

## Construction noise management and control policy in Hong Kong and innovative quieter methods for renovation work

Joe MOK<sup>1</sup>; C.L. WONG<sup>2</sup>, C.W. LAW<sup>3</sup>; C.K. LEE<sup>4</sup>

<sup>1,2,3,4</sup> Environmental Protection Department, The Government of the Hong Kong Special Administrative Region,  
The People's Republic of China

### ABSTRACT

Many concerns revolve around construction noise particularly in such a densely populated metropolis as Hong Kong. The statutory permit system for construction work during restricted hours and labeling system for powered mechanical equipment (“PME”) have been well established in Hong Kong to manage and control construction noise. However, renovation work within high-rise residential buildings remains one of the most challenging noise sources as the renovation cycle is relatively short and it usually involves noisy PME. Common noisy activities in Hong Kong, such as demolition of concrete partitions, reformation of flooring and various types of fitting-out work, produce intrusive noise disturbing quite a number of neighboring flats through both air-borne and structure-borne transmissions. Structure-borne noise is difficult to be mitigated without substantial treatment in the noise transmission path which is almost impossible in a dense residential setting. Owing to rising public aspiration for a quieter living environment, it is necessary to address the concerns associated with renovation work within multi-flatted residential buildings. This paper will give an account of the statutory and administrative noise control framework in combating noisy construction and explore the effectiveness of innovative quieter construction methods to further mitigate renovation noise at source to achieve a quieter living environment.

Keywords: Noise Control, Renovation, Powered Mechanical Equipment

### 1. INTRODUCTION

With a total population of over 7.4 million, Hong Kong is one of the most densely populated cities in the world, having a population density of 6,300 people per square kilometer. It has a total land area of 1,111km<sup>2</sup> with a highly developed transportation network and densely populated buildings. The urban environment is dominated by closely packed high-rise residential or commercial buildings. According to the Census and Statistics Department of the Hong Kong Special Administrative Region (“HKSAR”), as of September 2018, there are more than 1,500 construction sites in the territory (1). Alongside economic development in recent years, a number of mega infrastructure projects, such as Shatin to Central Railway Link, The Lok Ma Chau Loop Innovation and Technology Park, The Third Runway, etc., are under construction. In addition, many refurbishment and redevelopment projects are in full swing to respond to the growing demand for housing and economic development in Hong Kong. Apart from construction sites, it is estimated that more than 20,000 residential units are renovated every year in Hong Kong. Construction noise, including renovation noise, is often a concern for the community. Around 16,000 pollution complaints were received by the Environmental Protection Department (“EPD”) in 2017, and noise complaints accounted for more than 20% (approximately 4,700 cases) (see Figure 1).

<sup>1</sup> joescmok@epd.gov.hk

<sup>2</sup> clwong@epd.gov.hk

<sup>3</sup> cwlaw@epd.gov.hk

<sup>4</sup> ckleee@epd.gov.hk

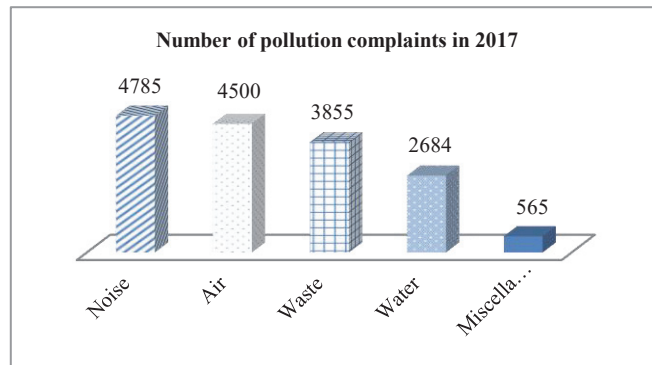


Figure 1 – Pollution complaints received by the EPD in 2017

Furthermore, the number of prosecutions associated with construction noise is the highest among various categories of environmental pollution. Of the 102 prosecution cases related to noise in 2017, 95 were violations related to construction noise (see Figure 2).

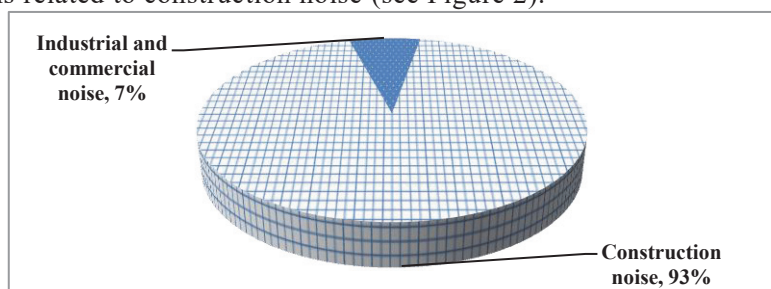


Figure 2 – Prosecution cases related to noise in 2017

The Noise Control Ordinance (“NCO”) of the HKSAR provides statutory control over the noise generated by construction activities and the noise emission performance of certain noisy equipment through the Construction Noise Permit (“CNP”) system and Noise Emission Label (“NEL”) system respectively (2). In addition to the statutory noise control, the EPD has also implemented an administrative instrument, namely Quality Powered Mechanical Equipment (“QPME”) Label system, since 2005 to encourage the use of significantly quieter PME. Moreover, the EPD is committed to exploring other low noise innovative construction equipment to replace traditional equipment in order to mitigate noise annoyance caused by renovation work in residential buildings.

This paper outlines an overview of the noise control and management framework implemented in Hong Kong; low noise innovative equipment and methods for different renovation and building maintenance work; and the collaboration among stakeholders to prevent and mitigate renovation noise.

## 2. CONSTRUCTION NOISE MANAGEMENT AND CONTROL IN HONG KONG

### 2.1 Legislative Policy

The EPD manages noise from construction work through the CNP system, which is preventive in nature. A CNP must be obtained from the EPD before the commencement of general construction work during the restricted hours (i.e. between 7 pm and 7 am on weekdays and any time on public holidays including Sundays), and for percussive piling between 7 am and 7 pm on any day other than a public holiday. Such permit may only be issued if the cumulative noise level, not only from the concerned work, but together with all neighboring site(s), is in compliance with the relevant requirements as set out in the Technical Memoranda issued by the EPD under the NCO (3, 4). Thus the requirement prevents “creeping up” of noise levels due to increasing number of work sites. More stringent controls are imposed on certain noisy manual construction activities as well as certain PME within the Designated Areas established under the NCO, which generally represent built-up areas with dense population. If the construction works are carried out within the Designated Areas and involve the use of 5 types of specified PME or 3 kinds of prescribed construction works, the works will be subject to more stringent control in terms of noise limits or noise mitigation requirements in order to offer additional protection for noise sensitive receivers in densely populated areas (5). Percussive piling is entirely prohibited in the territory during the restricted hours. The use of noisy diesel, steam and

pneumatic piling hammers is generally banned. As for noise caused by renovation works in domestic premises, it remains a challenging issue in Hong Kong since each residential flat can be the one which emits noise and the one which is affected. While noise from domestic renovation can be intrusive to a neighboring flat, it is of transient nature and at present not subject to any legislative control during the non-restricted hours. For most residential estates, house rules are developed to address the need and constraints for individual buildings with respect to the management for domestic renovation noise in terms of say, mutually agreed days and hours of operation.

Besides, the NEL system mitigates noise from construction equipment at source. It prevents Hong Kong from being a dumping ground for 2 types of commonly used and noisy PME, i.e. hand-held percussive breaker and air compressor (6). Breakers that weigh more than 10kg and air compressors that can supply compressed air at 500kPa or above must be fitted with NELs when being operated for carrying out construction work (see Figure 3 and 4).



Figure 3 – Sample of NEL



Figure 4 – Hand-held percussive breaker with NEL

In order to obtain an NEL, or even to import / supply these two types of PME for use in the Hong Kong, the equipment must comply with the international noise standards specified in the relevant regulations.

**2.2 Administrative Policy**

The QPME Label system serves as a product labeling scheme to recognize significantly quieter equipment (7). To be eligible for a QPME label, the equipment should be in compliance with noise limits stipulated in Article 12 of the Directive 2000/14/EC relating to the noise emission in the environment by equipment for use outdoors of the European Union; or the equipment has been designated and issued with Low Noise or Super Low Noise Emission Label under the relevant Low Noise Construction Equipment Regulations by the Ministry of Land, Infrastructure, Transport and Tourism of Japan (see Figure 5).

類別 Type	履帶式搬土機 Tracked Loader	
製造商 / 牌子 Manufacturer / Trade Name	ABC	
生產日期 (月/年) Date of Manufacture (mm/yyyy)	8/2012	
型號 Model	XY-123	
編號 Serial Number	0123456	
聲功率級 Sound Power Level	105	分貝(A) dB(A)
識別號碼 QPME ID Code	EPD-12345	
本標籤簽發日期 (日/月/年) Date of Issue (dd/mm/yyyy)	8/12/2012	
本標籤屆滿日期 (月/年) Date of Expiry (mm/yyyy)	12/2017	
環境保護署簽發 Issued by Environmental Protection Department		

Figure 5 – Sample of QPME label

At present, 15 types of commonly used PME are included in the QPME Label system, including tracked bulldozer, wheeled bulldozer, tracked loader, wheeled loader, excavator; generator, mobile crane, vibratory roller, road roller, asphalt paver, vibratory compactor, power rammer, hand held percussive breaker, air compressor and concrete crusher. As of May 2019, more than 8,300 QPME labels have been issued for those QPME.

There are several incentives for the construction industry to adopt QPME. Firstly, the chance of obtaining a CNP for construction work with QPME will be relatively higher. Moreover, the QPME items are recognized in the Public Works Projects initiated by the HKSAR Government as being eligible for additional monetary benefits. In addition, construction companies which purchase QPME are entitled to have profit tax concession.

### 3. INNOVATIVE QUIETER METHODS FOR RENOVATION WORK

Near 90% of Hong Kong residents live in multi-family dwellings of a single concrete building structure. More and more new high-rise residential buildings have more than 50 floors with more than 8 units on the same floor, which means more buildings contain more than 400 families together in one building structure, and almost all dwellings can be affected by renovation noise from even one renovation work (see Figure 6).



Figure 6 – Closely-packed high-rise residential buildings in Hong Kong

Moreover, according to our statistics in 2012, the movement of families in Hong Kong was about 5 years (8). Hence, noise due to the frequency, density and influence of domestic renovation work in Hong Kong is always an issue. The EPD strives to explore and promote the quietest practicable construction methods for the industry. In general, annoying structure-borne noise from renovation work comes from demolition activities with the use of percussive breakers. The sound power level of traditional hand-held percussive breakers can be as high as 108dB(A). Given the control of structure-borne noise transmission along multiple transmission paths is nearly impracticable, using low noise innovative equipment appears to be the only option.

#### 3.1 Diamond Coring Tool

Diamond coring tool can be used for fastening fixtures, as well as installing brackets for water pipes or electrical cables (see Figure 7).



Figure 7 – Diamond coring tool

Along with the electrically-powered water management system, wet coring can be performed in concrete and other metallic materials. The water management system can supply water and recycle water for the operation of wet coring, thus minimizing structure-borne noise and vibration. Moreover, it can also collect debris and hence reduce dust (see Figure 8 and 9).



Figure 8 – Electrically-powered water management system



Figure 9 – The operation of diamond coring tool together with water management system

To evaluate the noise emission performance of diamond coring tool, the EPD has conducted a study about structure-borne noise transmission to compare the coring tool with a traditional hand-held drilling tool. The noise measurement was carried out in two separate rooms, namely the noise source room and noise receiver room. A vertical concrete wall between the two rooms isolates the air-borne noise transmission. Compared to traditional drilling tool, not only could the use of diamond coring tool reduce the transmission of structure-borne noise by 4dB(A), it also gave a resultant noise level of even 14dB(A) lower in the noise receiver room (see Table 1). In addition, air pollution generated by dust formation during machine operation can be minimized.

Table 1 – Noise comparison between diamond coring tool and traditional drilling tool

Tool	Noise level, dB(A)		Noise difference, dB(A)
	Source room	Receiver room	
Diamond coring tool	87	62	-25
Traditional drilling tool	98	76	-21

### 3.2 Battery-driven Fastening Tool

The battery-driven fastening tool is capable of fastening cables or conduits, and installing drywall or wood tracks into concrete and steel plates (see Figure 10).



Figure 10 – The battery-driven fastening tool is capable of fastening conduits into concrete

Its advantages include low recoil, dust-free and virtually no vibration. According to a sound propagation report commissioned by the manufacturer, compared to traditional hammer drills, the use of battery-driven fastening tool can reduce the transmission of structure-borne noise by 8dB(A). Inside the noise receiver room, the noise level of operating a battery-driven fastening tool is 9dB(A) lower (see Table 2). It greatly reduces the noise impact on neighboring flats without compromising on the productivity. Compared to gas-actuated fastening tool, changing of gas cans and cleaning of dirty cartridges are not required.

Table 2 – Noise comparison between battery-driven fastening tool and traditional hammer drill

Tool	Noise level, dB(A)		Noise difference, dB(A)
	Source room	Receiver room	
Battery-driven fastening tool	88	65	-23
Traditional hammer drill	89	74	-15

### 3.3 Wall Chaser

Wall chaser is used for preparing grooves on the interior walls for installation of in-wall electrical sockets, conduits, water pipes, etc. (see Figure 11).

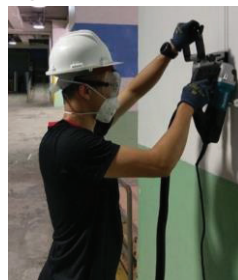


Figure 11 – Wall chaser is used for preparing grooves on walls

Experimental results reveal that the application of a wall chaser achieves a significant structure-borne noise reduction of 19dB(A) more as compared to using a traditional hand-held percussive breaker. In the noise receiver room, the noise level of operating a wall chaser is 9dB(A) lower (see Table 3). In the use of removing wall plaster, a wall chaser can be alternately used with a chisel, which can largely reduce the noise annoyance to neighboring flats.

Table 3 – Noise comparison between wall chaser and traditional hand-held percussive breaker

Tool	Noise level, dB(A)		Noise difference, dB(A)
	Source room	Receiver room	
Wall chaser	109	80	-29
Traditional hand-held percussive breaker	99	89	-10

### 3.4 Other Low Noise Innovative Equipment

In addition to the above portable tools for renovation work in residential units, there are some other low noise equipment in the market for building repair / maintenance work as well, such as high pressure water jetting machines, hand-held concrete crushers and wall cutters, as quieter alternatives to the traditional percussive PME (see Figure 12, 13 and 14).



Figure 12 – High pressure water jetting machines can be used for removing deteriorated concrete and tiles



Figure 13 – Hand-held concrete crushers can be used for concrete breaker



Figure 14 – Wall cutters can be used for dismantling plaster, brick and mortar walls

#### 4. PROMOTING AWARENESS OF QUIET CONSTRUCTION

In the past, the construction industry may have a lack of awareness of innovative quieter construction equipment and methods. Many contractors tend to stick to conventional practices as a culture and take advantage of the convenience from some traditional tools such as a breaker and a drilling device that can primarily perform most of the tasks for renovation works. But now, many innovative quieter alternatives have been proved to be not only quiet but effective in carrying out those tasks. The Government realizes the importance of raising the environmental awareness of all stakeholders because they can play an active role in reducing noise nuisance from renovation work. To achieve this aim, the EPD has produced a variety of education / publicity materials and established close collaboration with the relevant sectors, such as the construction industry, the property management sector and the vocational training institutes, to promote the adoption of more environmentally friendly equipment or methods.

The EPD and the Hong Kong Construction Association have set up a Quiet Construction Working Group to regularly explore and promote the use of quieter construction methods and low noise equipment for projects ranging from large-scale infrastructure development projects to domestic renovation work.

In addition, the EPD has set up a website to promote the use of the latest quieter alternatives and the noise mitigation measures (9). Moreover, the EPD partners with the property management sector to promote green property management and establish house rules. For smaller scale renovation works in domestic flats, the EPD has developed relevant guidelines for addressing the common interests of all stakeholders and for the property management sector to better manage domestic renovation noise (10). At present, many residential estates have developed their own house rules, such as working time restrictions and timetables for renovation work mutually accepted by all parties involved, to deal with the noise issues arising from renovation activities. The EPD has also developed a set of educational package to disseminate knowledge about basic acoustics, noise generation, minimization and

prevention of noise problems for the general public (11).

Besides, the EPD cooperates with the Construction Industry Council in enhancing the environmental awareness of the construction industry through better understanding of the legislative control on construction noise, and sharing on quieter construction methods and practical experience. The EPD also values every opportunity to facilitate frontline construction practitioners to familiarize with low noise innovative equipment through seminars and demonstrations.

## 5. CONCLUSIONS

With the concerted efforts of the Government and various partnering sectors, including the construction, property management and education, some quiet construction equipment and good management practices have been promoted and even adopted to control the impact of renovation noise. Looking ahead, the EPD will continue to adopt a "win-win-win" approach in minimizing construction noise, by meeting the public's rising aspiration for a quiet environment, addressing the need of construction efficiency through innovative technologies, and enhancing public service by exploring and promoting low noise construction methods.

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