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PLANNING AND INDUSTRIAL NOISE

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1. INTRODUCTION

Any industrial or commercial development which entails noise emission to the atmosphere is likely to be the subject of strict planning control. Not only must developers be aware of the planning requirements with regard to noise but they should also be aware of the relevant sections of the Control of Pollution Act 1974 (Reference 1), which give provision for action to be taken by local authorities and private individuals in the case of alleged noise nuisances.

This paper reviews the way in which planners consider the interaction of industrial and residential development with regard to noise. In the course of this it considers the existing relevant government planning circular, reviews the latest thoughts on the revisions to BS 4142 (Reference 2) and gives some examples, based on direct experience of the author, of areas where problems or confusion in planning matters and noise can arise.

2. PLANNING CIRCULAR 10/73

In January 1973 the Department of the Environment and the Welsh Office issued a joint circular entitled "Planning and Noise". The purpose of the circular (Reference 3) was to lay down principles and specific criteria by which the Secretaries of State would in future be guided in taking planning decisions and on which they urged local planning authorities to base their own policies. The circular, which still reflects current Department of the Environment thinking (Reference 4), deals with the bringing of noise to people and with the bringing of people to noise. This circular is therefore still a primary source of reference with regard to planning matters and noise.

Paragraphs 24 - 34 of the circular deal with noise from industrial premises and other fixed installations. For new factories and other fixed installations (with an inferred reference to commercial premises in para. 24), a suggested procedure for assessing the noise impact of proposed developments is given in Appendix 4 to the circular. This states:

"1. The applicant should be required to provide predictions of corrected noise levels at the boundaries of the application site.

2. The Public Health Authority (nowadays Environmental Health Services) should then be asked to comment on the acceptability of the applicant's predictions and to advise on:

   a) The corresponding noise level outside the nearest existing noise sensitive development.

   b) The current background and criterion noise levels (Part 4 of BS 4142) at the same location; and any expected increase in the background level, and

   c) The predicted noise rating of the proposed development (Part 5 of BS 4142) in terms of its liability to produce complaints."

If used in this form, an Environmental Health Officer would often have difficulty in advising on the "corresponding noise level outside the nearest noise sensitive development", based on a knowledge of plant boundary noise limits. For example, where does he assume the source of noise to be, does he have to worry about a distributed noise source, does he need to understand the frequency characteristics of the noise?

Very often, and possibly to overcome this particular problem, planning conditions are imposed as an allowable increase on plant boundary noise levels. An example of such a condition which was placed on a grain handling plant is:

"Noise levels arising from activities or operations conducted on the premises, when measured at the boundary of the application site, shall not cause the prevailing background (L_{90}) to be exceeded by more than 5 dB(A)."

The limit, as set is fraught with problems. In one direction, the plant boundary is located just beyond some large earth mounds (ie. screening the boundary from the plant). In another direction, the plant boundary runs alongside a number of drying fans (within a few metres). No mention is made of time of day or night, whether the lowest value of L_{90} should be taken, whether any correction should be made for the character or duration of noise from the plant etc. The planning noise limit was clearly not appropriate as the locations of concern were some houses about 200 m away. It would have been eminently better to have considered an allowable increase on background noise level at the nearest noise sensitive location. However, the question of averaging time for the background noise level still exists.

Another planning condition which is sometimes seen is:

"There shall be no increase in background noise level with the plant in operation".

Questions which immediately come to mind are:

i) What is meant by the background noise? (presumably L_{90}, but again is this a long term averaged value to take account of meteorological variations, time of day/night)

ii) Should an absolute minimum value of background noise be used?

iii) In order not to increase the background noise level, the noise from the plant will have to be at least 10 dB(A) below the existing background level (even this will add approximately 0.5 dB(A) to the background level). Is this realistic?

iv) Should any correction be made for the character of the noise?

Sometimes the word "significant" is added to the planning consent, viz

"There shall be no significant increase in background noise level with the plant in operation".

What is the interpretation of the word "significant". Is 5 dB(A) above background significant? Sometimes this is taken to mean an allowable increase of 3 dB(A) on background noise. Does this mean that the noise from the plant should be designed to be equal to the assumed numerical value of the background (L_{90}) level?

The circular also states that

"where by the standard established in BS 4142 the noise from the proposed development 'is likely to give rise to complaints' even if reasonable sound insulation is required and provided, it will hardly ever be right to give permission".

It also states that where existing levels are already high, it will scarcely ever be justifiable to allow new development which is liable to have the effect of bringing the ambient level affecting residential and other noise sensitive development above a Corrected Noise Level (see BS 4142) of 75 dB(A) by day or 65 dB(A) by night. These maximum external levels are also reflected in paragraph 34 of the circular relating to the bringing of new residential development to industry. Internal noise levels are also quoted in the circular - 45 dB(A) CNL refers to a maximum internal noise level with windows closed (20 dB(A) attenuation therefore assumed), and 35 dB(A)

represents a "good standard" of noise with windows closed. The latter equates to an external CNL of 55 dB(A). Based on this it might therefore seem reasonable to allow new housing development where industrial noise is present, up to a level of 65 dB(A) CNL at night. But developers and house purchasers beware! Experience with a new housing development built in the vicinity of an isolated, but large industrial plant, illustrates problems that can arise. There was an existing well established terraced style residential development built originally to serve the workers of the industrial plant. The new development was executive style housing, built in a direction generally upwind of the prevailing wind direction from the plant. During the daytime the plant was virtually inaudible (although clearly visible) for typical westerly wind conditions. During the night, however, the plant became audible at the new housing, particularly under easterly wind conditions. Although the noise level, in absolute terms did not exceed the 65 dB(A) CNL criteria, even under easterly winds, there was at least a 10 dB(A) difference in noise levels depending on wind direction. There were vigorous complaints from the new house purchasers. No doubt the problem was exacerbated by the knowledge that the purchasers had viewed the property in daylight when noise levels seemed quite satisfactory. It is interesting to contemplate a BS 4142 type of assessment in this situation - treating the more frequent plant level under westerly wind conditions as the 'normal' background noise level and the higher, less frequent, plant noise under easterly wind conditions as the offending source. The increase of about 10 dB(A), takes the assessment into the "complaints may be expected" category.

3. BRITISH STANDARD BS 4142

This standard is currently being completely revised, although at the time of preparing this paper, it has not been published in its final form. Since the standard was issued in 1967 it has been widely used (and often abused) in investigations both of alleged noise nuisance and also in planning matters relating to industrial noise. One impetus to this revision has been the perceived need to bring BS 4142 in line with ISO 1996/1 (Reference 5) which presumably will then be published as an equivalent British Standard. Several forms of the revision to BS 4142 have been debated by the standard's technical committee and a version was issued for public comment in April 1988 (Reference 6). The document was debated at a one day meeting organised by the Institute of Acoustics in June 1988 (Reference 7), where it received widespread, but constructive, criticism. It is understood that a further revision of the standard has now been prepared for debate by the technical committee. One of the aspects stressed at the meeting in June was that the new version of the standard should give similar results to the current version.

The title of the standard is "Method of rating industrial noise affecting mixed residential areas", but in reality the details of the rating method per se are secondary to the ability to use the standard for rating the noise for complaint purposes. The method of rating is a comparison of the pre-existing background noise level (real or notional) during specific periods of the day or night with the level of noise from the noise in question, after due allowance has been made for intermittency and the character of the noise. Under the current version of BS 4142 the preferred measure of background noise is defined as the L_{90} level. The measure of the noise in question is obtained by recording its "typical" level if it is reasonably steady or if it fluctuates within a range of about 10 dB(A) an estimate is made by visually averaging the excursion of the meter. (At the time the standard was written in 1967 it is unlikely that anyone had seen a sound level meter with a digital display, but nowadays it is mainly this type of meter which is produced).

The most significant changes with regard to the proposed new version of BS 4142 is the proposed use of L_{eq} as a measure of the specific noise level (ie. the noise in question). In theory, this unit would appear to have merit and brings BS 4142 into line with ISO 1996. In many practical situations it is extremely difficult, however, to obtain a meaningful measured value of L_{eq} directly, as relating to the noise from an industrial premises potentially affecting residential property nearby. The reason for this is the interfering effects of noise from other, more intermittent sources such as passing road vehicles, overflying aircraft, trains, birdsong etc. The energy content of the noise from these sources, in many cases, controls the measured L_{eq} value during an environmental noise survey and is almost impossible to eliminate accurately from the measurements.

From experience, depending upon where the measurement location is in relation to passing vehicles etc, the measured L_{eq} level is typically 5 - 15 dB(A) greater than the measured L_{90} level, for sample periods of 10 - 15 minutes. It would therefore be almost impossible, in most situations to following the guidance of Section 6.1.3 of the draft revision, which stated:

"Make the measurements only where the predominant noise is unequivocally identified as being due to the specific noise source".

A recent noise complaint case illustrates this point exactly. A resident living about 80 m from an industrial plant complained about the noise from three dust extraction vent exhausts which had been re-orientated on the roof of the plant and were now pointing in the direction of the complainant's property. The property had a railway line on one side, a country lane on the otherside, surrounding trees with birds, and aircraft occasionally flying overhead.

A survey of the noise levels with and without the vents running was measured over 15 minute sample periods. An extract of the survey is given in Table 1 below.

Sound Level Index, dB(A)	L_{90}	L_{50}	L_{10}	L_1	L_{eq}
Vents on	52.0	54.0	56.0	71.5	57.7
Vents off	45.0	50.5	55.5	72.5	57.3
Arithmetic Difference, dB(A)	7	3.5	0.5	-1	0.4

Table 1: Comparison of Measured Noise Indices in a Complaint Situation

A complaint had arisen due to the increased noise from the industrial plant, the EHO concerned felt it was justified, and following the author's own investigation the complaint was also felt to be justified. Clearly the noise from the vents was influencing the L_{90} level but not the measured L_{eq} levels, which was being controlled by extraneous noise sources (ie. traffic, trains etc.).

In this situation the change in the L_{90} index gave the best measure of the increase in noise from the industrial plant which was causing the complaint.

If the L_{eq} index is to be retained as the basis for the rating level then the problem described above must be addressed by the standard's committee otherwise the standard will, in many situations, become unusable. It is recommended that an option is given for calculating (as opposed to measuring) the L_{eq} due to a specific noise source based on the use of meaningful measurements, for example, at some closer distance to the source.

The scientific validity of the assessment procedure of BS 4142 appears never to have been reassessed. Perhaps the task is too daunting, but surely in the 22 years use of BS 4142 there is a wealth of available data lodged with local authorities, academic institutions and industry describing the standard's use in complaint investigation situations. The scientific validity of comparing a noise level measured in one index (L_{eq}) against another index (L_{90}) must be challenged. Are we comparing apples with oranges in making this assessment?

The stated intent is for the new standard to give as similar results as possible to the old standard. It is imperative therefore that more specific guidance be given to the reference time interval particularly in relation to intermittent noise.

In broad terms a maximum reference time interval should be specified for different times of the day. This could be:

T ref = 1 hour for other than night-time

T ref = 5 minutes for night-time.

However, without an additional correction factor for the number of events within that reference period then significant discrepancies will arise as compared to the existing version of the standard. This is illustrated in Tables 2 and 3, which show that discrepancies of more than 10 dB(A) will arise if these reference time intervals are used and no further corrections are made for the number of events occurring in the time period.

The assessment procedure for complaints, given in the draft revision of BS 4142 issued for public comment, was far too loose, with a range of 20 dB(A) between "complaints may be expected" and "indicates that complaints are unlikely". Gone is the + 5 dB(A) "of marginal significance", and also the phrase "positive" indication that complaints are unlikely. It is understood, however, that the standard's technical committee is now contemplating bringing back the "+ 5 dB(A) of marginal significance" comment.

It has generally become recognised that the assessment procedure of BS 4142 based on a signal/noise concept fails where the background noise level falls to low levels (eg. 30 - 35 dB(A)), particularly at night. In this situation an absolute level is usually more appropriate because the major concern at night will be one of sleep disturbance. External noise levels of 30 - 35 dB(A) will be attenuated in many cases by the facade of a dwelling to very low, insignificant internal noise levels.

This is now recognised in the draft version of the standard. Also recognised in this draft version is the breakdown in the assessment procedure which may occur with the presence of relative high levels of low frequency noise. In this situation the rating procedure by means of an 'A' weighted noise index can fail to quantify the annoyance which can arise. This is discussed more fully in Reference 8 for example. Major industries such as the CEGB and British Gas also understand this problem and set their own design octave band community noise limits with levels in the 31.5 Hz octave band near the threshold of audibility (References 9 and 10). Failure to do so may lead the developer open to action under Section 59 of the Control of Pollution Act.

The draft revised version of BS 4142 had a number of minor inconsistencies which will need to be corrected in the final version. This is of paramount importance as the standard is used widely in legal situations and must be consistent, even if consistently wrong! One final point about BS 4142 is

that the draft version states that a + 5 dB(A) penalty should be imposed on the specific noise level due to noise with an impulsive character, as measured on a L_{eq} basis. However, the energy content of the impulsive component of the noise will already have raised the numerical value of the L_{eq} index as compared to the situation with no impulsive component. To maintain consistency with the current version of the standard it is possible that a smaller correction factor should be applied.

4. CONCLUSIONS

Living on a crowded island like the United Kingdom presents increasing pressures in the demand for land use. The nation has become used, in recent months, to hearing about "green" issues and the increasing concern which is being placed on conservation of the environment. Although not as dramatic as the depletion of the ozone layer, or the warming of the globe due to the greenhouse effect, a high level of noise in the community is an important environmental issue which inevitably reduces the quality of our lives. Industry, government and local authorities must work together in order to ensure that noise is controlled effectively at the planning stage. It is suggested that planning Circular 10/73 is now in need of revision with regard to industrial noise and that the technical committee of BS 4142 should strive to publish a final version of this standard which is sensible, practical and consistent and will stand the test of time for at least the next ten years.

5. REFERENCES

[1] Control of Pollution Act 1974, Chapter 40
[2] British Standard 4142, 1967, "Method of Rating Industrial Noise Affecting Mixed Residential and Industrial Areas".
[3] Circular 10/73, Circular 17/73, "Planning and Noise". Joint circular from the Department of the Environment and Welsh Office.
[4] Personal communication with Department of the Environment.
[5] ISO 1996/1 "Acoustics - Description and Measurement of Environmental Noise - Part 1 Basic Quantities and Procedures".
[6] Draft BS 4142, BSI document 88/57668, dated April 1988, issued for public comment.
[7] Institute of Acoustics, One day open discussion on BS 4142, 28th June 1988.
[8] Proc of Inst of Acoustics, Vol 11, Part 5 (1989) pps 429 - 436 "Environmental Noise Aspects of a Gas Turbine Power Generating Plant", B.C. Postlethwaite
[9] CEGB GDCD Standard 182 (1978) "Noise Limits for New Power Stations".
[10] Gas Engineering Management, April 1987, "Effective Control of Environmental Noise", C.D. Lyle.

Comparison of Intermittency Correction Factors, Other Than Night-Time

Duration of Event	No of Events in 8 Hour Period (1 Hour Period)			
	1 (1)	10 (1)	10 (2)	100 (12)
1 second				-1.6
2 seconds		-2.5	+0.5	-1.6
5 seconds	+1.4	-6.1	-3.1	-2.6
10 seconds	+0.4	-7.6	-4.6	-3.6
20 seconds	-0.5	-7.6	-4.6	-4.1
1 minute	-1.8	-7.8	-4.8	-2.8
2 minutes	-2.8	-7.3	-4.3	
5 minutes	-2.8	-5.8	-2.8	
10 minutes	-2.0	-4.8	-1.8	
20 minutes	-1.0			
60 minutes	+2.0			

Table 2: Difference in intermittency correction factors, dB(A), for proposed BS 4142 if T ref = 1 hour minus intermittency correction factors for current BS 4142. (Negative values imply proposed version of standard is less severe than existing version).

Comparison of Intermittency Correction Factors, Night-Time

Duration of Event	No of Events in 8 Hour Period (5 Minute Period) 1 (1)	10 (1)	10 (2)	100 (1)	100 (2)
1 second	+1.2	-4.8	-1.8	-10.8	-7.8
2 seconds	-0.3	-5.3	-2.3	-9.8	-6.8
5 seconds	-1.8	-5.8	-2.8	-10.3	-7.3
10 seconds	-2.3	-5.8	-2.8	-9.8	-6.8
20 seconds	-2.8	-5.3	-2.3	-8.3	-5.3
1 minute	-2.0	-3.5	-1.5	-5.5	-2.5
2 minutes	-1.0	-2.0	+1.0		
5 minutes	+1.0	+0.5			

Table 3: Difference in intermittency correction factors, dB(A), for proposed BS 4142, if T ref = 5 minutes, minus intermittency correction factors for current BS 4142. (Negative values imply proposed version of standard is less severe than current version)