REVISION OF CALCULATION OF ROAD TRAFFIC NOISE

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1 INTRODUCTION

The Technical Memorandum *Calculation of Road Traffic Noise*[1] (CRTN) was first published in 1975. The prediction method was developed to enable entitlement to sound insulation for residential properties under the 1975 Noise Insulation Regulations[2] and to provide guidance on the prediction of noise relating to the design and location of highways and other aspects of environmental planning[3]. In 1988, CRTN was revised to widen its range of application and to update the procedures to include the results from research that had been carried out since it was first published in 1975[4].

In 2011, the Highways Agency commissioned a review of the various standards and advice notes that the Agency had developed over a number of years to help it identify and mitigate both existing and possible future traffic noise issues. As part of this review, the Transport Research Laboratory (TRL) was appointed to lead a review of CRTN and identify those procedures which required updating.

A Steering Group which includes representatives from Government, noise consultants and the Institute of Acoustics will take into consideration the feedback from a questionnaire survey designed to collate the views from users of CRTN, policy makers and software developers. The outcome of the consultation will be reviewed with the Steering Group and appropriate changes agreed which will then form the basis for amending CRTN. At the time of writing this paper, a revised CRTN document is planned to be delivered to the Highways Agency by 31st August 2011.

This paper describes the progress made so far in the consultation process, including the results from the questionnaire survey. This is followed by various topics which are being discussed as part of the revision of CRTN. At this stage of the revision process, it is not possible to describe in detail the proposed amendments to CRTN but an overview of the topics being considered is included in the paper. It is hoped that by the time of the Conference, a detailed description of the amendments will be presented.

2 QUESTIONNAIRE SURVEY

2.1 Survey Details

Prior to the revision of CRTN it was important to canvas the views of interested stakeholders to determine how CRTN is used and viewed by those who come into contact with it. As such it was decided to disseminate a survey to a number of different groups including the Institute of Acoustics, the Association of Noise Consultants, Environmental Protection UK, Local Authorities, Highway Authorities and software developers. The survey was hosted on-line and covered topics such as the background of the respondent and their organisation, their understanding of CRTN, their opinion on the layout and clarity of the document, the appropriateness and clarity of the methodology and guidance for both predicting and measuring traffic noise, their suggestions for improvements and their experience with additional traffic noise guidance and procedures outside of CRTN.

Over 200 responses were received, primarily from acoustic consultants but also including Local Authorities, software developers, students and other authority figures.

2.2 Survey Results

The majority of respondents use CRTN in software packages, to inform measurements and perform hand calculations and calculations in their own spreadsheets. Most work is in modelling traffic noise as part of new road and infrastructure projects, including NIR assessments, although strategic mapping and action planning are also important.

The general feeling amongst respondents was that CRTN is relatively easy to understand if a little onerous to wade through, the main complaint being that parts of the document are open to interpretation and therefore difficult to code into software. Suggestions for any revisions to the layout were varied in scope, although most were satisfied with the existing structure.

2.2.1 Procedures

This section outlines some of the procedures within CRTN with which respondents had issues. In some instances, where a change to the procedure is possible, the document will be revised as outlined in Sections 3.1.1 to 3.1.6. In other instances, greater guidance and clarity on existing procedures is what is required, and these topics are outlined in Sections 3.1.7 and 3.2.

Segmentation: The segmentation process was considered cumbersome, with its iterative nature not ideal, and was also not well understood. Further guidance on this process was recommended.

Basic noise level: A conversion to L_{Aeq} was considered by many as an obvious improvement to the methodology. Guidance was requested on adapting external traffic flow data for use in CRTN.

Traffic speeds: Guidance was requested on the handling of low speeds for inner city modelling and on appropriate speeds to be used near junctions and roundabouts.

Road surface: The road surface corrections were considered out of date and difficult to apply in practice because texture information is rarely available and numerous road surface types are not covered. Additionally there is currently no guidance in CRTN on changes in acoustic performance with age. Clarification of low speed corrections was requested to avoid a step change in noise at 75 km/h. The road surface corrections in HD 213/11 were considered poor approximations under certain circumstances[5].

Obstructed propagation: Guidance was requested on the obstruction level of trees and foliage.

Barriers: The barrier correction procedure was considered poor and the ability to account for absorptive barriers, refraction at the end of barriers and different barrier shapes was requested. It was considered that the statement in HD 213/11 regarding absorptive noise barrier corrections being overestimated is inadequate to deal with modelling these mitigation measures. The calculation being based on perpendicular cross section is difficult for some software applications on curved roads.

Reflection effects: Improved guidance on when to account for reflective surfaces was requested.

Low traffic flows: Guidance on how to handle traffic flows below the low flow limit was requested.

Combined screening and reflection effects: This methodology was considered difficult to apply, especially within computer programs.

Measurement procedure: Responses indicated that the shortened measurement procedure is widely used but advice was requested as to its suitability and/or accuracy including increased clarity on the minimum sampling time in each hour.

A night-time measurement procedure (shortened if possible) was considered to be useful by many with, if feasible, a relationship with respect to daytime noise. The issue of an appropriate night time index and the importance of L_{Amax} were also raised.

Increased clarity was requested with respect to situations where the measurement conditions cannot be achieved. In particular, it was noted that the wind velocity requirements can make the measurement option difficult to pursue.

Annexes: The annexes were considered very useful but not all ambiguous/problematic text in the main document was considered to be covered. Additional annexes on complicated junctions, hard shoulder running, night-time noise, low-speed flow, and multiple lanes/bus lanes and split flows were requested.

2.2.2 Application

Guidance on the limitations, assumptions and the scope of use was considered by many as important, together with advice on the document's application. It was pointed out that there is a contradiction with PPG24 as to whether measurement or prediction is preferred. The certification of any proprietary software using CRTN was considered beneficial.

3 TOPICS CONSIDERED IN REVISION OF CRTN

This section describes the main topics which are being considered in the revision of CRTN. The first, Section 3.1, deals with the technical details associated with procedures for predicting noise levels. This is followed by Section 3.2 which deals with specific applications of CRTN with regards to: noise insulation; noise mapping and its general application within the Highways Agency's *Design Manual for Roads and Bridges*[5].

3.1 Procedures

3.1.1 Dual Source Lines

In 1989 the Secretary of State for Transport announced additional measures to relieve congestion on major roads in England which included increasing the capacity of existing routes by introducing road widening schemes, typically 4-lane dual carriageways.

A consequence of these measures was to increase the spread of traffic across the carriageway further than had previously been examined when the method was first developed.

Research carried out by TRL in 1994[5] recommended that the procedures which already exist in CRTN for predicting the noise from separated carriageways should also apply to dual carriageways with four or more lanes per carriageway. However, to resolve inconsistencies in the method where, for example, a 3-lane dual carriageway is widened to a 4-lane dual carriageway and would result in comparing noise levels based on a single source line model with that based on a dual source line model, a dual source line approach is proposed for all dual carriageways irrespective of the number of lanes per carriageway or the separation of horizontal or vertical alignments.

3.1.2 Vehicle Classification

The vehicle classification system described in CRTN identifies two vehicle groups 'light vehicles' and 'heavy vehicles' which are defined according to the unladen weight of the vehicle i.e. vehicles with unladen weight greater than 1.525 tonnes are classified as 'heavy vehicles'. The classification assumes that vehicles within each group are acoustically similar. However, since this classification

system was first introduced in 1975, the proportion of vehicles within the range 1.525 tonnes to 3.5 tonnes has grown significantly and the maximum permissible weight of heavy vehicles has increased from 38 to 44 tonnes. Therefore, the range in vehicle noise emissions within the heavy vehicle category has increased. To address this problem it is proposed that the heavy vehicle category is redefined as vehicles with unladen weight greater than 3.5 tonnes. Those vehicles with an unladen weight between 1.525 and 3.5 tonnes should be treated as light vehicles.

3.1.3 Surface Correction

The present surface correction provided in CRTN is not adequate to deal with assessing the influence of low-noise road surfaces on traffic noise levels, in particular, those referred to as thin surfaces. It is proposed that a correction based on the Road Surface Influence (RSI) value is introduced which has been developed for UK conditions[6] from ISO – 1189[7].

3.1.4 Extrapolation Beyond 300m

Research carried out by TRL has shown that noise levels from field measurements out to 600m from a motorway, where the intervening ground cover was grass, were in good agreement with predicted noise levels using CRTN with the attenuation with distance functions, Chart 7 and 8, extrapolated to 600m[5]. It is, therefore, recommended that this is adopted for predicting noise levels out to 600m from the road. For distances greater than 600m from the road, predicted noise levels become less reliable and the benefits from ground absorption diminish with distance. An approximate indication of noise level can be calculated by applying the attenuation with distance function Chart 7 (extrapolated to distances in excess of 600m) with the correction for ground absorption function Chart 8 (extrapolated to 600m). For this it is assumed that the attenuation rate for distances in excess of 600m is approximately 3dB per doubling of distance.

3.1.5 Median Barriers

Median barriers, designed to prevent vehicles from crossing the central reserve, may provide additional benefits in screening noise. Where a concrete barrier is constructed along the central reserve, the screening performance of the barrier relating to the far-side source line should be taken into account according to the procedures described in paragraph 22 of CRTN. In situations where there is additional screening, for example from a purpose-built noise barrier erected alongside the nearside carriageway, then the combined screening of both barriers should be calculated according to the procedures described in paragraph 35 of CRTN when calculating the noise contribution from traffic on the far-side carriageway. Generally, the height of the median concrete barrier above the road surface is less than 1.5m and therefore, reflection and screening effects from the nearside source line are negligible. However, where the height of the median concrete barrier is equal to or greater than 1.5m, a reflection correction is required when calculating the noise contribution from the nearside traffic and calculated according to the procedure described in paragraph 26.2 of CRTN or paragraph 36 where there is additional screening provided by a barrier alongside the road.

3.1.6 Reflection effects from Opposite Facades

Reflection from opposite facades, paragraph 26.2 of CRTN, provides a correction for reflections where there are houses, other substantial buildings or a noise fence or wall beyond the traffic stream along the opposite side of the road. However, there is no advice given concerning the position of the reflecting façade relative to the position of the traffic stream to determine when to apply the correction. Research based on a theoretical model has shown that the reflection correction is dependent on the ratio of the distance between the receiver and the source line and the distance between the source line and the opposite façade[8]. From this work a procedure has been proposed for determining whether the reflection correction from opposite facades (including barriers) should be applied.

3.1.7 Additional topics

There are a number of additional topics where advice on procedures may also be included in the revision these include:

- The segmentation process
- Traffic forecasts and traffic speeds
- Sound absorptive noise barriers
- A night-time measurement procedure
- Congestion Management Systems including hard-shoulder running and
- The application of the procedures in software packages.

3.2 Application

It is proposed to include in the revised document a chapter which provides guidance on specific applications where the method for predicting noise from road traffic is that described in CRTN. This will include the following applications:

- Strategic noise mapping as required by the END Directive[9];
- The Noise Insulation Regulations[10];
- The Highway Agency's DMRB[5].

The Charts and Annexes which accompany the procedures will be revised accordingly.

4 SUMMARY

The Highway Agency has commissioned work with the objective to revise the UK national noise prediction method CRTN. The revision will be guided by a Steering Group which includes representatives from Government, noise consultants and the Institute of Acoustics and will take into consideration the feedback from a questionnaire survey designed to collate the views from users of CRTN, policy makers and software developers.

A detailed questionnaire survey has been sent out to stakeholders and over 200 responses received. The issues raised by respondents are being addressed as part of the on-going revision process. This paper provides an overview of progress. It is hoped that by the time of the conference the revised document will be completed and a more detailed account will be presented.

5 REFERENCES

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