



## Challenges in Planning against Road Traffic Noise in Hong Kong

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### ABSTRACT

Hong Kong is one of the most densely populated metropolitan cities in the world in which road traffic noise is the major environmental noise problem. Given the scarcity of land and distinctive compact cityscape of Hong Kong with major roads running near high-rise residential buildings, traffic noise impact has become a huge challenge to overcome in the course of increasing housing supply to meet the demand of the society. With the space availability and other technical concerns, at-sources mitigation measures, e.g. roadside noise barrier, may not always be the most suitable ways to reduce noise. This paper will give an account on how the traffic noise problems to new residential development in Hong Kong are minimized with illustration of practical examples on effective noise mitigation measures provided at the housing development. Also from the planning procedures angle on how the noise mitigation measures are eventually implemented and materialized. The government's effort in putting forward innovative noise mitigation measures in resolving traffic noise problem in residential development, by ways of launching a web-based database for sharing successfully implemented noise mitigation designs and participating in studies of innovative building envelop designs, will also be discussed.

Keywords: Planning, Road traffic noise, Web-based Database, Innovative Building Envelop Designs

### 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 noise control professionals and practitioners in Hong Kong. There is no dispute that good planning and designs are one of the most effective measures in preventing road traffic noise. The Hong Kong Special Administrative Region (SAR) Government is committed to tackle traffic noise problems during the implementation of new development areas and large-scale major road projects.

For new major road projects or projects involving substantial widening of existing roads, environmental impact assessments are required in accordance with the Environmental Impact Assessment Ordinance (EIAO). Accordingly, project proponents would be required to take appropriate measures according to the Technical Memorandum under the EIAO, such as revising the road alignment, using low noise materials for surfacing and erecting noise barriers, to ensure that the noise limit will not be exceeded; otherwise, the EIA reports would be rejected.

As for the residential developments that require planning permission from Town Planning Board (TPB), the Hong Kong SAR Government and the TPB can ask the developers to conduct traffic noise impact assessments and to adopt appropriate noise mitigation measures so that the proposed residential developments will not be affected by traffic noise from the roads nearby. These noise mitigation measures can also be deemed as one of the conditions for granting approval. For sites that undergo land sales, similar requirements can be included in land sales conditions to achieve the same results.

This paper will give an account on how to minimize the traffic noise problems affecting new residential development in Hong Kong with illustration of practical examples on effective noise mitigation measures provided at the residential developments. Also, this paper would look at how the noise mitigation measures are eventually implemented and materialized. The efforts in putting forward innovative noise mitigation

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measures in resolving traffic noise problem affecting residential developments, by ways of launching a web-based database for sharing successfully implemented noise mitigation designs and participating in studies of innovative building envelop designs, will also be discussed.

## **2. NOISE PLANNING TO PREVENT NOISE PROBLEMS AFFECTING NEW RESIDENTIAL DEVELOPMENTS**

To demonstrate to the Hong Kong SAR Government or the TPB that future residents of the proposed residential developments will not be affected by traffic noise from roads nearby, the developer would need to submit a noise impact assessment report in their submission to the TPB or as requirement under land sales conditions. Chapter 9 of the Hong Kong Planning Standards and Guidelines (HKPSG) (1) has already laid down objective criterion, 70 dB(A)  $L_{10}(1hr)$  and guidelines with practical examples regarding the prevention of road traffic noise. In a nutshell, different types of practicable noise mitigation measures and building design forms like building setbacks, screening structures, balconies etc. are available in the HKPSG for developers, professionals and practitioners to consider and incorporate into designs of their developments as appropriate. It is entirely for the developers, professionals and practitioners to consider the types of measures to be used taking into functional and other relevant design factors. The noise impact assessment reports should be able to demonstrate that all practicable and effective measures have been explored and considered to minimize the traffic noise impacts. The consideration of the technical feasibility and the acoustical effectiveness of each direct mitigation measure should be well recorded and documented.

To ensure that the noise impact assessment report is not a paper exercise, the developers would be required to undertake to implement all the proposed mitigation measures. The prime idea of the undertaking system is to obtain a guarantee that the developer would provide the proposed noise mitigation measures properly, from design to construction and handover to the future residents. Also, under the undertaking system, the developer is required to appoint an independent professional to certify that all noise mitigation measures identified in the approved noise impact assessment report have been duly implemented before completion of the development. The developer would also undertake to include in the "Deed of Mutual Covenant" the details and locations of the proposed noise mitigation measures. Such "Deed of Mutual Covenant" would 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 developments the traffic noise situations and the measures taken before their decisions to purchase the respective flats are made.

## **3. PRACTICAL EXAMPLES OF NOISE PLANNING OF RESIDENTIAL DEVELOPMENTS**

A land lot in New Territories, Hong Kong, was put to sale through a public auction and was planned to be used for residential purpose. Since it was located near a heavily trafficked carriageway with traffic flow of more than 10,000 veh/hr during peak hour, traffic noise impact can reach at levels as high as 78 dB(A) $L_{10}(1hr)$  at the boundary of the development and traffic noise impact was no doubt a prime concern. In the land sale conditions of the lot, the developer was required to submit a noise impact assessment report to the Authority and to propose appropriate noise mitigation measures to tackle the problem. The development contains about 200 flats. With conscientious efforts from noise control professionals, architects and town planners, mitigation measures in the form of special designed recessed windows, parapet walls and balconies (see Figure 1) were included with a result in which all the flats were found complying with the HKPSG traffic noise criterion. Under the undertaking system, the project proponent committed to implement all the above mitigation measures and to put them into the "Deed of Mutual Covenant" of the development. The development was completed in 2012 with all the proposed noise mitigation measures certified by the appointed independent professional as duly implemented.

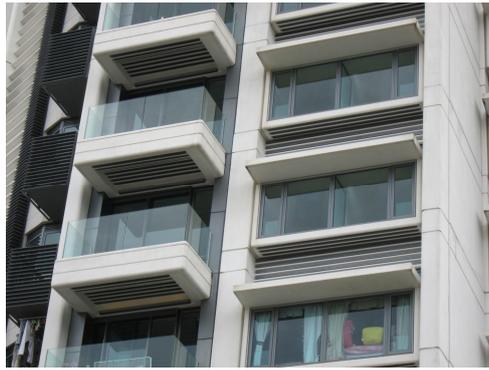


Figure 1 – Special Designed Recessed Windows and Balconies Implemented

#### 4. EXPLORING AND DEVELOPING INNOVATIVE NOISE MITIGATION MEASURES

Apart from applying a planning mechanism for new residential developments, the Hong Kong SAR Government is also dedicated and committed in exploring and putting forward innovative noise mitigation measures. In recent years, the Administration in particular Environmental Protection Department (EPD) has been proactively collaborating with research unit in university and acoustic professionals in the studies of noise reduction effectiveness of different plenum windows (2,3) and acoustic balcony designs. Some of these innovative building envelope designs such as plenum type acoustic windows and acoustic balconies have been incorporated into residential developments and were found to be effective in abating traffic noise. In addition, for sharing information amongst concerned professionals and interested parties on the development of innovative noise mitigation designs and measures, EPD launched a web-based database in 2012 collating examples on innovative building forms and measures that have been proven effective in mitigating traffic noise for public access. The ensuing paragraphs briefly describe two residential development projects in Hong Kong that have adopted innovative building envelope designs.

##### 4.1 The Use of Acoustic Balcony

To meet the ever-increasing housing demand, a public housing estate was proposed next to a heavily trafficked flyover. For alleviating the traffic noise impact on the future residents, the specially designed acoustic balcony has been considered, tested and implemented. To enable evaluation of noise reduction achievement and also constraints to design and maintenance aspects, an in-situ mock-up test was conducted in Dongguan, China with simulated traffic noise source to examine its noise reduction performance. The mock-up test results showed that the acoustic balcony design could provide attenuation up to 6dB(A). After the completion of the project, on-site measurements were conducted to verify its noise reduction effectiveness. In general, the on-site measurements indicate close resemblance of noise reduction performance as in the mock-up test. Figure 2a & 2b below show the section and outlook of the acoustic balcony the development project respectively.

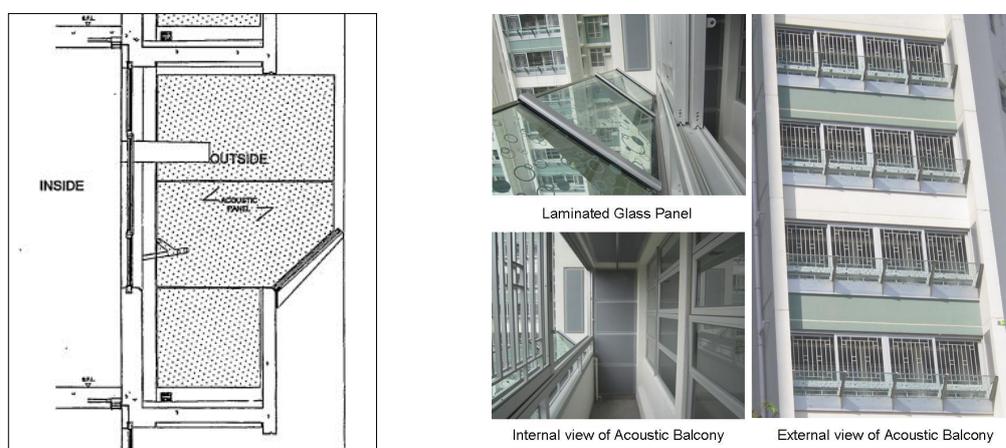


Figure 2a & b – Acoustic Balcony Installed in a Public Housing Development

## 4.2 The Use of Plenum Type Acoustic Window

In another residential development project in which the site was located next to a heavily trafficked road, the concept of plenum type acoustic window design was put into application. The benefit of this plenum type acoustic window design is that tangible noise reduction can be achieved at the residential flats and at the same time allowing natural ventilation. Laboratory tests were conducted to facilitate window design for the development. Subsequently, mock-up tests were conducted at the project site with the actual traffic noise source to study the actual noise reduction performance. Results of the mock-up test revealed that depending on the flat layouts, a noise reduction up to 8dB(A) could be achieved. Figure 3 shows the mock-up test of the plenum type acoustic window.



Figure 3 – Mock-up Test of Plenum Type Acoustic Window Design

## 5. LAUNCHING WEB-BASED DATABASE ON INNOVATIVE NOISE MITIGATION DESIGNS & MEASURES

To facilitate the use of innovative noise mitigation designs and measures against road traffic noise, EPD has collated examples on innovative building designs and measures that have been proven effective in mitigating traffic noise affecting residential developments, in a web-based database (Figure 4) (4). The database would act as a platform for information sharing amongst concerned professionals and interested parties, and has been uploaded to EPD's website for public access.



Figure 4 – Web-based Database of Innovative Noise Mitigation Designs and Measures

## 6. DISCUSSIONS

Planning against traffic noise in Hong Kong is a great challenge to the noise control professionals and practitioners. This paper has shown examples illustrating that preventing future traffic noise problem at outset of planning of residential projects is a very effective approach. In view of the scarcity of land, many residential developments have to be inevitably built near carriageways and would be subject to traffic noise impact. The planning mechanism adopted in Hong Kong ensures that the residential developments under

planning would meet the HKPSG's criterion. In particular, the undertaking system ascertains that the proposed mitigation measures would be duly materialized and be made known to the future owners. The Administration, noise control and acoustics professional are committed to explore and to develop innovative building envelope designs for mitigating road traffic noise. Apart from the studies, the promotion of its applications is of equal importance. To facilitate and encourage the use of innovative noise mitigation designs and measures against road traffic noise, EPD has launched a web-based database providing update on innovative building designs and measures. The continuous concerted effort of the Administration, noise control and acoustics professionals would be essential in achieving a better living environment for Hong Kong.

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