Preventive Planning Helps Keeping Traffic Noise at Bay in Hong Kong

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ABSTRACT
Road traffic noise is a major environmental noise problem affecting the densely populated Hong Kong, in which over 7 million people are living in only 1,100 sq. km with more than 85% being hilly area. Due to the compact cityscape of Hong Kong with major roads running near high-rise residential developments, it is always a big challenge to overcome traffic noise impact in the course of developing residential buildings in particular in meeting the increasing housing supply demand. The Hong Kong Special Administrative Region (HKSAR) Government is committed to tackle traffic noise problem and has adopted a series of proactive preventive actions to keep traffic noise at bay. This paper gives an overview of the proactive planning action to prevent traffic noise affecting future residents. A case example is studied to illustrate the effectiveness of this preventive planning process; and practicability of innovative noise mitigation measures designs. The implementation mechanism of these measures is also discussed.

Keywords:  Road traffic noise, Planning, Residential development, Innovative noise mitigation measures
I-INCE Classification of Subjects Number(s): 52.9
(See http://www.inceusa.org/links/Subj%20Class%20-%20Formatted.pdf.)

1. INTRODUCTION
Like other metropolitan cities, Hong Kong is facing severe road traffic noise problems and how to keep noise at bay becomes a challenge to acoustical and noise control professionals and practitioners; and professionals of other disciplines in Hong Kong. Due to huge housing demand and land scarcity, over 7 million people need to reside in about 1,100 sq. km with only less than 15% being reasonably flat land suitably for residential developments, most residential housings are often built close to major road networks. There is no dispute that good planning and design are one of the most effective measures in preventing road traffic noise. The Hong Kong Special Administrative Region (HKSAR) Government is committed to tackle traffic noise problems and has adopted a series of proactive preventive actions to keep traffic noise at bay. To effectively discharge the proactive planning process, there is well established mechanism through requiring noise impact assessment, exploring innovative measures, ensuring incorporation of necessary and practicable measures to avoid future residents from traffic noise impact. Marco Wu et al reported this mechanism in 2014 in InterNoise 2014 in Melbourne (1).

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This paper will give an account on how traffic noise problems could be minimised through proactive planning process with illustration of case example on how these noise mitigation measures can be appropriately implemented and materialized through a series of planning control, administrative and undertaking procedures. Lastly, it will briefly discuss how to encourage and disseminate these innovative noise mitigation measures in resolving traffic noise problem and share successful noise mitigation designs with the trade and stakeholders, and participate in various studies of innovative building envelop designs.

2. PREVENTIVE NOISE PLANNING TO KEEP TRAFFIC NOISE AT BAY FOR NEW RESIDENTIAL DEVELOPMENTS

To ensure that future residents of new residential development would not be affected by traffic noise from roads nearby, one of the tools is to require a noise impact assessment (NIA) report with detailed proposals of noise mitigation measures to meet with the requirements in Town Planning Process or land sales/lease agreement. The acoustical and noise control professionals and practitioners; and also professionals of other disciplines shall refer to Chapter 9 of the Hong Kong Planning Standards and Guidelines (HKPSG) (2), which stipulates objective criterion, 70 dB(A) $L_{10}$ (1 hour) and guidelines with practical examples. There are different types of practicable noise mitigation measures and building design forms like building setbacks and orientation, screening structures, balconies etc. available in the HKPSG for consideration in design of the developments as appropriate. It is entirely for the developers, professionals and acoustic practitioners to consider the types of measures to be used taking into consideration of functional and their own preferred design of the developments and other relevant factors. In essence, the NIA report would demonstrate that all practicable and effective measures have been explored and considered to minimize traffic noise impacts. The consideration of the technical feasibility and the acoustical effectiveness of each mitigation measure should be well recorded and documented in the noise impact assessment report.

3. CASE EXAMPLE ILLUSTRATING THE EFFECTIVENESS OF THE PROACTIVE PLANNING PROCESS TO PREVENT FUTURE NOISE PROBLEM

3.1 New Residential Development near Tolo Highway

A residential development near Tolo Highway is used to illustrate the effectiveness of this proactive planning process. The site is 22,100 sq. m to accommodate about 1,500 people or 500 flats and is situated next to Tolo Highway which is one of Hong Kong strategic expressway connecting from eastern to northern districts of New Territories, as well as a major land transportation route to the Mainland China, which consists of a dual four-lane carriageway with daily flow 125,000 vehicles at 100 km/hr. (Figure 1). Due to its close proximity to Tolo Highway, traffic noise at site boundary was in range of 75 – 78 dB(A) with highest up to 80 dB(A).

3.2 Evolution of Noise Conscientious Designs in Various Stages of Development

Initially, a “saw-teeth” concept building façade with architectural fins was adopted (Figure 2).
This was intended to avoid noise sensitive facades having direct line of sight of Tolo Highway. The design could have limited the angle of view of future residents to Tolo Highway, however, the entire development was not benefitted from this design from noise perspective. According to the NIA report, there was still more than 30% of habitable rooms subject to high traffic noise at level up to 76 dB(A). Also, it brought along other issues like potential reverberation of parallel architectural fins; and to some extent a less attractive aesthetical outlook of the entire development, as well as less number of flats could be produced.

Having observed the deficiency, the project team gave thoughts to concept of “cascade” balcony design (Figure 3). Instead of a “saw-tooth” only benefitted individual flat, the “cascade” design allowed the outermost unit to screen off the other units next door from Tolo Highway, as well as to increase their setback distance. For this building layout, it could apparently achieve full compliance. However, these “cascade” facades still relied on a number of large-scale vertical architectural fins (up to 2.5m deep protruded from the building facade) to maximize their noise reduction effect. Since these fins were closely adjacent to each another, it would be at a high risk of possible reverberant field built-up there and the actual noise effect became uncertain and subject to be further verified.

Eventually through collaborative efforts from project architect and noise control professional, a noise conscientious building orientation and floor plan layout (Figure 4) was evolved, together with specially designed recessed window and balcony incorporated (Figure 5) based on which all but a handful of dwellings would comply with the HKPSG traffic noise criterion. Both measures are capable of achieving 4 to 5 dB(A) reduction.
3.3 Full Implementation of Proposed Noise Mitigation Measures

The proactive planning process does not finish at the assessment stage. It is essential to ensure all noise mitigation measures committed are to be materialized in the development. In this regard, the developers are also required to undertake full implementation of all proposed mitigation measures in the future development. The purpose of the undertaking system is to obtain guarantee from the developer to provide the proposed noise mitigation measures appropriately, from design to construction and lastly handover to the future residents. The developer shall also be required to appoint an independent professional to certify that all noise mitigation measures proposed in the NIA report have been duly implemented and incorporated before completion of the development. The developer shall also undertake to include in the “Deed of Mutual Covenant” (“DMC”) the details and locations of the proposed noise mitigation measures. Such DMC will contain binding and enforcement conditions for the control, operation, financial support and maintenance for such measures. The undertaking system also requires the developers to inform in advance the prospective buyers of the development in sales brochure (Table 1) the traffic noise situations and the measures taken before their decisions to purchase the respective units have been made.

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<tr>
<th>Table 1 – Notes to Purchasers of First-hand Residential Properties in Sales Brochure</th>
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<td>Relevant Information on Noise Mitigation Measures</td>
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4. INNOVATIVE AND PRACTICABLE NOISE MITIGATION MEASURES

The above example illustrates how the process or mechanism would facilitate proactive and preventive noise planning against traffic noise impact on new residential developments. As a prerequisite, there should be technically feasible and practicable noise mitigation measures available for consideration. The HKSAR Government always encourages to explore innovative measures in the form of various building envelope to mitigate noise problems within the development. In recent years, the Environmental Protection Department (EPD) has been proactively collaborating with university researchers and acoustic professionals to study noise reduction effectiveness of different acoustic windows (3) and balcony designs (4). Some of these innovative building envelope designs such as plenum type acoustic windows (capable of reducing noise from 4 to 6 dB(A)) (Figure 6) and acoustic balconies (capable of reducing noise up to 5 dB(A)) (Figure 7) have been incorporated into residential developments or student hostels and were found to be effective in abating traffic noise. To encourage the use of innovative noise mitigation designs and measures against road traffic noise, EPD established a web-based database to disseminate some successful examples of innovative building designs and noise mitigation measures that have been proven effective for residential developments. The database has been uploaded to EPD’s website for public access to serve as a useful platform for information and knowledge sharing amongst concerned professionals and interested stakeholders (5).

Figure 6 – Plenum Type Acoustic Window for a Student Hostel Development

Figure 7 – Acoustic Balcony in a Public Housing Development

5. DISCUSSIONS AND CONCLUSIONS

Although road traffic noise is one of the major environmental noise problems in Hong Kong, the HKSAR Government has to adopt a series of proactive preventive actions to keep traffic noise at bay. The task will apparently become a great challenge to the noise control professionals and practitioners. This paper illustrates a good example of how effective in preventing future traffic noise problem can be done at outset in planning stage of a residential project. With conscientious efforts from the professionals and the Authority, the innovative building design and practicable noise mitigation measures can be progressively evolved and put into full implementation. Besides, the undertaking system can ascertain that the proposed mitigation measures will be duly materialized and be made known to the future purchasers of the property through an open and informed channel. Such planning
mechanism adopted in Hong Kong is not only a single purpose tool to ensure compliance of the HKPSG’s criterion, but also provokes development of innovative building envelope design at outset of the development planning, as well as raises awareness of property purchasers and the public for quiet environment. To encourage the use of innovative designs and measures against road traffic noise, EPD has established a web-based database providing a common platform to share update on innovative building envelope designs and measures. The continuous concerted effort of the Government, noise control and acoustics professionals would be prerequisite for achieving a better living and quiet environment in Hong Kong.

ACKNOWLEDGEMENTS

The authors wish to extend their appreciation to EPD of the Government of the HKSAR for their permission to publish this paper. The opinions in this paper are those of the authors and do not necessarily reflect the views or policies of the Government of the HKSAR.

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