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# LESSONS LEARNT FROM AN INTERNATIONAL PERSPECTIVE ON CONSTRUCTION NOISE

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## 1. INTRODUCTION

At the early stages of planning a project, the information available may be limited, particularly as regards construction. In those circumstances assumptions have to be made to generate noise predictions on which to base an assessment of impact. It is sometimes not clear what level of detail is necessary (or desirable) in construction noise predictions. Inappropriate predictions can lead to conflicts when site work begins.

This paper discusses and contrasts current practice in the UK, Hong Kong and Peru based on ERM's recent experiences of major projects in these countries. The effects of location and cultural or regulatory differences between countries are described. The author discusses these influences whether lessons can be applied to UK practice.

## 2. CURRENT UK PRACTICE AND PROBLEMS

### 2.1 Prediction Methods

At present, various methods are used to carry out predictions of construction noise. These include simple single fixed source calculations, increasingly sophisticated calculations using BS 5228 with ground absorption effect, and computer assisted models. Each of these methods can be appropriate and it is important for the acoustician to consider which of them is most appropriate for the situation being considered. Generally, the simplest methods are most easily verified by others and this has considerable advantages if the prediction is to be reviewed by a local authority or main contractor or at the tender stage. Review of complex calculations carried out with computer models is often difficult and may lead to a lack of transparency and reduced trust between parties. Generally, clear and simply generated outputs are the most successful. However, if this approach suggests that noise levels may be close to noise limits, and activities are well defined, a more sophisticated approach may be necessary. On the other hand the effort involved in making and checking sophisticated predictions is often wasted if calculations need to be revised later due to changes in construction programme or method.

2.2 The Difference Between Early Prediction and On-site Noise
Sophisticated prediction procedures provide accurate predicted noise levels for specific plant configurations. However, in practice it is possible that engineering changes may occur, and it may not be possible to use the construction equipment which was originally envisaged. Changes in method are quite common in long term engineering projects and may lead to noise levels on site being different to those envisaged at the early planning stages.

In some cases, early predictions have indicated that a particular working method may lead to noise problems and the method has been changed to reduce the potential effects. For predictions to be effective in time to make changes to working methods speed is of key importance. A simple prediction approach may be adopted at this stage and will usually provide the level of information required.

2.3 Implications for Projects where Prior Consent or Contractual Noise Limits are Required
It is important to ensure that noise level agreements with local authorities or contractual requirements on subcontractors should not be based on unreasonable assumptions or early estimates which may not reflect the work which takes place on site. If site noise levels are found to be higher than expected, conflicts can occur since work may be limited to certain working hours in order to meet an average noise limit or, in extreme cases, may make it impossible to carry out works whilst complying with agreed limits.

2.4 Examples of Agreed Level and Site Noise Level Not Being Compatible
ERM's noise group was instructed to measure noise from backhoe dredging during construction of the Cardiff Bay Barrage. Prior to ERM's involvement a Section 61 agreement had been made. It was necessary for the dredger to operate at night and to follow tidal movements by working close to the shore and some housing since its working depth was limited. Concerns had now been raised over the noise from the dredger, particularly at night. It was found that the original consent for the dredging works had been based on a predicted level from a different sort of dredger which was quieter than the one that was used. Works management practices and physical noise control measures were applied in order to ensure that limits were not broken.

During work with the Jubilee Line Extension Project, predictions had indicated that sheet piling at Canary Wharf could be accommodated within a specified noise level. Local authority monitoring had suggested that the noise levels could lead to an exceedence. ERM was asked to provide staff to monitor the piling and ensure that contractors had sufficient information to avoid exceeding noise limits. Since noise levels were higher than the agreed limit it was necessary to either request dispensations for essential works or reduce working time and investigate alternative working methods to reduce noise levels.

An alternative procedure which would avoid the possibility of limits being exceeded would be to set no limits but rely on the developer to use best practical means to minimise noise. It is notoriously difficult to define this concept in terms of the construction process and lengthy discussions are often required before the parties agree what constitutes best practicable means in particular circumstances.

An increasing number of major projects in the UK require noise predictions to be carried out. Difficult situations can occur if the prediction is inappropriate. Room for improvement in the current situation exists and it may be possible to extract some useful features of construction assessment procedures in other countries. Recent experiences in Hong Kong and Peru are discussed below. The positive features are considered and the differences and similarities to the UK system are discussed.

## 3. CONTRUCTION NOISE IN HK

### 3.1 Project Involvement

ERM's HK office recently undertook and Environmental Impact Assessment (EIA) for the West Rail Passenger Scheme which was to run from the densely populated Kowloon area to the more rural, so called, New Territories. These stretch up towards the north of the special administrative region and the former boundary with China. The West Rail EIA for the passenger related activities has now been accepted and the experience gained during this period was considerable. Hong Kong provides an interesting environment in which to carry out acoustic projects.

### 3.2 Assessment Structure

In Hong Kong noise control forms part of the planning process as in the UK, although the procedures are quite different from those in the UK and reflect the particular nature of the area and its cultural differences. Construction noise control is covered under the Noise Control Ordinance (NCO) which is supplemented by guidance in Technical Memoranda (TMs) which describe the process of assessment that should normally be used. Standard noise levels for plant are also contained in the TMs. The NCO is administered by the Environmental Protection Department (EPD).

If work is to be carried out during the daytime a Construction Noise Permit (CNP) is not required. Although there are no legislative standards in Hong Kong for the control of construction noise during normal working hours, a limit of 75 dB LAeq 30 mins for dwellings has been proposed in Noise from Construction Activities - Non-Statutory Controls, EPD Practice Note for Professional Persons, May 1993 (ProPECC PN2/93). This limit has been applied on major construction projects, and is now generally accepted in Hong Kong. This limit is often used in Environmental Impact Assessments.

Some areas are referred to as designated areas, and lower noise levels are specified for these areas than others. If work is to be carried out in a designated area (see below) during restricted hours a construction noise permit would be required. Such works will be required to meet acceptable Noise Levels (ANL) which are generated for the area under consideration. ANLs are dependent on the nature of the activity, the sensitivity of the area, the duration of the works, and proximity to other major noise sources such as the airport.

Percussive piling noise is considered separately from other construction activities and higher limits are permitted for this activity. The difference between the Acceptable Noise Level (ANL) and the Construction Noise Level (CNL) dictates the times over which piling may be carried out.

For piling which gives rise to noise levels equal to the relevant ANL, piling is permitted from 0700 to 1900 hrs. For higher noise levels, it is limited to the beginning and end of the working day and a period in the middle which may coincide with less sensitive times of the day in terms of work activities. In future, it is intended to substantially reduce noise levels from piling.

Three TMs are available for use:

- Technical Memorandum on Noise From Construction Work in Designated Areas;
- Technical Memorandum on Noise From Percussive Piling; and
- Technical Memorandum on Construction Work Other than Percussive Piling.

3.3 Prediction Method

Possibly because of the large number of construction projects that are conducted in Hong Kong, the method adopted for prediction is somewhat more straight forward than in the UK. Predictions usually assume a fixed source position which is mid-way between the approximate geographical centre of the construction site and the boundary nearest to the NSR. This position is referred to as the notional source position. On very large sites a position 50m from the site boundary is adopted.

Standard noise levels for plant are used. It is possible to use manufacturer's noise data however this is not common. Evidence to justify any non-standard assumptions will be required. This reduces the amount of processing required by the EPD and reduces some of the opportunities for misunderstanding in the construction prediction process.

No formulae exist for haul road calculations and other moving plant but during the West Rail Project it was agreed with the EPD that some information from BS5228 could be adopted in certain cases if it was more appropriate to a particular situation.

On-time is assumed to be 100% which would not be expected in the UK. This is because in HK, engines on vehicles with cabs are left running in order to operate air conditioning systems. Switching off vehicles during loading is not a preferred option.

Ground absorption is usually not considered although there is the possibility to agree standard acoustic principles at locations which are a long way from the site. In most situations in HK propagation is over hard ground.

During driven piling the nature of the surrounding buildings changes the ANL. The presence of central air conditioning is deemed to reduce the sensitivity of a building by 5 dB compared to a naturally ventilated building. Most buildings in densely populated areas have air-conditioning. However, noise insulation does not increase if neighbouring buildings have through the wall chiller units since these do not require a sealed facade.

In some cases hospital, medical clinics, educational institutions, and courts of law may be specified to be 10 dB more sensitive than other buildings. This is at the discretion of the EPD.

3.4 Implications for Minimising Noise

Hong Kong developers usually work to shorter time scales than for projects in the UK. The process of assessment therefore needs to be as streamlined as possible. Developers do not seem to object to carrying out major screening of worksites etc to reduce noise despite the high cost. Partly this appears to be due to pragmatism and a wish to have the project up and running as soon as possible. Certainly the profits from a development deal would outweigh some of the marginal cost of noise control. This makes HK a very exiting place for an noise consultant to work since the opportunities to have innovative solutions adopted by the developer are greater, on most projects, than in the UK. This probably does not apply to very high profiles projects such as JLE where innovative designs have also been used.

3.5 Useful aspects of Hong Kong System

The predictions which result from the assessment system in Hong Kong are generally over estimates. However, this leads to a simpler system with less interpretation needed than in the UK. Simplification in prediction allows the calculations to be carried out relatively quickly and to be checked thoroughly (which is always the case). Absolute limits also simplify the system and provide early guidance on the amount of noise mitigation that should be applied. Factors which might make one are more sensitive than another are still considered in this approach.

## 3. CONTRUCTION NOISE IN PERU

In Peru construction noise in the capital Lima, is not specifically controlled. Major projects in or outside Lima may be subject to a construction noise assessment if an EIA is required. This will be considered by the ministry responsible for environmental matters. ERMs recent involvement in a project in a jungle region highlighted some of the differences in assessment between densely populated areas and extremely remote and sparsely populated regions. Desk studies of construction sites are of little use without an understanding of the baseline in specific environments. Attitudes to, and effects of, construction noise on specific indigenous peoples within the region also need to be considered. The area in ERM's recent project includes the remote Camisea area where little contact with outsiders is experienced. This generates an important moral responsibility on developers to be sensitive to local requirements and needs. Isolated villages sometimes view new development as an opportunity to obtain compensation for environmental impacts and it is the responsibility of the EIA author to consider the real effects of construction on activities which are important to the sustainability of village life.

INTERNATIONAL CONSTRUCTION NOISE

In order to assess the effect of construction on local people it was necessary to conduct extensive baseline studies. As well as noise studies the purpose was for a multi-disciplined party of professionals to visit remote villages and establish the social impacts of construction of new development. This proved valuable information in terms of locating hunting grounds and farm areas where noise might also be an important factor.

WHO and other references were considered and criteria are still being developed in the light of the recent field trip and baseline study to the region. However, relatively stringent criteria have been adopted compared to UK standards. This is to recognise that mechanical plant noise is being introduced into a region where most sounds are natural and that the new noise may be more intrusive than in the UK. For fixed plant an impact assessment criterion of LA90 - 6 dB has been adopted. This is so that noise levels are not increased substantially. This would be applied to plant items such as drilling rigs.

At night, the curious effect of increasing background noise is observed. Night time noise levels can be around 7 dB higher than daytime. This effect is due to the increase in insect noise and, in some areas, from frog song. This has the curious effect that fixed plant assessment would be carried out usually with a criterion based on the lower daytime levels.

Since not all remote villages have light at night, daytime and night-time are determined by natural light. Activity is carried out between 0600 to 2000 hrs and after this period it is assumed that sleep may occur.

Assessment of noise in jungle areas is made extremely difficult since the arduous conditions and remote locations mean that a full support team are required with local guides and boatmen to reach the appropriate settlements. Villages are generally located along the river which provides a useful communication route. The river will also be used to transport construction and other equipment to the area. Noise from boats and barges need to be considered for the periods when the river level was high and hovercraft noise assessment was required for the periods during the dry season when there was insufficient water in the river to transport goods.

Helicopters and fixed wing aircraft will also be needed and their effects on both social human activities and that of hunting activities will be considered.

The effect of underwater noise from hovercraft movements has also to be considered as part of the construction phase. The effect on fish stocks must be considered. However, rather generic approaches are necessary since no studies have been carried out in this region. It fact it would be extremely fortunate to find a study relating to local species since a large proportion of fauna has still to be identified.

In Peru the assessment of baseline noise conditions and possible social effects of noise are more important than in the UK. In the UK, past studies of human reaction are available and some guidance exists on acceptable levels (particularly at night). Studies in Peru, require development of criteria which could be unique to a particular area.

## CONCLUSIONS

Construction noise assessment in the UK appears to be most effective when calculations are carried out from an early stage in a project. A detailed assessment at this stage is not always necessary provided calculations are carried out as the project evolves.

In HK a simplified, prescriptive, assessment framework limits the amount of time involved for developer and regulator in dealing with applications. Calculations can be overestimates which can lead to a high level of noise mitigation. However, the system can reduce the possibility of misinterpretation.

Peruvian legislation does not provide specific construction noise assessment procedures. In remote regions the aspects of life which could be affected by construction noise vary from urban situations.