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INDUSTRIAL NOISE IMPACT ASSESSMENT USING PRACTICAL APPLICATION OF BS4142:2014 TO A COMPLEX REAL LIFE CASE

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BS4142:2014 (Methods for rating and assessing industrial and commercial sound) recently revised the older BS4142:1997, and included greater detail regarding the impact of acoustic features (including tones and impulses) as well as consideration of uncertainty and context. The practical application of this standard will be illustrated by its use at a complex noise pollution case to isolate and quantify the pollution from adjacent waste processing sites. This work is likely to be of interest to consultants and regulators involved in the control of environmental impacts of industrial activities.

1. Introduction

BS4142:2014 is a recently revised British Standard, and is widely used to quantify the scale of noise pollution from industry. This revision included consideration of the context of the pollution as well as variable feature corrections for acoustic characteristics, such as impulses, tones and intermittency. BS4142:2014 considers the corrected sound level that has been isolated from the source, and compares it to the Background L_{90} when the source is inactive. A difference of +10dB or more is likely to be an indication of a significant adverse impact depending on the context, and a difference of around +5dB is likely to be an indication of an adverse impact depending on the context.

This standard was used in the case of two adjacent waste processing sites that had a noise impact on residences that were around 85m away. One site processed skip waste (Site A), and the other site dismantled scrap vehicles (Site B). There were other light industries in the area as well as commercial premises, all adjacent to a large area of housing.

In this case the Background L_{90} would include the other industrial and commercial operations in the area, even though the residential receptors would no subjectively perceive the noise in this way. This means that this method could underestimate the severity of the perceived pollution, but modifying the BS4142:2014 method to accommodate this was considered to be an unacceptable deviation from the standard.

BS4142:2014 allows for a degree of interpretation given the context of the pollution. In this case, the context of the pollution is of a location that is equally balanced between industrial and residential

use, and so it was not deemed appropriate to modify the sensitivity of the assessment away from the normal criteria.

2. Acoustic feature corrections in BS4142:2014

BS4142:2014 isolates the sound from the industry under investigation (the Specific sound level) by using decibel subtraction. The average sound level when the site is inactive (the Residual sound level) is subtracted from the average sound level when the site is active (the Ambient sound level). Alternative methods of isolating the investigated sound can be used if the average sound level does not drop by 3dB when the site is inactive. The sound from the site is then given acoustic feature corrections (then termed the Rated sound level) and is compared to the Background L_{90} when the site is inactive.

The sound from the industry can be given acoustic feature corrections for tonality, impulsivity, and intermittency, as well as a correction for an acoustic characteristic that does not fit into the other categories. These characteristics must be audible at the receptor in order for the correction to be applied.

The correction for tonality can be assessed subjectively, with a 2dB correction if the tone is just perceptible, 4dB correction if it is clearly perceptible, and a 6dB correction if it is highly perceptible. Alternatively, the 1.3 octave bands can be analyzed objectively for the presence of a prominent tone. This is indicated by side band drops in excess of 15dB between 25Hz and 125Hz, 8dB between 160Hz and 400Hz, and 5dB between 500Hz and 10kHz. This objective method only assesses the presence or absence of a prominent tone that warrants a 6dB correction, and does not assess the presence of lesser tones that could be given a lesser correction. Alternatively, the tonal correction can be determined using the 'reference' method using FFT analysis.

The correction for impulsivity can also be assessed subjectively, with a 3dB, 6dB or 9dB correction for impulses that are just perceptible, clearly perceptible or highly perceptible respectively. Alternatively the impulsive correction can be determined using the 'reference' method, which calculates a correction of up to 9dB for impulsive sounds using SPL data at a resolution of 25ms or higher.

If the sound has features that are neither impulsive nor tonal, but are still distinctive, then a 3dB correction can be applied. This could include chatters and rattles. If the sound has identifiable on/off conditions that are readily identifiable against the residual acoustic environment, a correction of 3dB can also be applied. A 3dB correction can also be applied if the sound has a distinctive intermittent character.

It is important to note that the feature corrections can all be applied additively if they are present during the same period of time

3. Monitoring data and assessment

Monitoring was undertaken for a period of one week at the nearest residence, which included periods of attended monitoring at the start and finish of the measurement, and unattended monitoring for the remaining time. Each site shut down in turn, which allowed for each site to be assessed individually. Subjectively the overall noise was intrusive, with the continuous drone of grab engines and occasional impulses from material handling. The monitoring period averages are presented in Table 1.

Table 1 shows that when only Site A (skip waste) was active the subjective acoustic environment was largely unchanged. The BS4142:2014 objective (reference) method for assessing the prominence of impulsive sounds found events that warranted an acoustic feature correction of +6dB(A), and tonal features that warranted a correction of +4dB(A). When Site A stopped operation, and Site B was still active, the sound level dropped from an Ambient level of 42dB(A) $_{(Leq,\ 1820\ mins)}$ to a Residual level of 39dB(A) $_{(Leq,\ 270\ mins)}$ with an L_{90} Background of 35dB(A) $_{(L90,\ 270\ mins)}$. An assessment of these levels

using the BS4142:2014 method is presented in Table 2. This shows a Rating over Background of +14dB(A), which is likely to be an indication of significant adverse impact given the context of the pollution.

When only Site B (scrap vehicles) was active, the subjective acoustic environment was considerably quieter with no industrial noise audible (indicating that most of the noise pollution was from Site A). In addition, when Site B stopped operating, the measured sound level did not decrease, so an alternative method for assessing the sound levels from this site had to be used.

4. Predicted sound levels

BS4142:2014 presents various options to assess the sound levels when the operation contributes less than a 3dB increase. This includes measuring closer to the sound sources, measuring equivalent sources elsewhere, only measuring for the brief periods when the measurable sound from the site exceeds the residual sound level by 10dB, measuring when the residual sound level is quieter, or measuring at a surrogate monitoring location.

In this case, both operators had measured the sound power levels of the individual sources, and by using this data it was possible to construct a propagation model which could then be validated against the specific sound levels measured from site A. The propagation model considered distance attenuation, air absorption and the barrier effect. The ground effect was not predicted due to the erratic terrain. The propagation dimensions are presented in Figure 1.

The predicted sound levels for Site A are presented in Table 3. This shows a predicted sound level at the receptor of 39.4dB(A), which closely matches the corrected measured level of 39dB(A) presented in Table 3.

As the predicted and measured sound levels for Site A matched to within 0.4dB(A), the same model (adjusted for distance) could then be used to predict the sound levels from Site B. This is presented in Table 4.

The predicted sound levels for Site B shows a level of 34.8dB(A), which can then be used in a BS4142:2014 assessment, as presented in Table 5.This shows a predicted Rating level that is 3dB below the measured Background. This is below the level where BS4142:2014 predicts an adverse impact.

5. Conclusion

BS4142:2014 can be used to predict and quantify the impact of noise pollution from industry, and together with propagation models, can be used to isolate the sources of noise pollution from within a complex acoustic environment.

Table 1: Period averages

Date	Active site(s)	Leq	L90	Duration
A & B	A & B	43.0 dB(A)		160 mins
Wed 24th Sep	A & B	42.1 dB(A)		290 mins
Thu 25th Sep	A	42.3 dB(A)	37.8 dB(A)	210 mins
Thu 25th Sep	A & B	43.1 dB(A)		180 mins
Fri 26th Sep	B	38.6 dB(A)	34.8 dB(A)	270 mins
Mon 29th Sep	A & B	41.4 dB(A)		490 mins
Tues 30th Sep	A & B	41.9 dB(A)		400 mins
Wed 1st Sep	A & B	41.2 dB(A)		300 mins

Table 2: BS4142:2014 assessment for Site A

	dB(A)
Measured sound level	42
Residual sound level	39
Background sound level	35
Specific sound level	39
Impulse correction feature	+6
Tonal correction feature	+4
Rating level	49
Rating over background	+14

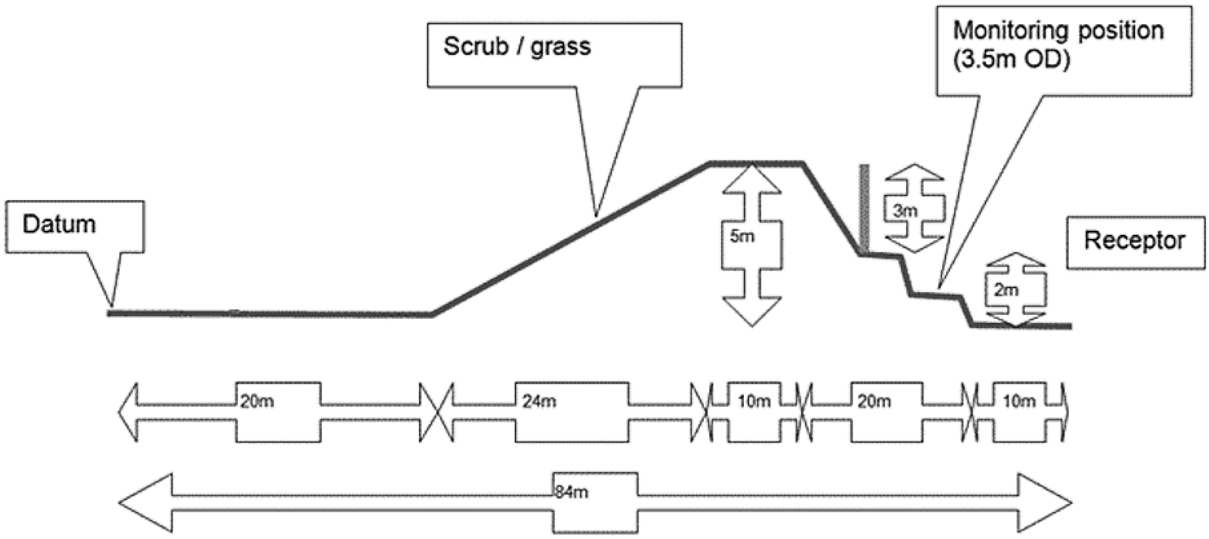

Figure 1: Propagation dimensions (not to scale)

Table 3: Predicted sound level from site A.

Source	Level at meter 10m from source (SPL, dB(A))	Distance from source (m)	Distance to receiver (m)	Propagation correction to receiver (dB(A))	Level at receiver
Telehandler	72	10	100	-20.0	52.0
130 LCN	77	5	100	-26.0	51.0
Trommel	77	8	100	-21.9	55.1
				Sum	57.8
				Air Absorption	-0.4
				Barrier Effect	-18.0
				Total	39.4

Table 4: Predicted sound level from site B.

	Level at meter (L1)	Distance from source (m) (R1)	Distance to receiver (m) (R2)	Level reduction (L2-L1)	Level at receiver (L2)
JCB telehandler	72	10	130	-22.3	49.7
130 LCN	78	5	130	-28.3	49.7
Grab	71	8	130	-24.2	46.8
				Sum	53.7
				Air Absorption	-0.9
				Barrier Effect	-18.0
				Total	34.8

Table 5: BS4142:2014 assessment for Site B.

	dB(A)
Background sound level	38
Predicted Specific sound level	35
Rating over background	-3

MAIN CONTACT DETAILS

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REFERENCES

1 BS4142:2014 *Method for rating and assessing industrial and commercial sound*, British Standards Institute (2014).