	57	78
Semi-mobile screen/stockpiler												
14	Screen stockpiler	56	15 t	93	86	79	78	75	71	69	62	81
15	Screen stockpiler	51	17 t	84	82	79	79	74	74	71	64	81
Transport of material												
16	Wheeled loader ж	193	31 t	83	89	92	80	71	69	64	58	85ж
17	Wheeled loader ж	184	23 t	77	83	91	75	75	72	65	59	84ж
18	Articulated dump truck ж	309	37 t	87	85	83	81	78	74	71	66	83ж
19	Articulated dump truck ж	239	23 t	98	94	89	85	79	79	70	65	87ж

Table 1(b) – Other Quarries (i.e. sand and gravel)												
Ref no.	Equipment	Power rating, kW	Equipment size, weight (mass), capacity	Octave band sound pressure levels @ 10m (Hz)								A-weighted sound pressure level, L_{Aeq} , dB @ 10m
				63	125	250	500	1k	2k	4k	8k	
Field conveyor system												
20	Conveyor drive unit	42	—	71	69	68	71	75	67	63	57	77
21	Conveyor drive unit	37	—	73	75	73	73	70	68	66	59	76
22	Feed hopper conveyor drive unit	6	—	71	68	62	63	66	62	58	51	69
23	Field conveyor (rollers)	—	—	58	52	52	43	43	42	47	47	53

⌘ Drive-by maximum sound pressure level in L_{max} (octave bands) and L_{Amax} (overall level)

Table 1(c) – General												
Ref no.	Equipment	Power rating, kW	Equipment size, weight (mass), capacity	Octave band sound pressure levels @10m Hz								A-weighted sound pressure level, L_{Aeq} , dB @ 10m
				63	125	250	500	1k	2k	4k	8k	
Pumping surface water												
1	Diesel water pump	136	—	81	83	77	75	76	75	69	63	81
2	Diesel water pump	25	—	81	71	67	62	65	65	63	59	71
3	Electric water pump	37	—	67	65	65	64	63	63	60	54	69
Lorry movements on access road												
4	Lorry ж	350	44 t	82	80	78	75	76	78	75	69	83ж
5	Lorry ж	350	36 t	92	82	77	76	77	72	68	63	80ж
6	Lorry ж	343	29 t	92	82	76	78	77	76	74	68	83ж
7	Lorry ж	313	44 t	87	79	77	74	73	73	70	64	79ж
8	Lorry ж	313	40 t	81	79	79	83	84	81	76	70	88ж
9	Lorry ж	313	32 t	99	82	81	76	78	74	71	66	82ж
10	Lorry ж	310	32 t	91	79	77	74	71	69	64	61	77ж
11	Lorry ж	306	44 t	96	79	75	79	82	80	72	67	86ж
12	Lorry ж	298	44 t	96	80	75	75	74	72	67	60	79ж
13	Lorry ж	283	44 t	84	80	76	74	73	70	67	61	78ж
14	Lorry ж	254	32 t	93	79	76	74	73	72	69	66	79ж
15	Lorry ж	242	32 t	86	94	81	77	80	77	75	69	85ж
16	Lorry ж	235	26 t	86	81	74	76	73	72	69	60	79ж
17	Lorry ж	233	32 t	91	78	74	70	72	74	66	59	78ж
18	Lorry ж	216	32 t	85	78	83	82	86	80	73	69	88ж
19	Lorry ж	201	26 t	87	76	73	81	79	75	68	62	83ж
20	Lorry ж	160	18 t	91	76	79	78	80	76	70	64	83ж

ж Drive-by maximum sound pressure level in L_{max} (octave bands) and L_{Amax} (overall level)