ENVIRONMENTAL PROTECTION DEPARTMENT
PRACTICE NOTE FOR PROFESSIONAL PERSONS

Application of Innovative Noise Mitigation Designs in Planning Private Residential Developments against Road Traffic Noise Impact

Preamble

This Practice Note (PN) is developed to provide guidelines to practitioners and professionals, e.g. environmental / acoustic consultants, in evaluating noise reduction performance of Innovative Noise Mitigation Designs (INMDs)[1] i.e. Acoustic Window and Enhanced Acoustic Balcony. This PN also aims at providing technical information in designing and applying Acoustic Window and Enhanced Acoustic Balcony against road traffic noise impact in planning private residential developments in Hong Kong[2].

Acoustic Window and Enhanced Acoustic Balcony

2. "Acoustic Window" and "Enhanced Acoustic Balcony" are INMDs developed by the Environmental Protection Department in collaboration with Housing Department and Buildings Department. One of the unique characteristics of INMDs is that they offer high degree of noise reduction and at the same time allow natural ventilation. The idea of shutting off noise from outside of habitable room while providing natural ventilation becomes more popular in building designs because the "open window living environment" promotes sustainable living.

3. "Acoustic Window" comprises two layers of glass panel. An additional glass panel layer is introduced to a conventional side-hung window in a staggering position. The outer layer is a conventional push-pull type window whilst the inner one consists of a half-size sliding window. By properly positioning the openings, noise entering indoor can be reduced while allowing air flow into the room through the air gap between the two layers of glass panel (Figure 1). "Acoustic Window" can be designed to meet the natural ventilation requirement stipulated in *Building (Planning) Regulations (B(P)R)* for residential developments. Possible designs of Acoustic

[1] *This PN provides information for general practice. In case of special cases or issues involving additional features or measures, enquiry should be made to the Environmental Protection Department. The proposed INMDs should comply with relevant legislation and guideline(s)*

[2] *This PN is prepared for planning of private residential developments. For public housing developments planned, designed and constructed by the Housing Authority, there are other sets of documents covering similar guidelines and other procedural matters.*

Window for 8m^2 and 18m^2 habitable rooms (i.e. dining room, living room or bedroom) can be found in Annex A(I).

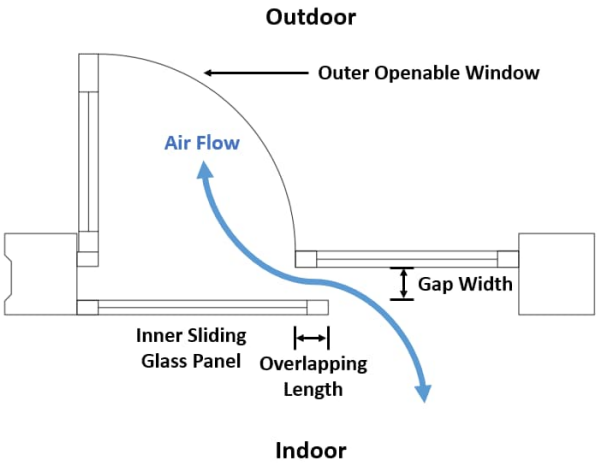

Figure 1 – A Plan on Acoustic Window (Baffle Type)

4. Typical acoustic balcony has a depth of more than 1000mm, solid parapet height of about 1200mm, and balcony ceiling lined with Sound Absorptive Material (SAM). "Enhanced Acoustic Balcony" is specially designed balcony which adopts a combination of mitigation features for the purpose of noise reduction (Figure 2), it incorporates more noise reduction features, e.g. full-height side wall(s), increased solid parapet height of not less than 1450mm, additional screen wall(s), Micro-perforated Absorber (MPA) and/or additional SAM on more surfaces. Possible designs of Enhanced Acoustic Balcony for 14m^2 and 18m^2 habitable rooms (i.e. dining room, living room or bedroom) can be found in Annex A(II).

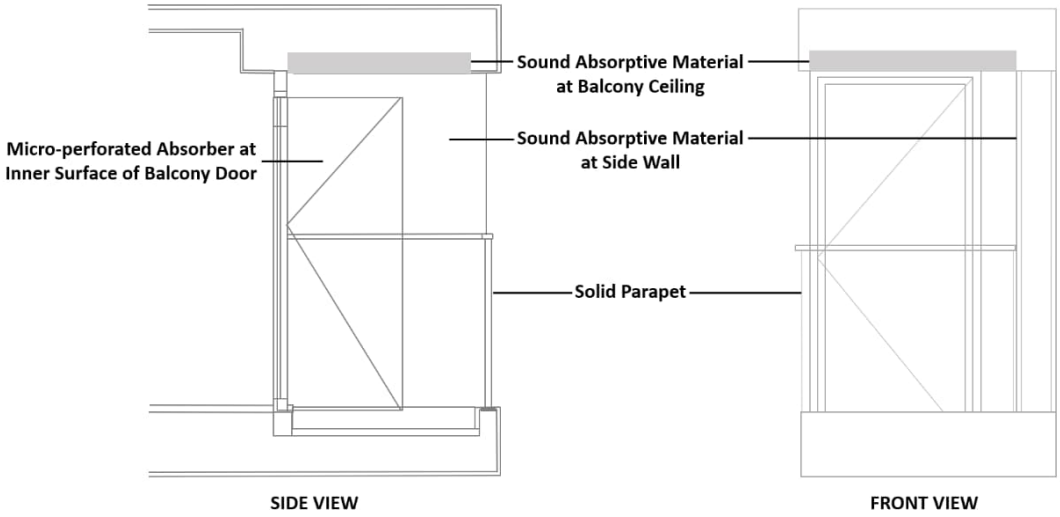

Figure 2 – Conceptual design of "Enhanced Acoustic Balcony"

Noise Reduction Effectiveness of Innovative Noise Mitigation Designs (INMDs)

5. Noise reduction effectiveness of "Acoustic Window" and "Enhanced Acoustic Balcony" are expressed in Relative Noise Reduction (RNR) which is the difference between (i) the IN-OUT difference of averaged noise levels (in terms of L_{10}) of the habitable room with INMD, obtained in actual site measurement or in laboratory measurement, and (ii) that of the habitable room with conventional window. For details, please refer to Annex B. In the same annex, two sets of RNR are listed respectively for "Acoustic Window (Baffle Type)" (AW(BT)) in $8m^2$ and $18m^2$ habitable rooms and "Enhanced Acoustic Balcony (Baffle Type)" (EAB(BT)) in $14m^2$ and $18m^2$ habitable rooms for easy reference of practitioners and professionals.

6. When conducting Noise Impact Assessment (NIA) Study, practitioners and professionals can subtract the RNR of the INMDs adopted in the designs of the residential developments from the assessed traffic noise level. If the resultant noise level rounded to the nearest whole number is smaller than or equal to 70 dB(A) L_{10}(1hr), it is considered to meet the traffic noise standard in Table 4.1 of Ch. 9 of the Hong Kong Planning Standards and Guidelines (HKPSG).

7. For the examples of residential developments adopting "Acoustic Window" and "Enhanced Acoustic Balcony", please visit the following web-link:

https://www.epd.gov.hk/epd/Innovative/greeny/eng/
(Innovative Noise Mitigation Designs and Measures)

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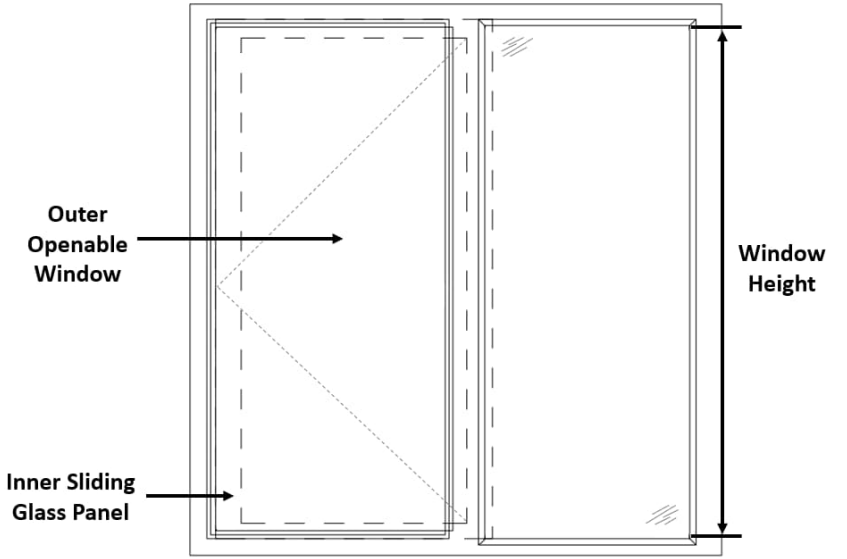
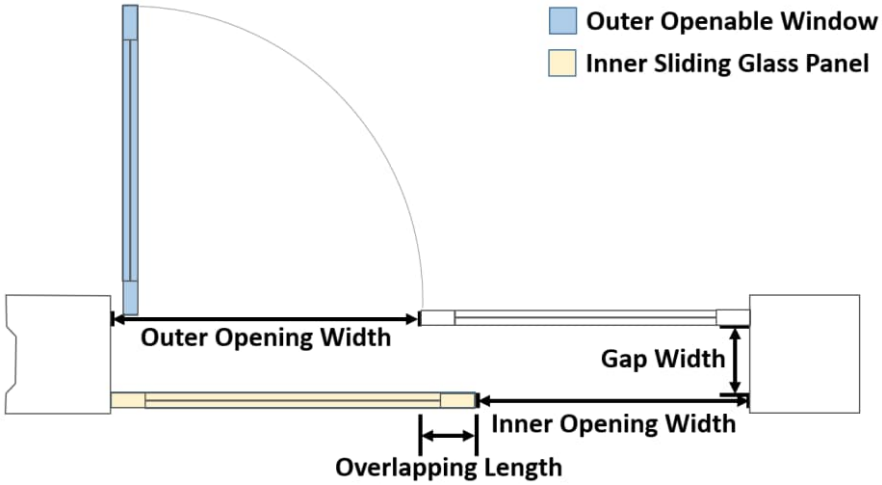
Environmental Protection Department
Issued: December 2023

(I) Possible design of "Acoustic Window (Baffle Type)" for 8m² and 18m² habitable rooms (i.e. dining room, living room or bedroom)



INTERNAL VIEW (NOT TO SCALE)



PLAN (NOT TO SCALE)

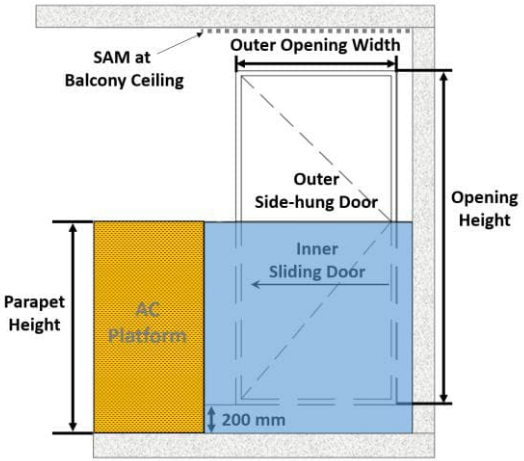
Possible Designs of "Acoustic Window (Baffle Type)" for 8m² and 18m² rooms					
Room Size (m^2)	**Room Dimensions (mm^3)**	**Inner Window Opening (mm^2)**	**Outer Window Opening (mm^2)**	**Overlapping Length (mm)**	**Gap Width (mm)**
8	**3200 (W) x 2500 (D) x 3400 (H)**	**580 (W) x 870 (H)**	**600 (W) x 870 (H)**	**≥ 100**	**100 to 175**
18	**5300 (W) x 3390 (D) x 3400 (H)**	**750 (W) x 1500 (H)**	**750 (W) x 1500 (H)**	**≥ 100**	**100 to 175**

Notes:

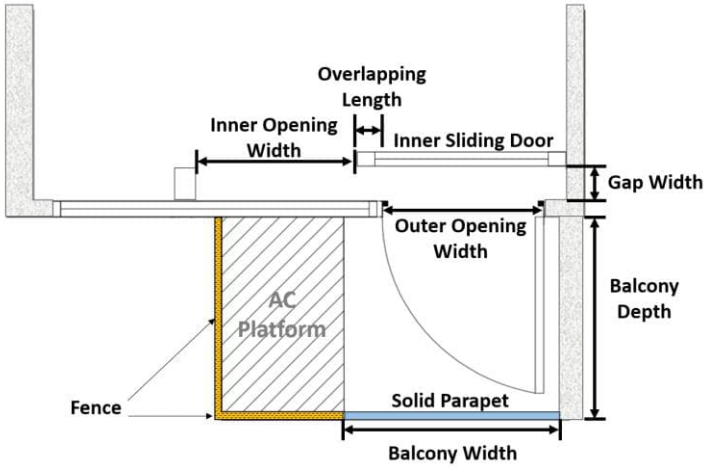
a. These are feasible designs of AW(BT) for 8m² and 18m² rooms.

b. For optimum performance of noise reduction, the air gap should have a pane-to-pane overlapping length of ≥ 100mm and a gap width between 100mm and 175mm, with the inner sliding glass panel in a closed position. The window pane shall be ≥ 6mm in thickness.

(II) Possible designs of "Enhanced Acoustic Balcony (Baffle Type)" in 14m^2 and 18m^2 habitable rooms (i.e. dining room, living room or bedroom)



EXTERNAL VIEW (NOT TO SCALE)



PLAN (NOT TO SCALE)

Fence (≥ 70% Permeability) Solid Parapet

Possible Designs of "Enhanced Acoustic Balcony (Baffle Type)" for 14m^2 and 18m^2 rooms								
Room size (m^2)	**Room Dimensions (mm^3)**	**Balcony Width (mm)**	**Balcony Depth (mm)**	**Parapet Height (mm)**	**Inner Opening (mm^2)**	**Outer Opening (mm^2)**	**Overlapping Length (mm)**	**Gap Width (mm)**
14	**3400 (W) x 4100 (D) x 3100 (H)**	**≥ 1440**	**≥ 1300**	**≥ 1450**	**1025 (W) x 2210 (H)**	**1150 (W) x 2210 (H)**	**≥ 100**	**100**
18	**5300 (W) x 3390 (D) x 3400 (H)**	**≥ 2055**	**≥ 1300**	**≥ 1450**	**1150 (W) x 2210 (H)**	**1150 (W) x 2210 (H)**	**≥ 100**	**100**

Notes:
1. These are feasible designs of EAB for 14m^2 and 18m^2 rooms. The room with EAB should meet the natural lighting and ventilation requirements in regulations 30 & 31 of the Building (Planning) Regulations (B(P)R). The AC platform should comply with the requirements under Appendix B of Code of Practice on Access for External Maintenance 2021 (AfEM Code), and balconies for residential buildings should comply with the criteria and conditions set out in Joint Practice Note (JPN) 1 for application of exemption from gross floor area and/or site coverage under the B(P)R.
2. SAM at balcony ceiling refers to sound absorptive material of noise reduction coefficient ≥ 0.7. It is an essential feature to attain the basic noise reduction performance in Annex B.
3. Comparable noise performance is anticipated should the AC platform be replaced by balcony with solid parapet.

Annex B

Relative Noise Reduction (RNR) of Innovative Noise Mitigation Designs (INMDs)

1. RNR of INMDs is the difference between (i) the IN-OUT difference of averaged noise levels (in terms of L_{10}) of the habitable room with INMD, obtained in actual site measurement or in laboratory measurement, and (ii) that of the habitable room with conventional window.

$$RNR = ANR_{INMD} - ANR_{CW}$$

where RNR = Relative noise reduction [dB(A) L_{10}(1hr)]
ANR_{INMD} = *Adjusted noise reduction with [@] INMD (in acoustic mode) [dB(A) L_{10}(1hr)]
ANR_{CW} = *Adjusted noise reduction with [#] CW (conventional window meeting B(P)R and natural ventilation requirement) [dB(A) L_{10}(1hr)]

** Adjusted with traffic noise spectrum according to the BS EN 1793-2:2012. This would be applied only if source of traffic noise is not from the actual road traffic but by means of a line of speakers.*

[@] INMD (in acoustic mode) means that "Acoustic Window (Baffle Type)" or "Enhanced Acoustic Balcony (Baffle Type)"is operated in acoustic mode delivering the noise reduction effect while INMD itself meets B(P)R and natural ventilation requirement.

[#] CW (conventional side-hung window) meeting B(P)R and natural ventilation requirement means that the openable area of conventional side-hung window is not less than 1/16 of the floor area of the room under B(P)R.

RNRs for Acoustic Window (Baffle Type) in 8m^2 and 18m^2 habitable room and for Enhanced Acoustic Balcony (Baffle Type) in 14m^2 and 18m^2 habitable room

2. Table 1 and Table 2 below show the base case such that conventional window is at the same horizontal incident angle as mitigated case against dominant line source. The practitioners and professionals would find these tables useful at the stage of detailed noise impact assessment of residential development when building layout is largely formed [i].

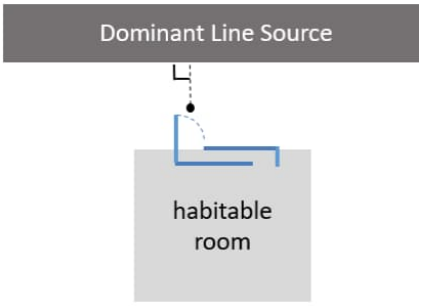
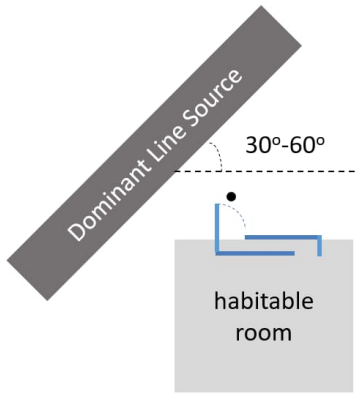
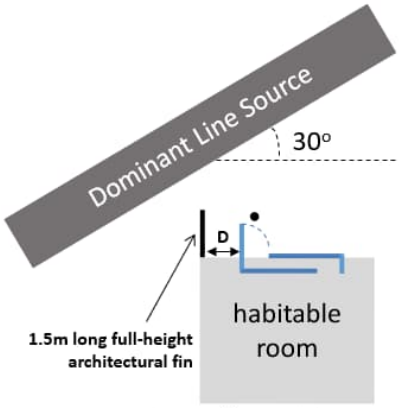
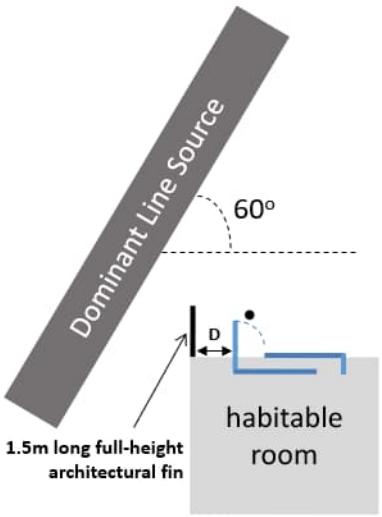
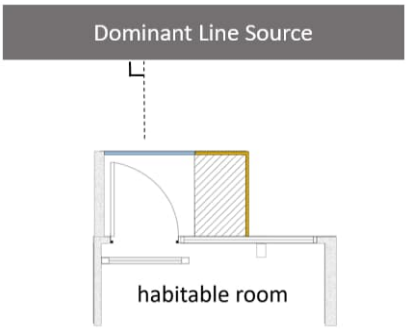
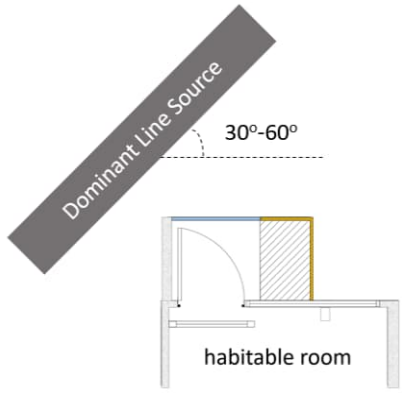
Table 1: Summary on RNR of Acoustic Window (Baffle Type) (for use in NIA) *Plan not to scale		Correction dB(A) L10(1hr)	
		8m²	18m²
	**(a) Provision of AW(BT) parallel to dominant line source** (whichever side the outer side-hung window is)	- **6.0** - **7.5 (added SAM[1])**	- **7.0** - **8.5 (added SAM[1])**
	**(b) Tilting the AW(BT) in (a) above to 30° - 60° horizontal incident angle to dominant line source** (whichever side the outer side-hung window is)	- **7.0** - **8.5 (added SAM[1])**	- **8.0** - **9.5 (added SAM[1])**
 D = Distance from architectural fin to nearest window frame should be at most 900mm.	**(b1) If tilted AW(BT) is at 30° horizontal incident angle to dominant line source** **+ 1.5m long full-height architectural fin[2]** *** AW(BT) + architectural fin should be considered as ONE package of noise mitigation measures. Outer side-hung window of AW(BT) and architectural fin should be installed at the side nearer to dominant line source.**	- **8.0** - **9.5 (added SAM[1])**	- **9.0** - **10.5 (added SAM[1])**

Table 1: Summary on RNR of Acoustic Window (Baffle Type) (for use in NIA) *Plan not to scale		Correction dB(A) L10(1hr)	
		8m^2	18m^2
 D = Distance from architectural fin to nearest window frame should be at most 900mm.	**(b2) If tilted AW(BT) is at 60° horizontal incident angle to dominant line source** **+ 1.5m long full-height architectural fin[2]** *** AW(BT) + architectural fin should be considered as ONE package of noise mitigation measures. Outer side-hung window of AW(BT) and architectural fin should be installed at the side nearer to dominant line source.**	**- 9.0** **- 10.5 (added SAM[1])**	**- 10.0** **- 11.5 (added SAM[1])**

Note 1: The additional Sound Absorptive Material (SAM) shall be of Noise Reduction Coefficient ≥ 0.7 and applied at top and outer opening side of mullion. The material of SAM is subject to the requirements of section 3 of Building (Construction) Regulation.

Note 2: The 1.5m long full-height architectural fin may be subject to the requirements for natural lighting and ventilation, gross floor area and site coverage under the B(P)R.

Table 2: Summary on RNR of Enhanced Acoustic Balcony (Baffle Type) (for use in NIA) *Plan not to scale		Correction dB(A) L10(1hr)	
		14m²	18m²
	**(a) Provision of EAB(BT) parallel to dominant line source**	- **8.0** - **9.5 (added SAM[1])**	- **9.0** - **10.5 (added SAM[1])**
	**(b) Tilting the EAB(BT) in (a) above to 30° - 60° horizontal incident angle to dominant line source**	- **11.0** - **12.5 (added SAM[1])**	- **11.0** - **12.5 (added SAM[1])**
Note 1: The additional Sound Absorptive Material (SAM) shall be of Noise Reduction Coefficient ≥ 0.7 and applied at top and outer opening side of the mullion. The material of SAM is subject to the requirements of section 3 of Building (Construction) Regulation.			

[i] *Should there be any variation on the proposed INMD, or practitioners and professionals consider that a higher RNR value should be adopted, justifications together with technical documents, e.g. corrections based on acoustic principles, laboratory testing reports, in-situ measurement reports, etc. should be submitted to the EPD for consideration. For requirements of laboratory measurement or in-situ measurement requirements, practitioners and professionals may contact the EPD for further details. As RNR varies with room size, practitioners and professionals may like to propose the preferred RNR to the EPD for consideration if different room size is encountered in the NIA study. Having said that, information indicates that for* ***Tables 1 and 2****:*

- *Variations of room size within +/- 10% would not affect the RNR;*
- *Variations of floor-to-ceiling height within +/- 5% would not affect the RNR; and*
- *Variations of window / door opening size within +/- 5% would not affect the RNR.*