THE ASSESSMENT OF SITES FOR RESIDENTIAL DEVELOPMENT

CASE STUDY

Introduction

The area under consideration for residential development stands next to a factory which processes and transports frozen foods (see Figure 1). The region is rural, the factory being the only source of industrial noise for several miles. The activity of the factory is such that for the majority of the day there is little noise produced. The exception being the periods when refrigerated lorries collect goods. During this time the sound of the refrigerated units and lorry movement increased the prevailing sound level considerably.

Noise Rating - Planning Stage

The method by which sound measurements may be taken and their impact on local people assessed is comprehensively covered in the Department of the Environment Circular 10/73 entitled 'Planning and Noise'.

Circular 10/73 makes reference to BS.4142 in several ways dependent on individual circumstances. These two documents are widely used and accepted and are the most appropriate to use when determining the suitability of such a site for residential development.

Circular 10/73 is a broad document covering several types of 'noise generators' (road vehicles, aircraft and industry) and their interaction with people. It recommends different methods of noise rating dependent on whether 'the noise is brought to the people' or 'the people to the noise'.

The following sections are relevant in this study.

Para 1 - 4. General introduction not of specific relevance other than recommending the use of CNL (corrected noise level) for assessing noise from industry.

Page 5 - 23. Only deals with noise from road traffic and aircraft except paras. 7 - 8 which are referenced in a later section.

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Para 24 - 34. The key section dealing with noise from industry as it affects local people. The first para 24 states:-

'in their planning work, authorities should seek to avoid the creation of situations in which new commerce or industry might inflict noise annoyance on existing development in the vicinity or in which new residential or other noise sensitive development might be subject to noise annoyance from existing industrial or other premises'.

This is noting that problems may arise when either

a) noise is brought to the people

or

b) people are brought to the noise.

Para 25 - 32. Deals very much with situations whereby noise is brought to the people i.e. industrial development. In these sections the BS.4142 method of rating is referenced. It is my contention therefore that paras. 25 - 32 deal exclusively with industrial development and do not apply to residential development.

Para 33 - 34. Deals with the situation whereby people are brought to the noise i.e. residential development. In these sections 10/73 recommends that

a) before allowing residential development the noise level should be measured and corrected for intermittency, duration and tonal content, using the method shown in BS.4142 parts 2 and 3 and that this level (CNL) should be adopted as the basis for judging the acceptability of the site

b) these CNL figures should be compared to levels set out in the table (abridged) shown in the appendix:-

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Col. 1	Col. 3. Corrected noise level dBA	
	Day	Night
site standard	75	65
inside max SPL		
window closed	55	45
window open	45	35

In para. 34 reference is made to earlier paras. 7 and 8 which deal mainly with traffic noise but which makes mention of the levels in the previous table as follows: 'these standards should constitute the limit of the acceptable rather than the standard of what is desirable'.

It can therefore be seen that 10/73 recommends the use of BS.4142 to measure and correct the ambient noise level. It does not refer to subsequent sections of BS.4142 which describe how to 'rate' these levels. In this respect it prefers to use the fixed levels set out in the appendix of 10/73, as the maximum acceptable levels.

In this specific project the relevant corrected noise levels were:-

CNL (continuous) = Ls = 49dBA
CNL (lorry movement) = Lh = 60.5dBA

The worse situation 60.5dBA should therefore be compared to the recommended site standard of 75dBA. Residential development could be strongly argued to be allowable on the basis of these relative levels.

<u>Noise Rating - Complaint Stage</u>

In the event of any subsequent noise complaint after completion of this development, the 'rating of the complaint' would be undertaken using the accepted method within BS.4142.

In this case the background sound level (mean minimum or LA90) would be measured as per section 4 and the noise rated as per section 5.

The rating method relies on a comparison of the CNL with the background sound level - LA90.

The LA90 for this site was measured at 46dBA. The difference between Lh (corrected) and background is therefore 14.5dBA.

BS.4142 states that complaints may be expected if Ls or Lh or both exceed the measured background level by 10dBA is more - the situation in this case. On this basis it has become accepted practice within the U.K. to conclude that a noise nuisance exists. On such an occasion it is our experience that a Local Authority would take corrective measures including, in the last resort, the serving of a Section 58 (Control of Pollution Act) notice on the offending industrial company.

Conclusions and Discussion

British courts and planning committees do not condone anything other than an objective and precise interpretation of Circulars and British Standards. Acoustic consultants, environmental health officers, company acoustic engineers and other parties are therefore obliged to use these documents strictly and without modification based on personal experience. They are therefore placed in the position of using guidance documents which in many areas have glaring conflicts.

It is hoped that this paper will help to highlight just one of these conflicts and areas for improvements within 10/73 and 4142 - The conflict of noise rating procedure for residential development at the planning stage (10/73 - 'fixed limit') and noise complaint stage (4142 - 'comparison with background limit').

It has to be said that the revised BS.4142 does not tackle this particular problem and that the long awaited Circular 10/73 revision is still long awaited.

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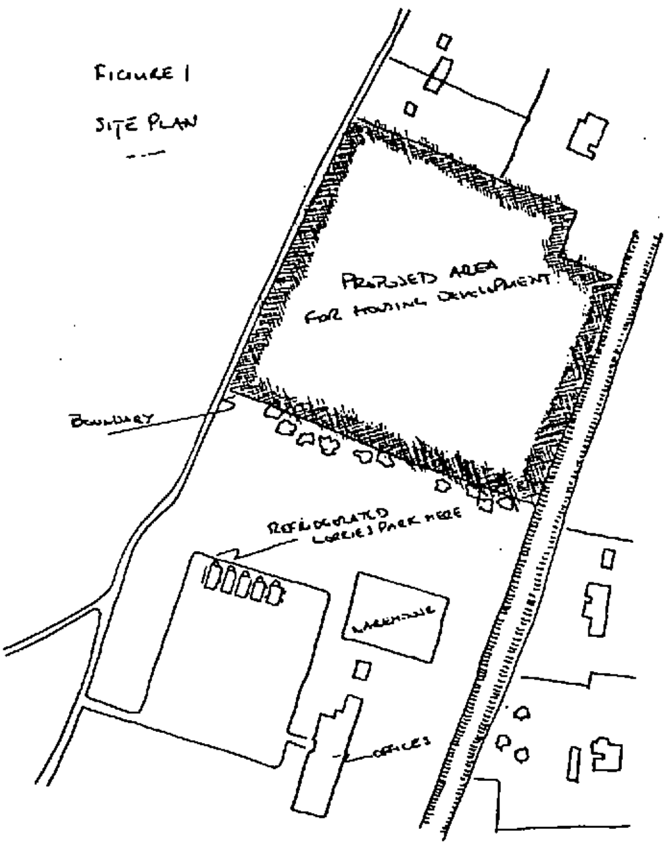
REFERENCE

Department of Environment Circular 10/73 - Planning and Noise.

British Standard 4142 - Method of Rating Industrial Noise Affecting Mixed Residential and Industrial Areas.



NOT TO SCALE.

THE PREDICTION OF PEAK PARTICLE VELOCITY ON A RESIDENTIAL STRUCTURE FROM QUARRY BLASTING

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Summary

This paper presents peak particle velocity measurements at the ground floor of a residential structure situated 60 metres from a quarry blast. Data obtained from monitoring twenty blasts at various distances and charge weights are given. The results show that although no structural damage results from the present tests, nevertheless annoyance to the community ensues. The results are compared to other published data.

Introduction

As the pressures on land use continually increase an ever growing number of quarries and other engineering projects are having to operate in close proximity to other industrial and residential areas.

The increase in the use of explosives in quarry blasting and the increasing awareness of the public, of their right to an undisturbed existence from external sources has confronted Planning and Environmental Health Authorities with the proportionately increasing problems arising from the resultant ground vibration and air blasts from such blasting operations. These cannot only be detrimental to structures but may also cause annoyance and other psychological effects to the local community.

This project examines the recent decision by the Planning Authority to extend the boundaries of an existing limestone quarry at Warmsworth, Doncaster, to a distance of only 60 metres from the nearest noise sensitive residential structure. Using data obtained from recent blasts at a distance of between 155 metres and 318 metres from the nearest residential structure, predictions can be made of the likely impact at the revised distance of 60 metres using the general propagation equation[1].

$V = H[D/W^{\frac{1}{2}}]^{-\beta}$ where

V = Peak particle velocity mm/s
D = Distance the vibration travels from source to measuring point (metres)
W = Charge weight per delay interval (kg)
H = Constant
β = Constant

The aim of this paper is to obtain the constants H and β as in the equation above so that predictions for damage at 60 metres can be achieved.

The paper discusses the future development of the quarry site with regard to the predicted values and examines the decision made by the Planning Authority to extend the boundary of the site to 60 metres from the nearest noise sensitive structure.

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Measurement Site

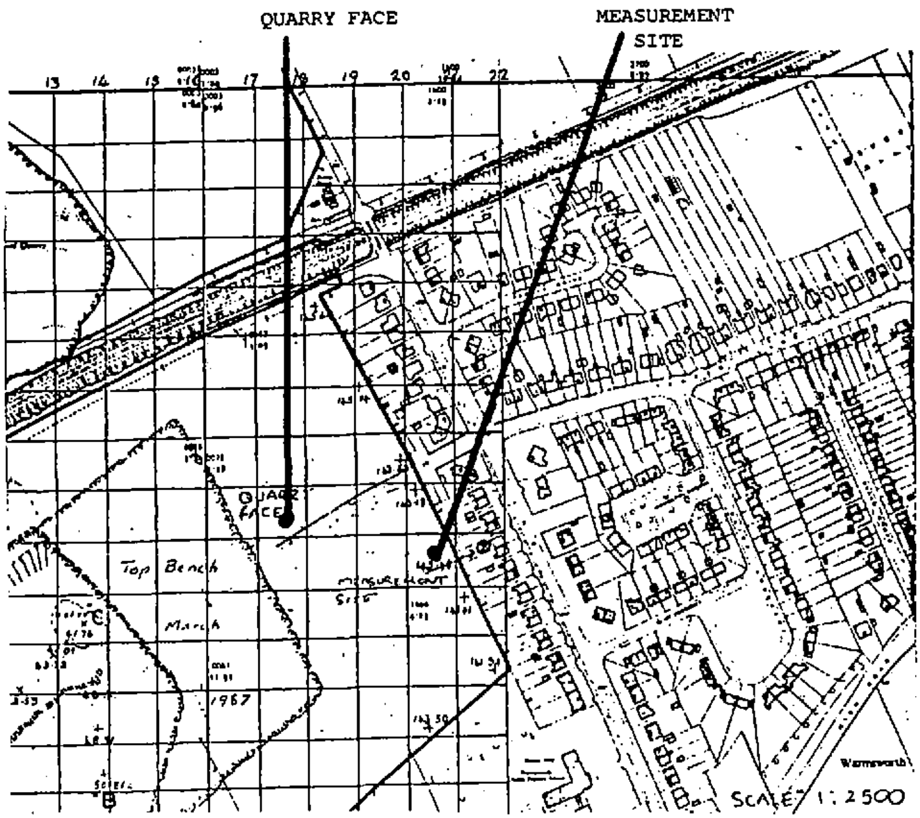
The measuring site is a semi detached house and is situated between 150 and 318 metres from the quarry face. The concrete ground floor was used for monitoring the vibration levels.

The land separating the measurement site and the quarry face is flat with only a narrow band of deciduous trees situated near to the garden boundary fence. Geological surveys of the site confirm a consistency of limestone rock with few faults.

A section of the ordnance survey map of the site and its environs are given in Figure 1.

Figure 1

Ordnance Survey Map showing quarry relative to measurement site.



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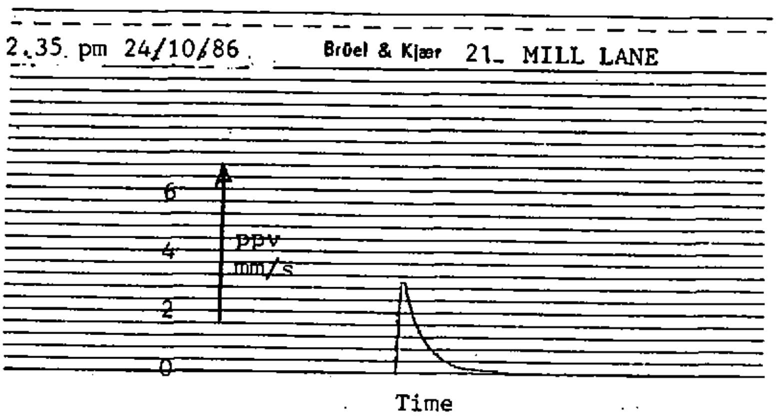
Method

A B & K 4370 accelerometer was used to monitor the vibration levels. This was attached by a stud to a heavy steel block which was mounted on to the floor. A thin layer of grease was applied to the mounting surface which neutralised the floor indulations.

A B & K 2511 purpose built vibration meter, using the velocity integration network was used to record peak particle velocity. The output of the vibration was made by a B & K 2306 level recorder. A typical trace from this instrument is given in Figure 2.

Figure 2

Typical trace obtained from the level recorder.



Results

Figure 3 shows the recordings of the peak particle velocities for distances from blast to measuring site and charge weight. The expense involved in blasting does not permit the luxury of controlled parameters such as distance and charge weight. Commercial pressures based on the cost of each blast and the concomitant serious nuisance to the local community necessitates that charge weights, distances and depths of charge are programmed to produce an effective throughput.

It follows therefore, that only statistical analysis of results for each quarry is realistic for resulting property damage or subjective discomfort. With this consideration, the line of best fit from the results is given below.

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It can be shown that the peak particle velocity 'v' for the results is given by

$$v = 6.582\ [D/W^{\frac{1}{2}}]\ 0.1645(\beta)$$

This compares with [1] where the result was 0.1 for β.

Discussion

From the twenty peak particle velocity results measured, Figure 3 exhibits a normal scatter for such tests. Thus from this predictions of ppv at distances of 60 m may be determined. This is important from the viewpoint of annoyance to the occupier in the event of planning permission being given.

The scatter which exists may be attributed to several factors, given below:

(i) Wave Propagation. The study assumes all blast waves are propatated as surface waves, on which assumption is based the calculated distances. However, in general the energy from the blast propagates omni-directionally. The vibration measured at a point remote from the source is a summation of all the waves, having a different velocity, different particle motion and experiencing different amounts of energy loss per unit area.

Briefly a blast will result in Rayleigh waves or surface waves (67%), shear waves (26%) and compression waves (7%). Although the surface wave is by far the most dominant this investigation neglects the influence of the shear and compression waves.

(ii) Rock Strata. The quarry site is of limestone rock with few faults. A difference in rock strata and type between measurement site and blasting source may introduce errors. Since no details were available relative to the direction and position of any faults in rock strata or the direction and position of any limestone beds, each were capable of concentrating the wave propagation along a certain path.

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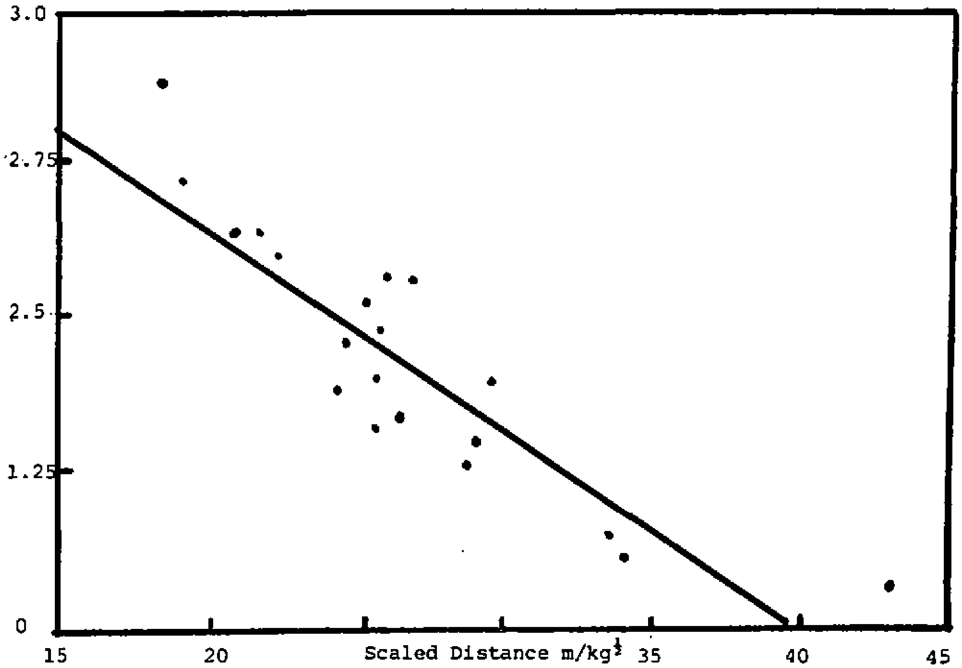

Figure 3 Peak Particle Velocity against Charge Weight and Distance

Conclusion

The predicted vibration levels at a distance of 60 metres from the measuring site range from 4.8 mm/sec to 8.1 mm/sec depending on the instantaneous charge weights used.

Although structural damage to the structure is unlikely to occur, annoyance to the local community is inevitable since any peak particle velocity level above 3.0 mm/sec monitored at ground level, will be magnified at the first floor level of the structure. If the nuisance persists then it is expected that complaints would be received from occupants of the residential community. The Local Authority may find it necessary to consider the possibility of a statutory nuisance under the Control of Pollution Act 1974, notwithstanding the fact that legal standards do not exist in this country.

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It is therefore essential that before planning permission is granted for the development of the quarry boundary to 60 metres from the nearest noise sensitive structure, ie (the measuring site), certain conditions or recommendations should be made:-

(i) The scaled distance approach should be adopted in the prediction of vibration levels, so that the correct charge weights can be used at various distances in order not to exceed the safety level of 3.0 mm/sec at the nearest noise sensitive structure, below which structural damage and annoyance to the community is unlikely to occur.

(ii) In order to reduce the vibration level when appropriate it would be good practice to split the quarry face from a height of 20 metres to a more manageable and safer height of 10 metres. This would require less explosives resulting in a smaller ground vibration. The quarry operator would benefit since face dressing blasts would not be required and smaller stones would be obtained, thus eliminating the requirement of mechanical breakage of the stone.

(iii) Millisecond delay blasting should be used according to the manufacturer's specifications. Consideration should be given to avoid superposition of waves, thus keeping the resultant vibration level to a minimum.

(iv) When necessary the holes should be drilled closer to the quarry face, this would result in a reduction in the charge weights used and again will provide the benefit of a smaller more manageable blast site, smaller stone and more important reduction in the vibration level.

(v) The choice and type of explosive should be in accordance with current standards of safety and the manufacturers specifications.

(vi) A warning siren should be sounded for at least 10 seconds before the onset of any blast in order to reduce the shock aspect of the noise/ vibration output and thus reduce the community response in terms of annoyance.

The above recommendations may be specified with planning permission, however, the most stringent of safeguards against excessive vibration can be rendered useless without a good relationship between the explosive user and his neighbours. It is therefore essential that good public relations between operators and those who live and work adjacent to a blast site is most beneficial to all concerned.

An explanation of the necessity to use explosives and the need of the product or services being constructed is often worthwhile with prompt and courteous handling of any complaint being essential. Whilst time consuming, in the long term, a good public relationship can be the most cost effective method of reducing vibration levels and thus reducing the possibility of structural damage and perhaps more important reducing complaints by the public regarding annoyance.

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Reference

[1] DUVALL W I et al (1983)

Vibrations from instantaneous and m second delayed Quarry Blasts, Bu Mines Rept of Inv 6151, 1963, 341P.

Appendix

Predicted vibration levels in peak particle velocity at the measuring site, 60 metres from the blast site at varying charge weights.

Charge Weight at 60 m (kg)	Peak Particle Velocity mm/sec
50	8.1
40	6.7
30	5.5
25	4.8