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PLANNING AND DESIGN OF NEW RAILWAYS - NOISE AND VIBRATION CONTROL

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1. INTRODUCTION

1.1 New Railways - The Legislative Process

To obtain the powers to construct a railway in the UK it is necessary to promote and successfully pilot through to Royal Assent a Private Bill in Parliament. The government plans to replace the private bill system to reduce the burden on Parliament with a new system of orders and public inquiries,

While the present system remains in place, Private Bills must be deposited in November each year, and Standing Orders require that in the case of railways a deposited Bill must be accompanied by an Environmental Statement. Those affected by the Bill may petition against it, and their petition will be heard by an opposed Bill Committee. Since Acts of Parliament have to pass through both houses, petitioners can petition both the House of Commons Committee and the House of Lords Committee.

Opposed Bill committees are conducted in a quasi-judicial manner, with resemblances both to public inquiries and to trials in courts of law. Counsel for the promoter makes the case for allowing the bill to pass into law, and tells the committee of the concerns of the petitioners; he leads evidence from his expert witnesses, who are cross-examined by petitioners (or their counsel), and examined by members of the committee. The petitioners present their cases (with counsel and witnesses, or merely in person), and the committee makes up its mind.

Committees are in an immensely powerful position, because without a report from them to the house that the Bill should be allowed to pass into law the promoters will be in serious difficulties. Committees exercise their power in two ways. The most common is to request the promoter to give an undertaking that he will do or not do something which they believe is required in order to take care of petitioners' concerns. Alternatively the Committee may amend the Bill. While there are opportunities for further amendment (or blocking) of the Bill on the floor of the house, it is crucial to the progress of a private bill that a satisfactory outcome of each of the committee stages, both Lords and Commons, is achieved.

Proceedings of the Institute of Acoustics

PLANNING AND DESIGN OF NEW RAILWAYS - NOISE AND VIBRATION CONTROL

Petitions against railway Bills are usually about fundamental planning matters (parliamentary committees have required promoters to change the alignments of more than one railway) property matters, or environmental matters. The most common environmental concerns are those about noise and vibration

2. NOISE AND VIBRATION CONTROL

Noise and vibration concerns usually relate not only to the operation of railways, but also to their construction. In the cases of the new central London railway proposals, the issue of noise and vibration from their construction is at least as great a concern by petitioners as are the effects of the operation of the railway.

2.1 Control of Noise During Construction

Where the building of a railway involves the construction of viaducts, bridges or tunnels, the potential impact of noise and vibration during construction can be substantial.

Noise from construction work is subject to both statutory and common law. Statutory controls on construction noise are to be found in the Control of Pollution Act 1974, sections 60 and 61 (which are sections that were not repealed by the Environmental Protection Act). Section 60 empowers Local authorities to issue notices limiting noise from construction works; Section 61 enables those intending to carry out construction works to apply in advance to the local authority for a consent to carry out the works, specifying the method of working and noise controls that will be applied, and the consent may include noise limits imposed by the local authority. In addition, individuals may complain to magistrates courts about construction noise as a statutory nuisance, under the terms of Section 82 of the Environmental Protection Act (formerly Section 59 of the Control of Pollution Act).

In common law, the law of nuisance applies. Nuisance is the unlawful interference with the enjoyment of rights over property, for which the remedies are injunctions and/or damages. An injunction is an order of court restraining the continuance of an unlawful act or commission. Damage is either damage to property or financial damage, i.e. loss of business due to inability to work because of noise, or the cost of relocation on account of inability to sleep because of noise.

Both Section 60 notices and the terms of Section 61 consents are subject to rights of appeal. The 'best practicable means' ground for appeal is not explicit, although there is indirect reference to it as a matter to which the local authority shall have regard. An important basis for appealing an excessively onerous notice is that it is unreasonable in its character or extent.

In Statutory Nuisance cases, statutory undertakers have a strengthened 'best practicable means' defence in that the BPM test is applied only so far as is compatible with the duties imposed upon them by law. In common law, in an action for nuisance

PLANNING AND DESIGN OF NEW RAILWAYS - NOISE AND VIBRATION CONTROL

resulting from the carrying out of activities empowered by Act of Parliament, a statutory undertaker will be liable only if he is negligent in carrying out those activities. The status of a Section 60 notice in the case of a railway undertaking has not been tested; London Regional Transport's legal moves following the service of a Section 60 notice on Contract 1 of the Docklands Light Railway Beckton Extension were settled out of court with the withdrawal of the Section 60 notice and the granting of a Section 61 consent, including noise limits conditional on the carrying out of a noise insulation scheme.

The over-riding difficulty is that there are no fixed limits for construction noise or vibration laid down either in any statutory regulations or in any British Standard. In its simplest form, the position is that a local authority can require anything of a construction site unless it is unreasonable in its character or extent. What is reasonable at one site may not be reasonable at another; for example 24-hour working may be essential at a tunnel portal, but not so at a station construction site; work during night possessions may be the only reasonable way of proceeding on one railway, but on another temporary closure of the railway may be the more reasonable method.

Most railway promoters have adopted, or are adopting noise and vibration policies which include sets of numerical limits; however, the numerical limits which matter are those contained in Section 61 consents.

Although the Control of Pollution Act was passed 17 years ago, and much of it has been repealed by the Environmental Protection Act, local authorities have avoided issuing Section 61 notices to a remarkable extent, because of the effect in removing their powers to act retrospectively. Only in recent times, with the advent of several major railway construction projects in London, has the importance of the Section 61 provisions come to the fore, with the result that the number of Section 61 consents granted for major worksites will rapidly grow. Although the first batch of consents will be made on a site-specific basis, taken as a whole they will form an important body of precedent which should take some of the uncertainty caused by the current lack of formal standards for construction noise.

2.2 Control of noise from operating railways

At the time of writing, the law imposes no specific requirements relating to noise or vibration from railways. Their impact must be assessed, however, in the Environmental Statement. Furthermore, the promoters of most of the recent Private Bills relating to railways have had policies on noise and vibration, including voluntary noise insulation schemes. In one case, the London Docklands Railway (Beckton) Bill, the House of Lords Select committee required a voluntary noise insulation policy to be modified by reducing the insulation threshold by 5 dB before they would recommend that the Bill be allowed to pass into law.

Proceedings of the Institute of Acoustics

PLANNING AND DESIGN OF NEW RAILWAYS - NOISE AND VIBRATION CONTROL

The effect of the existence of these voluntary (or not-so-voluntary) noise policies is that a railway promoter is unlikely to succeed in obtaining Royal Assent without a broadly equivalent scheme.

The Mitchell Committee was appointed by the Secretary of State for Transport with a brief to recommend a national noise insulation standard for the operation of new railway lines which equitably relates to the standard set by regulations for new highways.

They reported in the spring of 1991, and recommended a scheme in which noise insulation is provided for dwellings that are expected to be exposed to noise in the 15 years after the opening of a new line which satisfy the following requirements (excluding street running light rapid transit systems):

- 1) The value of L_{Aeq} (24 hours) 1m in front of a facade is at least 66 dB(A).
OR
- 2) The value of L_{Aeq} (2300-0700) 1m in front of a facade is at least 61 dB(A).
AND
- 3) The level of railway noise increases by at least 1 dB(A)
AND
- 4) The new line contributes at least 1 dB(A) to the total railway noise level.

One of the main issues which faced the Mitchell Committee was the fact that research has shown that at the same L_{Aeq} level, public annoyance due to noise from railways is less than it is from road traffic noise. Given the committee's brief to recommend a scheme which equitably relates to the highway noise insulation regulations, this matter was of no small importance. In the event, the Committee reached a conclusion on how big this negative difference in annoyance is, but discounted some of it by introducing a positive correction for 'disturbance to communications'. Critics of their recommendations say that 'disturbance' is already taken account of in the research work which led to the conclusion as to the difference in annoyance, and the Committee are therefore double counting this factor.

To date, the Secretary of State has not publicly responded to the Mitchell Committee's recommendations, but it is unlikely that any noise insulation regulations made for railways will be based on insulation thresholds lower than those recommended by Mitchell.

British Rail's current voluntary policy is to provide insulation where noise from a new railway is predicted at a facade L_{Aeq} (24 hour) level of at least 70. The policy does not apply to intensification of existing lines.

PLANNING AND DESIGN OF NEW RAILWAYS - NOISE AND VIBRATION CONTROL

The Mitchell Committee recommendations, as far as L_{Aeq} (24 hour) is concerned, are 1 dB less strict than the noise insulation policy required of London Transport in the case of the Beckton Extension to the Docklands Light Railway (DLR) at 65 L_{Aeq} (24 hour). The DLR also has the distinction of having a set of noise targets couched in terms of day, evening and night L_{Aeq} levels at much lower levels than the insulation threshold of 65. These targets have their origin in the original design-and-build contract for the initial railway, with the objective of seeking to procure the quietest possible railway. Their philosophy is that they represent noise levels below which the impact of the railway is likely to be low, rather than limits of the acceptable at which the impact is high enough to warrant noise insulation. There is therefore a substantial jump from 'low impact' thresholds to 'limits of the acceptable'. The DLR's noise targets are 60 L_{Aeq} (0700-1900), 55 L_{Aeq} (1900-2300) and 50 L_{Aeq} (2300-0700).

The position regarding noise from underground railways is somewhat different. Trains running in tunnels can be perceived in buildings above the lines concerned. The noise is typically perceived as a rumble with associated vibration which can be felt by touching building surfaces. Ground-borne noise differs from airborne noise in that localised mitigation measures are not possible - there is no equivalent to local noise barriers and no form of insulation is possible. The only design measures available concern the fundamental design of the tunnel track.

The design aim adopted by London Underground for the Jubilee Line extension and the Lewisham Extension of the DLR, and by British Rail and London Underground for CrossRail, is a maximum level of re-radiated noise of 40 dB(A). This level was found, following the opening of the Victoria Line, to represent a complaint threshold. In order to achieve this aim, the use of resilient track support systems is necessitated.

3. ENVIRONMENTAL STATEMENTS

The conventions of environmental impact assessment require that as a first step in assessing the impact of a proposed development, the baseline environment should be quantified, following which any change in the baseline caused by the development is then predicted. Because the noise index primarily used to quantify rail noise, L_{Aeq} , can be used to measure any kind of noise (regardless of how the results are interpreted), it is tempting to characterise a pre-existing non-rail environment by measuring the baseline L_{Aeq} , and then to quantify impact by calculating by how much the values of these indices would be altered following the development.

Unfortunately, however, studies which have been carried out on the subject of people's reactions to noise from different sources, and to noise from different modes of transport in particular, have indicated that while an index such as L_{Aeq} can be used to measure the quantity of noise energy emitted in each case, people's responses depend not only on the L_{Aeq} level but also on the nature of the source. It follows that the traffic noise background (and with rare exceptions the noise background of most non-rail environments is controlled by road traffic noise) is not

Proceedings of the Institute of Acoustics

PLANNING AND DESIGN OF NEW RAILWAYS - NOISE AND VIBRATION CONTROL

necessarily a valid baseline against which to assess the impact of newly introduced railway noise. Only in environments already experiencing railway noise does there exist a true baseline for use in impact assessment. Comparisons between non-rail background noise environments and railway noise levels must be made with extreme caution.

Noise and vibration effects of the operation of surface railways are of four kinds:

- Intensification of existing rail corridors
- Establishment of new rail corridors
- Reinstatement of disused rail corridors
- Special cases, including street-running tramways.

3.1 Intensification of existing rail corridors

Assessment of the noise effects of intensification of existing rail corridors is the easiest of the four cases to carry out, but in some ways is the most contentious. Assessment of the change in noise level may be made using the same index a reasonable degree of confidence (although there is some evidence of different public reaction to different kinds of railway, e.g. different traction types, for the same noise exposure). Generally speaking changes of not more than 3 units on the L_{Aeq} scale are negligible; changes of 5 or more units are significant. However, the significance of changes depends on the persistence of memory, and the significance of absolute noise levels is arguably of at least as great, if not greater importance. This topic is further discussed below.

3.2 Establishment of new rail corridors

There are two essential differences between the intensification of an existing corridor and the establishment of a new rail corridor. The first is that comparisons between existing and future noise levels using an index such as L_{Aeq} are far from straightforward, and secondly the question of habituation to railway noise becomes important.

In recent years, much experience has been gained about public response to new light rail and rapid transit services. This experience points to two main conclusions. Firstly, complaints often occur when rail noise possesses particular characteristics such as strong low frequency content when running on elevated structures or joint noise. When the first section of the Tyne and Wear Metro opened in 1980, there were complaints of noise from several areas exposed to 24-hour L_{eq} levels of between 50 and 60 dB(A) where the service was running on either 60ft jointed track or welded 180 ft lengths. Where perceptible ground vibration occurs complaints may also arise. Secondly, in the absence of special characteristics, complaints are unlikely to occur at 24-hour L_{eq} levels of not more than 55 dB(A). It can be argued that the 24 hour L_{eq} index is an insensitive descriptor, and it is necessary at the same time to give consideration to night-time noise levels and the effect of individual train noise peaks

PLANNING AND DESIGN OF NEW RAILWAYS - NOISE AND VIBRATION CONTROL

on sleep. This is an area where the degree of habituation to the noise exerts a strong influence, and some studies have found that noise from new railways has the same effect on sleep disturbance as noise from well established railways which is 7 dB(A) greater in level. Another study found that maximum noise levels, as measured inside bedrooms, of less than 52 dB(A) did not result in the awakening of people living in the vicinity of a railway line. This is equivalent to an external sound level of approximately 82 dB(A) for closed double glazed windows; about 72 dB(A) for well-fitting closed single-glazed windows and 62 dB(A) for open windows.

For environmental noise in general, it can be said that sleep disturbance is insignificant at internal hourly Leq levels of not more than 35 dB(A), equivalent to an external hourly Leq level of 55 dB(A).

For daytime, Leq (24 hour) is a sufficient indicator of noise impact as long as maximum noise levels are not high enough to cause significant speech interference. The following table of outdoor noise levels in dB(A) gives an indication of the effects of noise events on communication for people inside a building with various window conditions:

open window	closed loosely fitting window	double window	Voice level necessary for indoor communication at a distance of 6 ft:
65-70	70-75	80-85	Normal voice
70-75	75-80	85-90	Raised voice
78-83	83-88	93-98	Very loud voice
85-90	90-95	100-105	Shout
100-105	105-110	115-120	Communication impossible

Noise exposures of less than about 55 dB(A) L_{Aeq} (24-hour) or maximum noise levels of less than about 75 dB(A) involve no more than minor impact. For comparison, a passenger car accelerating at 7.5 metres gives a maximum noise level of some 80 dB(A) and a lorry about 90 dB(A).

Criteria for the assessment of impact are inevitably set at lower noise exposures than levels at which noise insulation is considered desirable, since noise insulation is generally considered as a means of mitigating noise impact which is above the limit of

PLANNING AND DESIGN OF NEW RAILWAYS - NOISE AND VIBRATION CONTROL

the acceptable. Thus between the 'minor' impact threshold of 55 L_{Aeq} (24 hour) and an insulation threshold at around 65 to 70 L_{Aeq} , lie bands of 'moderate' and 'major'.

3.3 Reinstatement of disused rail corridors

The principal difference between the reinstatement of disused rail corridors and the establishment of completely new right of way is that noise sensitive property tends to be found very close to disused railway alignments (often to the extent that demolition of recently constructed property is required). Furthermore, the noise environment of such locations is frequently very low, particularly if the former alignment is lined on both sides by the back gardens of rows of houses, and the nearest roads are beyond the front facades of the houses.

Furthermore, the past existence of a railway does not confer any immunity to noise impact on a proposed new railway, even if planners are inclined to fall into the trap of thinking that it does. If there is a degree of habituation to railway noise in the case of people living alongside established railway corridors, 'de-habituation' tends to occur quite rapidly.

3.4 Special cases, including street-running tramways.

The special cases include railways on elevated structures, where both enhanced noise levels and noise with an abnormal spectrum shape can occur, short radius curves which cause wheel squeal, and street running where ground vibration can be a problem.

4. CONCLUSIONS

While, at the time of writing, no regulations exist limiting or providing insulation thresholds for railway noise, a promoter of a railway scheme has no choice but to examine the noise and vibration impact of a new scheme in great detail in order to be able to deal with the inevitable issues which arise during the passage of the necessary Parliamentary Bill. The situation will change only procedurally when eventually the private bill procedure is replaced.