ASSESSMENT OF THE IMPACT OF NEW RAILWAYS AND A CRITIQUE OF DIFFERENT METHODOLOGIES

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INTRODUCTION

The announcement by British Rail in 1988 to construct a new railway line between the Channel Tunnel and London to carry high speed trains was met by great degree of opposition from these community areas in the vicinity of the proposed line.

New Railway lines will inevitably be the cause of both noise and vibration impacts. Depending on the design parameters of a particular section of track and the propagation characteristics of the surrounding environment, people living and working along the proposed route will be affected to varying levels of impact from barely perceptible to severely disrupting.

For practical reasons, it is impossible to design and operate a major new railway such that it will have zero impact. There will therefore be some properties along new routes which will unavoidably suffer severe impacts and for which it will be reasonable to expect the scheme promptors to offer compensation either by way of sound insulation or as monetary compensation in respect of depreciation in property value.

Other properties away from the route will be affected to a lesser degree but nevertheless may experience a deterioration in their noise environment and a commensurate loss of amenity.

As the proposed new rail link has the potential to affect a large number of people in a variety of properties it was necessary to determine an impact assessment methodology which could be applied in a uniform way from community to community.

Impact assessment criteria can then be used to identify areas along a proposed route which would benefit from noise mitigation measures such as tunnelling, barriers, route alignment etc. They may also be used to give an indication of the area over which property prices might be influenced by the noise impact of the new route thus enabling to some extent a cost benefit analysis of the environment to be applied to the scheme.

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UNITS AND ASSESSMENT OF RAIL NOISE

The noise impact of differing transport design operations is most important when considering the costs and benefits of any particular scheme. This process however is not aided by the fact that very few countries have precise methods of determining noise impact. Some methods rely on comparisons of the future noise levels against the pre-existing noise level and others rely only on the future noise level and the numbers of properties which fall into predefined noise bands.

The most widely used criteria applicable to transportation noise impact assessments are comparisons between future L_{Aeq} versus existing L_{Aeq} and future L_{Aeq} versus L_{A90} or L_{A95}. These two methodologies form the basis of the impact assessment methods proposed by British Rail's consultants and ourselves acting on behalf of the Kent Local Authorities. In order to establish which of the two methodologies best quantifies human subjective response to noise intrusion, two principal arguments need to be addressed:

1. Is L_{Aeq} a meaningful indicator of an existing noise environment against which to assesses the annoyance due to an intruding or new noise source?

2. Does the measured L_{Aeq} give a statistically higher accuracy of repeatability than L_{A90} and in any case is this a requirement for a noise assessment tool?

For the concept to be robust the first of these is considered to be the dominating function and the second is of lesser importance.

The key to the argument probably lies in the long-standing debate on the subject in the drafting of a new BS 4142 for rating the impact of industrial noise in residential areas. The committee finally decided that assessments for industrial noise would be based on the concept of comparing L_{Aeq} from the industry against the existing background L_{A90}. This is similar in approach to the International Standard ISO R 1996 which had been used for the assessment of transportation schemes for many years. The argument for this is summarised below:

The concept of comparing L_{Aeq} against the existing L_{Aeq} has been used in noise assessments when the impinging noise is rising but of the same character. For instance, in situations where existing road traffic increases lead to a 3 dBA increase in L_{Aeq} then this change is considered to be significant enough to be identified in a framework as detailed in the Manual for Environmental Appraisal of trunk road schemes (Ref.1). It should be noted that as traffic is a constantly time-varying noise source, changes in annoyance are considered to be just perceptible for changes of 3 dBA in noise level. Noise sources more regular in character can be perceived as changing for rises as small as 1 dBA and indeed the 1 dBA increase is embodied as a condition within the Noise Insulation Regulations 1975 (Ref.2).

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I consider that the L_{Aeq} versus L_{Aeq} method is best suited for situations where there is already an existing noise source of the same predominant type and with similar characteristics; such as an intensification of an existing railway line. However, when considering a new railway line in areas which at present contain no similar background noise sources, the use of L_{Aeq} as an indicator of the existing noise environmental requires closer scrutiny.

A 3 dBA increase in traffic noise would be caused by a doubling of traffic; similarly a 3 dBA increase in train noise occurs when twice as many trains of a similar noise level use the line. A trebling of train passes would result in an increase of 5 dBA in the period L_{Aeq}. Increases of the period L_{Aeq} over existing background noise levels (L_{A90}) of 10 dBA are identified in BS 4142 as giving a 'significant likelihood of complaints arising'. These level differences would be even more noticeable during the evening and night-time periods when background noise levels are typically lower and peak noise levels could be over 50 dBA in excess of background. For industrial noise with a distinct tonal component a penalty of +5 dBA is added to the intruding noise and it could be argued that train noise has a distinct tonal component and therefore when considering the impact of new railway systems the 5 dBA 'penalty' should be used. The difficulty in adopting an impact methodology which relies on background noise is in determining what semantics to relate to the changes when the research is non-existent or at very best severely dated. Additionally, whilst the BS 4142 which relates to industrial noise was revised in 1990 it is still heavily criticised and the DoE are instigating further research into the matter.

Even adopting this approach, it is considered prudent to use prediction techniques to carry out comparisons. Because of the all-encompassing nature of L_{Aeq} any measured level will represent the actual noise source being considered plus all other noise from a variety of sources and may therefore give a false impression of the level; particulary as an isolated high level noise event may 'drive-up' the L_{Aeq} whilst not necessarily being considered by someone in the community as being representative of their noise climate. This particular case is demonstrated in Figures 1 and 2.

The real problem in using L_{Aeq} to describe any ambient noise is that the level gives no indication of the characteristics of the noise. There are many examples which can be quoted when the measured L_{Aeq} is similar but when the character of the noise environment is significantly different. L_{Aeq} is a means of averaging all the noise received and measured levels can be a contribution of natural sources, man-made noise, both intermittent and continuous. L_{Aeq} is only really meaningful if it can be directly attributable to a specific noise type. This is the only context in which L_{Aeq} should ever be used in noise assessments as the annoyance response due to a combination of noise sources has as yet not been sufficiently researched.

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L_{A90} on the other hand represents the general noise level in between noise fluctuations. It is a measure of the background noise and is easily identifiable by people as a reference on which to consider other noise sources. Rural areas well away from roads may well have L_{A90} values of 25-35 dBA whereas in the vicinity of roads these levels could be in the range of 40-50 dBA. Hence, isolated noise events of similar character and high level could result in similar L_{Aeq} levels which would mean that the additional intrusion of a large number of relatively high noise level events from train passes would not be rated as having any different impact despite the clearly different way in which inhabitants of the areas would rate their overall environment.

The choice of assessment criteria can have a profound effect of the perceived impact of a given noise source. The conflicting impact assessments carried out for the proposed Channel Tunnel Rail Link provide a good example of the differences that can arise. Due to the intermittent nature of high speed trains their actual contribution to the L_{Aeq} noise environment (at a particular reference position) over a 24 hour period may be marginal despite a 25 metre reference SEL in excess of 90 dBA and some 200 train passes in this period. Table 1 shows a comparison between the number of impacted properties and the degree of impact attributable to the Raillink under the two different impact assessment methodologies. Clearly an assessment of the impact against L_{Aeq} is unlikely to adequately describe the adverse reaction of people to the deterioration in their noise environment by the intrusion of 200 train passes at relatively high noise levels that will occur in such a situation. Peak noise levels from these trains would be in the region of 96 dBA at 25 metres from the rail.

It is therefore the choice between assessing impact against background or ambient noise levels as described by L_{A90} and L_{Aeq} respectively that results in the greatest controversy. By selecting L_{Aeq} to describe the prevailing noise climate prior to noise intrusion; typically a lower level of predicted impact is likely to arise particularly if the noise source is intermittent in nature.

Quantifying a level of impact necessitates attributing certain incremental increases in noise level above background or ambient criteria levels to a suitable rating on an impact scale. Quantifying significant incremental increases in noise level and dichotomization of the impact scale in terms of the allocation of a descriptor to a given noise level increase is necessarily to a certain extent a value judgement due to the subjective nature of both annoyance and perceptions of deterioration in environmental quality.

On the statistical argument, it may well be that L_{Aeq} measured will give more constant results than L_{A90}. Since a period L_{Aeq} averages and merges all noise sources, then more consistent results may be expected. What this means, however, is that areas of similar background noise levels but differing environments may not get distinguished as such in an assessment. A perceived quiet area may well be rated exactly the same as an area which is perceived to be noisier.

Clearly the method of impact assessment will affect to a greater or lesser degree which ever transport scheme options are chosen.

The impact methods chosen by British Rail's consultants is more fully explained in Working Paper on Noise Assessment Methodology (Ref.3) and this is shown for comparison purposes in Table 2 against the methodology adopted by the Kent Authorities.

CONCLUSIONS

The methodologies adopted by the two most interested parties for the determination of the noise impact of the Channel Tunnel Rail Link have resulted in differing levels of impact being identified and therefore the numbers of properties affected are different. The differing assessments will result in greater mitigation being identified for the Kent methodology than for the BR adopted methodology.

Neither assessment is backed up by detailed social studies in areas where new railway lines have been constructed. The debate which has arisen as to which is the correct method clearly demonstrates the need for such studies in order to ensure the adoption for planning purposes of a uniform approach to the problem.

REFERENCES

1) Manual of Environmental Appraisal, Department of Transport 1983
2) Noise Insulation Regulations, Statutory Instrument No: 1763, 1975
3) Working Paper on Noise Assessment Methodology, Ashdown Environmental Ltd, 1989.

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Comparison of Impact Methodologies

Impact	No. of Properties Affected	
	KCC Standard	BR Standard
Requires Sound Insulation	160	1
Minor/Slight	643	160
Moderate	265	41
Major/Substantial	92	11

Table 1

TABLE 2	
BR METHOD	KCC METHOD
Increases of $L_{Aeq,24hr}$ from 1998 without CTRL to 2013 with CTRL	Exceedance of period L_{Aeq} over period L_{A90}
> 15dBA - Severe 11 - 15 dBA - Substantial 6 - 10 dBA - Moderate 3 - 5 dBA - Slight	+15 to + 20 - MAJOR +10 to + 15 - MODERATE +5 to + 10 - MINOR +1 to + 5 - MARGINAL

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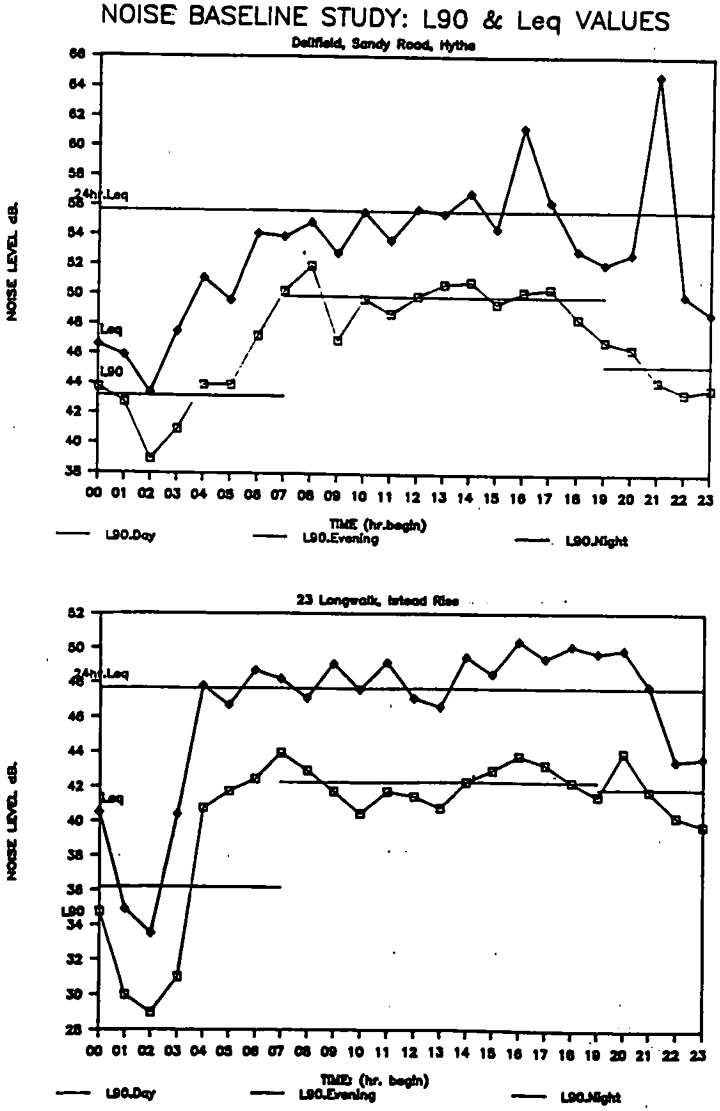

FIGURES 1 & 2