

# **NOISE MAPPING AND WEB-BASED NOISE IMPACT ASSESSMENT SYSTEMS IN HONG KONG**

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## **1. INTRODUCTION**

Hong Kong is one of the most densely populated cities in the world. Given the congested living environment, it is unavoidable that many housing developments are situated close to major roads, and thus road traffic noise is one of the most predominant environmental noise issues in Hong Kong. Over the years, Environmental protection Department (EPD) recognizes the importance of noise mapping in strategic planning which helps to identify and visualize the distribution of traffic noise level, and precisely the floor of a high-rise residential building which is affected. Apart from traffic noise, construction noise is also one of the public concerns in a compact city. In view of the shortage of housing supply, the Government of Hong Kong Special Administrative Region (HKSAR) has committed to generate more land and housing at a quicker pace and more efficiently [1]. Together with other mega-sized infrastructure projects, such as Kai Tak Development, Central Kowloon Route, Northern Metropolis Development, it is expected that the construction industry will remain active in Hong Kong. Effective construction noise management is therefore essential to minimize the impacts to the residents who are living in close proximity to the construction sites.

This paper discusses the noise mapping development in Hong Kong and highlights the importance of noise mapping in city planning. This paper also demonstrates how the web-based noise impact assessment systems could help environmental data sharing, facilitate the professionals in preparing noise models and formulating noise management plans.

## **2. DEVELOPMENT OF NOISE MAPPING IN HONG KONG**

Prior to the global widespread application of noise mapping, Hong Kong was among the first few places to develop noise mapping and 3D noise models for reviewing noise impact from infrastructure projects. Back to 2006, the EPD released the first generation of noise map of 2000 – about a year before European states were required to generate their own noise maps [2]. To better understand the change in road traffic noise situations in Hong Kong, and to evaluate the effectiveness of road traffic noise policies, the EPD has produced in total five version of noise mapping throughout the years for 2000, 2005, 2010, 2014 and 2020 [3].

On the other hand, in view of the unique environment in Hong Kong which

consists of many high-rise residential buildings near complex road networks and flyovers, a 2D noise mapping has its limitation to present the noise exposure environment thoroughly. With the aid of the advanced Geographic Information System (GIS) technology and enhancement of computation power, 3D noise map was produced which provides more accurate estimation of the predicted noise level at each building façade [4].

### 3. IMPORTANCE OF NOISE MAPPING IN CITY PLANNING

Based on the past experience over these years, noise mapping has undoubtedly played a critical role in city planning. Firstly, the effectiveness of road traffic noise policy could be evaluated when carrying out regular updates of the noise mapping. Secondly, the noise mapping results give the government better ideas of spatial distribution of road traffic noise situation, and hence more precise and more target-oriented measures could be implemented. Thirdly, member of the public can easily understand the potential road traffic noise impacts caused by a project through the 3D noise mapping during public consultation.

#### (i) Evaluation of effectiveness of noise policies

Regular updates on noise mapping have been done to continuously monitor the population exposed to excessive traffic noise in Hong Kong. Figure 1 shows the noise mapping results from 2000 to 2020.

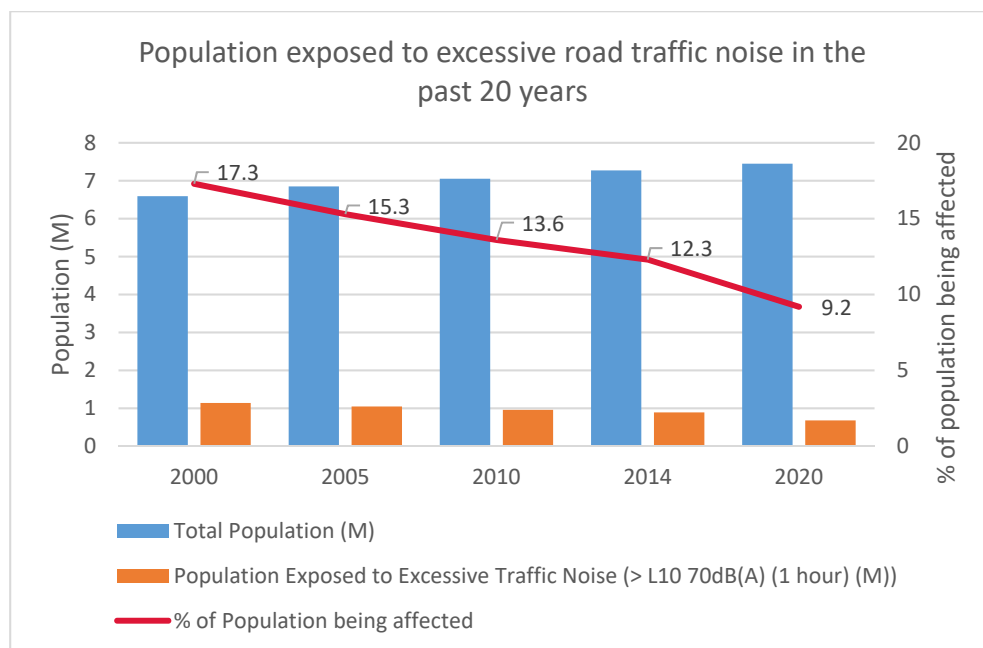


Figure 1: Population exposed to excessive road traffic noise in the past 20 years

Despite the population expanding by 820,000, the road length increasing by 200 km, and the number of vehicles growing by 290,000, the population exposed to excessive road traffic noise decreased from 1.14 million in 2000 to 0.68 million in 2020. Such a remarkable improvement verified the effectiveness of road traffic noise policies in Hong Kong which is imposed mainly through the following means:

- a) Preventing traffic noise exceedance from new roads / on new residential developments through careful planning;
- b) Noise abatement on existing roads by retrofitting noise barriers and resurfacing with low noise material; and
- c) Control of noise emissions from individual first registered vehicles.

*(ii) Identification of concerned areas that require targeted noise planning efforts*

Comparing the noise mapping results at district levels over the years, it gives a clear picture of the changes in traffic noise situations. Figure 2 shows the results for some new towns and old districts in Hong Kong as examples.

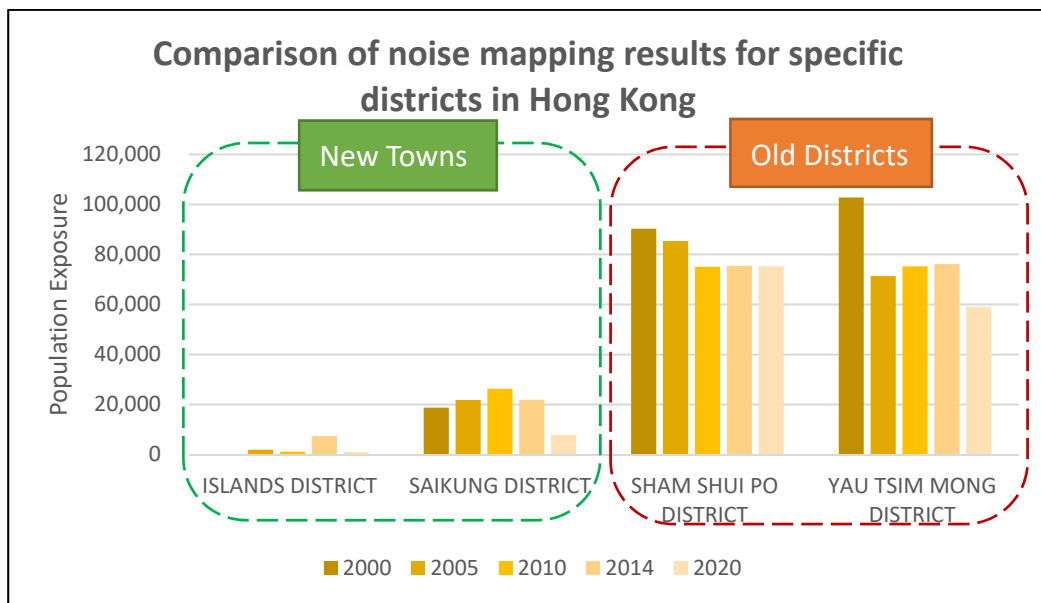


Figure 2 – Comparison of noise mapping results for specific districts in Hong Kong

In Figure 2, it is obvious that the population exposed to noise exceedance in new towns (e.g. Tung Chung in Islands District and Tseung Kwan O in Sai Kung District) is far lower than those in the old districts (e.g. Sham Shui Po District and Yau Tsim Mong District). This is because the EPD has get involved in planning new residential development or new roads projects, to ensure that existing and planned noise sensitive receivers are protected from excessive traffic noise. On the other hand, the population exposed to noise exceedance in these old districts is mainly due to the lack of proper noise planning in the past. To further minimize the population exposed to noise exceedance, urban renewal in the old districts could be the focus of future city planning to minimize the population exposure.

*(iii) Better understanding of the noise impacts of a Project*

In Hong Kong, proponents of new major carriageway are required to conduct Environmental Impact Assessment (EIA) to evaluate environmental impacts caused by the projects, including road traffic noise. 3D noise mapping was one of requirements in the EIA studies of many large-scale road projects (e.g. Tuen Mun Bypass, Route 11

between Yuen Long and North Lantau, Widening of Tsuen Wan Road). The 3D noise mapping allows users visualize the road traffic noise impacts under both unmitigated and mitigated scenarios easily with the aids of colors. During public engagement, such 3D noise mapping is considered a useful communication tool to demonstrate how the road traffic noise is managed by the proponents and the effectiveness of the noise mitigation measures.

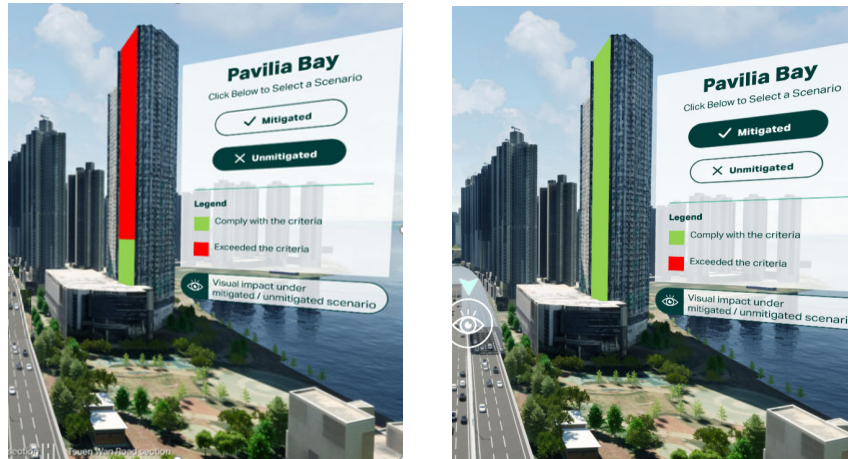


Figure 3 – Comparison of the noise impact assessment results under unmitigated (left) and mitigated scenarios (right) for the EIA Project “Widening of Tsuen Wan Road”

#### 4. INTEGRATION OF WEB-BASED NOISE IMPACT ASSESSMENT SYSTEMS AND NOISE PLANNING

##### (i) Sharing of environmental data through Centralized Environmental Database (CED)

During the production of noise map, extensive data preparation works are required and millions of input and output data were being handled by GIS and large-scale noise modelling software. These valuable modelling input data, including road centreline mapped with peak traffic volume and percentage of heavy vehicle, inventory of road side screening structures (e.g. noise barriers and noise enclosure), extent of Low Noise Road Surface, nature terrain, is very useful for future project proponents in preparing computer models for noise impact assessment at project wide level. Therefore, these kind of data have been uploaded onto the CED, which is an online platform developed by the EPD for sharing a wide range of environmental data. Such platform helps project proponents to better understand the potential environmental constraints at the early planning stage. The CED also provides a user-friendly tool for project proponents to conduct preliminary road traffic noise assessment with just a few clicks. A quick review on noise impacts of different project designs could be simply carried out at preliminary stage, and hence to facilitate the project proponents to realize the potential noise impacts of the new developments and to consider different options of mitigation measures at early planning stage.

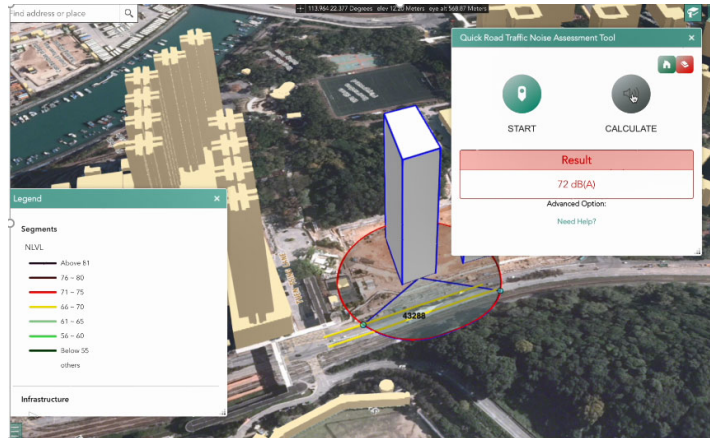


Figure 4 – The noise assessment tool in the CED

*(ii) Provision of web-based evaluation tools to make noise assessment efficient*

The EPD has endeavored to share the data for carrying out noise impact assessment using GIS-based platforms for both road traffic noise and construction noise, namely Web-based 3D Noise Modelling System (Web3DNoS), Web-based Traffic Noise Assessment Tool (Web-NAT) and Web-based Construction Noise Management Plan System (Web-CNMP). These applications preload all necessary modelling data, which can shorten the amount of time required to prepare noise models, thereby streamlining the submission process to the EPD, and enable users to utilize computer simulation to examine various schemes at an early stage.

Web3DNoS is an interactive Noise Modelling System for assessment of road traffic with the results displayed by 3D visualization. Users can add or change the preloaded modelling data, such as barriers, buildings, traffic flow, based on their project needs and then calculate the population of noise exposure.

In addition, the EPD has developed another tool “Web-NAT” to facilitate the preparation of traffic noise model files, plans and mitigation schedule for residential developments in a consistent manner. The tool can help to reduce the time needed for carry out a road traffic noise assessment and to ensure the quality of assessment report. Besides, the tool allows e-submission of the noise assessment report to the EPD. By using the Web-NAT to prepare the noise models and submit the report, the project proponents can follow the self-assessment procedures as stipulated in the Practice Notes for Professional Persons to facilitate and streamline the planning approval procedures [5].

Apart from road traffic noise, the EPD has also developed a web-based application “Web-CNMP” for the preparation and submission of Construction Noise Management Plan (CNMP). According to the revised Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM), the project proponents of designated projects shall submit a CNMP during the pre-tender stage, if any, and before commencement of the project to conduct the quantitative assessment with project implementation details and proposed noise mitigation measures for approval. The Web-CNMP allows the users to evaluate construction noise levels at representative NSRs based on work schedule and construction equipment involved. To promote the use of quieter construction methods and equipment, a comprehensive list of equipment has been included in the

platform for adoption in the projects. As the Web-CNMP helps standardize the format of CNMP, it is expected that the preparation and vetting of CNMP could become more efficient.

## 5. CONCLUSION

Hong Kong is one of the leaders in the field of noise mapping. Over the past years, the EPD has devoted considerable efforts to mitigate the road traffic noise impacts in Hong Kong. These efforts have paid off as it is observed that the percentage of population exposed to noise exceedance has gradually decreased from 17.3% in 2000 to 9.2% in 2020 even under a more challenging environment with more people, vehicles and roads.

On the other hand, the EPD has engaged the industry to utilize a series of GIS-based platforms for the assessment of construction noise and road traffic noise. Valuable environmental data related to traffic noise assessment is also shared through the CED. The development of these user-friendly tools help the project proponents to use simple interface to build complex computer noise models and submit the reports to the EPD at the same time. These innovative platforms not only greatly shorten the preparation time of noise models, but also standardizes the assessment approach. By comparing the noise impacts of different schemes at an early stage of engineering design, the project proponents are able to determine the most suitable option for their projects.

## 6. ACKNOWLEDGEMENT

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## REFERENCES

- [1] The Chief Executive's 2023 Policy Address, the Government of the Hong Kong Special Administrative Region, [Online] available: <https://www.policyaddress.gov.hk/2023/en/highlight.html>
- [2] European Commission, Directive 2002/49/EC of the European Parliament and the Council of June 2002
- [3] Ka-wai Chan, Edward Chan, Jamie Lai, Benson Lee and Chee-kwan Lee, The Development of Noise Mapping in Hong Kong, *29<sup>th</sup> International Congress on Sound and Vibration*, 9-13 July, (2023)
- [4] Lisa Tang, Edwin Chui, Chee-kwan Lee, Yat-ken Lam, and Dr. Kwok-keung Lau, An overview of the development of noise mapping in Hong Kong, *Inter-noise 2017*, 27-30 August, (2017)
- [5] Practice Note for the Planning of Residential Developments Against Road Traffic Noise (PN 4/23), [Online] available: [https://www.epd.gov.hk/epd/sites/default/files/epd/english/resources\\_pub/publications/files/pn23\\_4.pdf](https://www.epd.gov.hk/epd/sites/default/files/epd/english/resources_pub/publications/files/pn23_4.pdf)