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ENVIRONMENTAL NOISE IMPACT AND THE CHANNEL TUNNEL TERMINAL

D. Wright BSc(Hons), MSc, DIC, MIEnvSci

Regional Manager of Thomson Laboratories South-West.

1. INTRODUCTION

In October 1985 the Channel Tunnel Group-France Manche (CTG-FM) put forward their submission to design, construct and finance the Channel Tunnel Fixed Link transportation system. An integral requirement of the Invitation to Promoters issued in April the same year was for a comprehensive environmental impact assessment of the proposed scheme to be undertaken in order to support the submission. CTG-FM dedicated two volumes of their submission towards the provision of an environmental impact assessment, which followed the methodology detailed in the EEC Directive EEC/85/337 [1]. In adopting these guidelines 18 separate studies were commissioned to investigate the social, economic, and environmental impacts; one individual study dealt exclusively with noise and vibration.

This paper seeks to describe the way in which Eurotunnel and the project designers Transmanche Link have used the conclusions and recommendations made in 1985 to develop detailed design proposals for the mitigation of noise impact within and surrounding the UK Terminal.

2.0 THE PRELIMINARY EIA AND DESIGN LAYOUT

In April 1985, a detailed noise investigation was commissioned and undertaken by Wimpey Laboratories Ltd. As with any EIA, the general methodology applied was to first establish the ambient conditions present in the areas earmarked for development and then make predictions as to the impact of the proposals upon the prevailing noise conditions. Following this, the noise impact was assessed in terms of it's overall level, it's increase over the background situation and the type of noise that people were subjected to.

Due to the limited time available to undertake the initial investigations (proposals had to drawn up in six months) the establishment of ambient conditions was confined to four 24 hour L_{Aeq}, L_{A10} , and L_{A90} measurements with additional short term measurements at nine other locations. Around the Terminal site measurements were made at Newington, Peene, Frogholt, north-west Cheriton and north-east Cheriton. In general the ambient noise conditions in these areas was dominated by road traffic noise from the M20 motorway, the

A20, and railway noise from the existing Folkestone to Ashford line. Noise Levels ranged from 50-60 dB L_{Aeq} in Newington and Cheriton during the day to 35-40 dB L_{Aeq} at night [2].

Prior to any research studies it had been anticipated that the villages of Frogholt, Peene, Newington and parts of north Cheriton would be adversely effected by the development. A number of mitigating measures were therefore proposed and subsequently incorporated into the early design of the western end of the Terminal prior to their provision in the first noise assessment. These were :-

i) The return loop for shuttle trains would be sited in a tunnel which would be landscaped to act as a noise bund for the western end of the Terminal and would run from the rail viaduct to the western access road.

ii) North and east of the access road where it would not be possible to incorporate an earth bund there would be a requirement to continue screening in the form of a noise barrier up the lorry freight park.

iii) The access road would enter the site in a 180 metre long tunnel beneath the earth bund.

iv) There would be a noise barrier on the southern side of the access road to the Beachborough roundabout to shield the village of Frogholt.

At this stage it should be stressed that the entire access arrangement for the scheme was substantially altered during the Parliamentary Bill Proceedings. However taking this as a starting point, the EIA then made predictions of the operational noise using a model developed by Wimpey Laboratories. The predictions were made using the method put forward by Beranek [3], with excess attenuation calculated for the effects of soft ground cover, atmospheric adsorption, and natural screening. The effects of noise barriers were determined using the method proposed by Maekawa [4].

The various road vehicle and rail movements within the site were modelled by representing such movements as equivalent hemispherical point sources emitting noise from segments of rail lines, sections of roadways, service areas, loading ramps, bridges etc. The emissions were calculated in terms of their overall L_{Aeq} based on the speed of the vehicle or train, the time spent in each sector, and the number of

vehicular or train movements in each sector. Traffic flows were determined in a separate study undertaken by Cyril Lea Associates [5]. The modelling study adopted the 'worst case' approach in term of vehicular flow and was based on a busy August day in the year 2003, thus allowing for the system to become established in the public domain. Base sound power datum for the model were obtained from a number of sources including the work of Richards [6] and Nelson [7] on train noise and temporal traffic movements and the Department of the Environment [8] for road traffic noise. All noise levels were converted to Equivalent Continuous Mean noise levels to standardize the inputs using the Noise Advisory Council's guidance [9].

The predicted noise levels were subsequently presented as noise contours as is illustrated by Figure 1. During daytime operations, it was estimated that some dwellings to the south of Peene and on the northern outskirts of Cheriton would be subjected to noise levels of about 60 dB L_{Aeq}. The southern half of Newington would experience levels of around 60-65 dB L_{Aeq} mainly due to rail movements on the viaduct crossing the M20 and A20. At night most of the properties in the villages of Newington, Peene, Frogholt and the north-western areas of Cheriton would be subjected to noise levels in excess of 50 dB L_{Aeq}.

In order to derive a suitable evaluation criteria for the project guidance was also obtained from Planning Circular 10/73 [10] and British Standard 8233 [11]. External evaluation criteria were determined from the internal noise standards of 45 dB(A) day and 35 dB(A) night and subsequently adding to these values the typical facade attenuation factors outlined in BS 8233. This gives a range of 55-65 dB(A) day and 45-55 dB(A) night depending upon whether windows are open or closed. In addition to the above, advice was sought from studies carried out on sleep disturbance undertaken by Large [12]. The evaluation criteria subsequently identified by Eurotunnel were that daytime operational noise should not exceed 60 L_{Aeq} (07.00-19.00), evening noise levels 55 L_{Aeq} (19.00-22.00) and night levels 50 L_{Aeq} (22.00-07.00) as measured at the nearest noise sensitive facades to the development. In addition, the overriding limit on maximum noise levels should be 65 dB(A) at night. These criteria were adopted as the standard for further design studies to achieve.

The predictive work undertaken also indicated that in certain areas it would be the night time usage of the Terminal that

would have the major impact upon the environment. Clearly further research was required to investigate ways of reducing noise emissions during this period.

3. THE CHANNEL TUNNEL BILL AND PARLIAMENTARY UNDERTAKINGS

Following the decision to grant the concession for the Channel Tunnel to CTG-FM the Channel Tunnel Bill underwent it's passage through Parliament. This commenced in May 1986 and proceeded for 14 months up to the enactment of the Channel Tunnel Act on the 23rd of July 1987. Due to the Parliamentary procedures adopted during the passage of the Bill, objectors and witnesses were confined to discussions concerning alterations and measures to ameliorate the existing proposals rather than a review of the need for the system itself. Although this led to much resentment on behalf of those opposing the scheme, additional changes to the original proposals further mitigated the scheme's environmental impact.

With respect to noise the major change that was introduced to the design of the Terminal was to alter the access arrangements by confining all traffic to a narrow corridor to the north and south of the existing M20 motorway. This had the effect of reducing the problems of noise and severance to the villages of Frogholt and Peene but increased the potential impact to Newington and north-east Cheriton.

Another important undertaking made by Eurotunnel at this time was to provide noise insulation to certain residential areas effected by the operational noise from the Terminal. Although efforts would be made to reduce emissions by the use of remedial measures on site, where noise levels were predicted to exceed either the 68 dB L_{A10} 18-hour standard, as detailed in the Noise Insulation Regulations 1975 [13], or 50 dB L_{Aeq} from 22.00-07.00, Eurotunnel would provide insulation in the form recommended in the above Regulations, as far as could be predicted, before the commencement of construction.

4.0 RE-ASSESSING THE BASELINE

One of the recommendations contained in the EIA (1985) was that further work should be undertaken (prior to the

commencement of construction activities) to establish in more detail the ambient noise conditions surrounding the development sites. In the spring of 1986, whilst the Parliamentary Bill was being discussed, Eurotunnel commissioned a further acoustic baseline study the findings of which were published in 1988 [14]. The results of four long-term monitoring positions are summarized in Table 1. Measurements were made over two 10 day periods in April-May and September and noise levels monitored over individual 24 hour periods. Only L_{Aeq} levels are presented here though the original document also contains details of L_{A10} and L_{A90} levels.

Table 1 Summary Of Long Term Baseline Data Folkestone 1986

Location	Typical L_{Aeq} levels weekdays day	evening	night
Newington	51-48	48-45	48-45
Peene	52-45	50-42	45-37
NE Cheriton	59	56-57	54-51
NW Cheriton	56	54-53	54-51
	Typical L_{Aeq} levels weekends day	evening	night
Newington	50-48	45	41
Peene	51-52	49-50	45-47
NE Cheriton	59-58	57	52
NW Cheriton	46-54	52-53	48

The first value (ie 51-48) indicates typical levels for April-May and the second value (ie 51-48) indicates typical levels for September. One value alone indicates the typical level was the same for both periods (source reference [14]).

From the results of the ambient survey it was established that the M20 motorway presents the predominant source of background noise in the Terminal area with north-east Cheriton most badly effected.

5.0 THE DESIGN PROCESS SINCE 1987

From 1987 onwards the predictive modelling work, that had

first been undertaken as part of the original EIA , needed to be re-evaluated as the design of the Terminal progressed from it's initial concept to detailed design and finally to definitive design. At each stage of the process the environmental specialists within Eurotunnel and TML have reviewed the design work carried out by the Building Design Partnership.

One immediate need was to assess those houses likely to require noise insulation. This work was carried out in late 1987 using the original model, with alterations incorporated as a result of the Parliamentary Bill proceedings. From this work a list of the properties that fell into the categories previously outlined were established and the installation of insulation commenced in early 1988.

Since that date further detailed design work using modelling investigations has provided advice on remedial and mitigation techniques . As the detail of the design unfolds so it has been possible to incorporate a more accurate array of inputs into the model to refine predictions. A great deal of research is currently being undertaken to establish an accurate picture of the noise emissions from the Terminal and this has especially involved a review of the sound power sources with their appropriate frequency spectra. The design location and height of noise barriers has also been closely examined.

6.0 CONCLUSIONS

This paper seeks to review the preliminary investigations and assessments of the noise impact of the Channel Tunnel Terminal. For large scale projects of national importance the preliminary investigations into the environmental impact of the development play a major role in the future development and overall design of the scheme.

7.0 REFERENCES

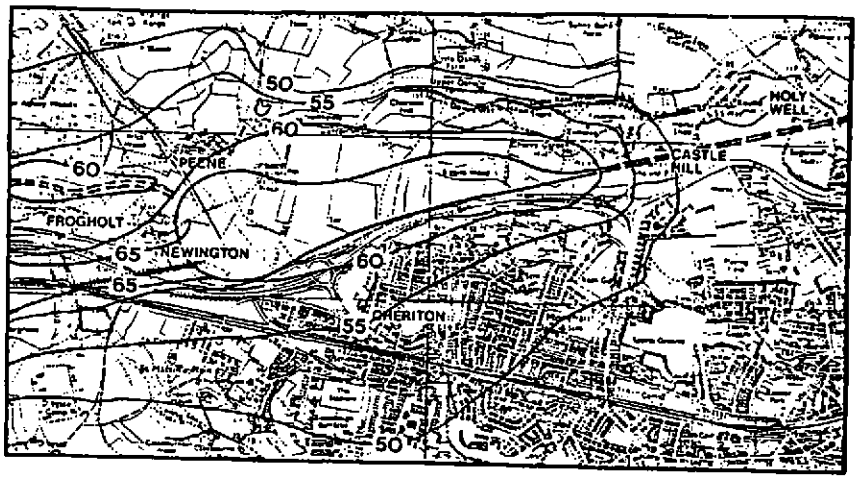
[1] EUROPEAN COMMUNITY DIRECTIVE ' Environmental Assessment', EEC/85/337, (1985). [2] CHANNEL TUNNEL GROUP ' The Channel Tunnel Project, Environmental Effects in the UK, 15. Residues and Emissions -Sound and Vibration ' (1895). [3] LL BERANEK ' Noise and Vibration Control' McGraw Hill

(1971).
[4] Z MAEKAWA ' Noise Reduction by Screens' Applied Acoustics No 1 pp 157-173, (1968).
[5] CHANNEL TUNNEL GROUP ' The Channel Tunnel Project, Environmental Effects in the UK, 14. Transport Networks' (1985).
[6] EJ RICHARDS ' A method of assessing the noise nuisance arising from the Channel Tunnel high speed rail system ', Journal of Sound and Vibration, Vol 43, No4, pp 633-657, (1975). [7] PM NELSON ' A computer model for determining the temporal distribution of noise from road traffic ',DOE TRRL Report LR 611, (1973). [8] DEPARTMENT OF TRANSPORT, WELSH OFFICE ' Calculation of Road Traffic Noise ', HMSO, (1988). [9] THE NOISE ADVISORY COUNCIL ' A Guide to the Measurements and Prediction of the Equivalent Continuous Sound Level L_{eq} ', HMSO, (1978). [10] DEPARTMENT OF THE ENVIRONMENT ' Circular 10/73, Planning and Noise', HMSO (1973). [11] BRITISH STANDARDS INSTITUTION 'BS 8233 Sound Insulation and Noise Reduction ', (1987). [12] JB LARGE ' Proof of Evidence to the Standstead Airport-London Public Enquiry ', (1981).
[13] SI 1975 No. 1763 ' The Noise Insulation Regulations ' (1975)
[14] EUROTUNNEL ' Environmental Effects in the UK, Baseline Studies, 15. Residues and Emissions-Sound and Vibration' (1988).

NOISE FROM THE CHANNEL TUNNEL TERMINAL

Figure 1

Daytime Noise During Operations at Cheriton



N.B. Predictions are made assuming adoption of earth mound landscaping from the railway viaduct to the access road, a 4m noise barrier north and east of the access road and the lorry freight park and a 3m barrier south of the access road. The access road will enter the site through a tunnel under the landscaped area.