

**Environmental Impact Assessment Ordinance, Cap. 499  
Guidance Note**

**Road Traffic Noise Impact Assessment**

**Under the Environmental Impact Assessment Ordinance**

(This guidance note supersedes EIAO Guidance Note No. 12/2005 with immediate effect)

*Important Note :*

*The guidance note is intended for general reference only. You are advised to refer to and follow the requirements in the Environmental Impact Assessment Ordinance (Cap. 499) and the Technical Memorandum on the Environmental Impact Assessment (EIA) Process. Each case has to be considered on individual merits. This guidance note may be subject to revision without prior notice. This guideline note serves to provide some good practices on EIA and was developed in consultation with the EIAO Users Liaison Groups and the Advisory Council on the Environment. You are advised to make reference to the guidance note current to the date. Any enquiry on this guidance note should be directed to the EIA Ordinance Register Office of EPD on 27<sup>th</sup> Floor, Southorn Centre, 130 Hennessy Road, Wan Chai, Hong Kong. (Telephone: 2835-1835, Faxline: 2147-0894), or through the EIA Ordinance web site-([www.epd.gov.hk/eia](http://www.epd.gov.hk/eia))*

**1. Purpose**

- 1.1 This guidance note (GN) serves to provide general reference for practitioners to prepare Road Traffic Noise Impact Assessment (RTNIA) for designated projects (DPs) under the Environmental Impact Assessment Ordinance (EIAO).
- 1.2 This GN is advisory in nature and is designed to facilitate the partitioners to prepare the RTNIA. It should not be construed in anyway as to supersede the relevant requirements in the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM). The principles set out in the EIAO-TM are to avoid (which should be given the highest priority) and minimize the potential adverse environmental impacts by alternative land use arrangements, alignments, siting and other measures, and should be followed when preparing the RTNIA.
- 1.3 This GN may be updated and supplemented by other advice from the Environmental Protection Department from time to time to take into account changing circumstances.

**2. Road projects or improvement work which requires an Environmental Permit under the EIAO**

- 2.1 The following two categories of road projects or improvement work would require an Environmental Permit for construction and/or operation under the EIAO (and hereafter called “road project” in this GN):
  - (i) A road which is an expressway, trunk road, primary distributor road or district distributor road including new roads and major extensions or improvements to existing roads, as defined under item A.1, Part I, Schedule 2 of the EIAO; and

- (ii) A material change to an exempted project would require an Environmental Permit under section 9(4) of the EIAO. The material change, under Schedule 1 of the EIAO, means a physical addition or alteration to a designated project which results in an adverse environmental impact as defined in the EIAO-TM. Under section 6.1 of the EIAO-TM, the material change shall refer to significant changes only and an environmental impact is considered to be adverse if any factor listed in Annex 3 of the EIAO-TM applies and the criteria in Annexes 4 to 10 of the EIAO-TM may be violated.

2.2 To determine whether the traffic noise impact due to a road improvement project/work would be considered significant as mentioned in paragraph 2.1(ii) above, detailed information with respect to factors such as change of nature of road, change of alignment and change of traffic capacity or traffic composition etc. would normally be required. The traffic noise impact would be considered significant if the traffic noise level with the road project would be greater than that without the road project at the design year by 1.0 dB(A) or more.

2.3 In general, the following road improvement works would not cause significant change of noise impact on a nearby Noise Sensitive Receiver (NSR) as it would not affect the designed capacity of the concerned road section and not significantly reduce the distance between the alignment of the main carriageway and the nearby NSR:

- Improvement of road auxiliaries, e.g. parapet wall, road repair and maintenance work;
- Addition of a lay-by;
- Improvement of a road junction.

2.4 In considering whether the road improvement work would require an Environmental Permit, the project proponent should make reference to the EIAO and the EIAO-TM for detailed consideration. For such situations, the project proponent is advised to provide the following information for determination of whether such work should be considered causing adverse environmental impact:

- whether there is any change on the nature of road, e.g. changed from a local road to a district distributor road;
- whether there is any alignment (horizontal or vertical) change of the road;
- description on the extent of the road improvement work;
- layout plan showing the road and representative nearby NSR without modification;
- layout plan showing the road and representative nearby NSR with modification (with the modified parts shaded);
- the prevailing traffic flow before the modification;
- the predicted maximum traffic flow within 15 years after the completion of modification;
- the predicted maximum traffic flow at that particular year if no modification is carried out; and
- the calculation of the following traffic noise levels at the worst affected NSR:
  - (i) the prevailing overall noise level before the modification;
  - (ii) the predicted overall noise level for the maximum traffic projection within 15 years after the completion of modification; and

- (iii) the predicted overall noise level at that particular year if no modification is carried out.

The overall noise level refers to the total noise together with noise from other roads in the vicinity.

### **3. Approach to RTNIA**

3.1 Section 4.4.1 of the EIAO-TM stipulates that the requirements set out in the Study Brief and EIAO-TM shall be complied with.

3.2 Whilst the relevant noise standards for road traffic noise and guidelines for road traffic noise assessment are stipulated in Annexes 5 and 13 of the EIAO-TM, the Study Brief spells out the purpose and objectives of the EIA study, and sets out the scope of the environmental issues to be addressed, procedural and reporting requirements to be fulfilled and where appropriate, methodologies or approaches to be followed. The formulation of the EIA Study brief is guided by section 3 of the EIAO-TM.

### **4. Major provisions and paragraphs in EIAO and EIAO-TM**

4.1 The followings are some points to note for general reference only. They should be read in conjunction with the EIAO and EIAO-TM.

#### **4.2 Assessment Area / Study Area**

4.2.1 According to section 3.3 of EIAO-TM, the study brief may stipulate the geographic and temporal boundaries of the assessment. An area within 300 m from the project boundary would usually be specified as the study area for traffic noise assessment. This area may be subject to the agreement with DEP, or may be reduced or extended in accordance with the prevailing situation to ensure that the assessment of the noise impact on NSRs is adequate, and there would not be unacceptable noise impact on NSRs.

#### **4.3 Identification of Noise Sensitive Receivers**

4.3.1 NSRs are defined under section 3, Annex 13 of EIAO-TM. According to section 2, Annex 1 and section 5.1, Annex 13 of the EIAO-TM, the NSR should include existing, committed and planned uses at the time of the submission of the EIA study. According to section 3.4 of the EIAO-TM, the assessment shall be based on the best available information at the time of the assessment. Project proponents may need to consult relevant authorities, e.g. Planning Department, regarding the latest land use planning in the vicinity of their proposed project(s).

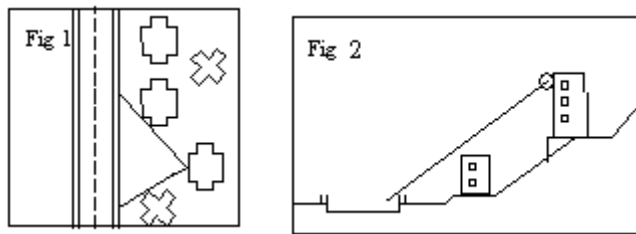
4.3.2 “Planned use”, as defined under Schedule 1 of the EIAO, means the land use proposed in the draft or approved plans prepared under the Town Planning Ordinance (Cap.131) or any other land use plans published by the Government. In this connection, the current Outline Zoning Plan (OZP), Development Permission Area Plans, Outline Development Plan, Layout Plan and any approved rezoning requests or section 16 applications for noise sensitive developments shall be referred to in searching for planned NSR. Usually, zonings designated as “Residential”, “Commercial/Residential”, “Comprehensive

Development Area”, “Residential (E)”, “Village Type Development”, “Government, Institutional/Community” and "Other Specified Uses (Comprehensive Development and Wetland Enhancement Area)" with allowed noise sensitive uses in the plans would be considered as NSRs. The practitioner is required to note that there may be noise sensitive development in other types of zoning.

4.3.3 Photos of the existing NSRs should be taken and recorded in the assessment report for future reference.

#### 4.4 Selection of Assessment Points

4.4.1 Section 4.1.1 of the EIAO-TM requires a detailed assessment in quantitative terms and in qualitative terms of the likely environmental impacts of the project. To this end, it is essential to ensure that sufficient assessment points which are able to represent all identified NSRs, and which are vulnerable to the change as stated in section 4.3.1(b)(ii) of the EIAO-TM, are selected. Examples in Figures 1 & 2 show some situations where NSRs behind the front layer of NSRs are not protected against excessive traffic noise impact.



Normally, the assessment points should be selected such that there exists at least one assessment point able to represent the noise level at each affected sensitive façade of every identified NSR for mitigated and unmitigated scenarios. For NSRs located close to or identified to be affected by the project but with no representative assessment point, detailed explanation should be provided to justify why they are not being included as assessment points (e.g. Single Aspect Building, etc.)

4.4.2 For committed or planned NSR where no development scheme is available, a practicable assumption for noise assessment should usually be made. Such assumption together with any constraints identified, such as setback of building, building orientation, extended podium, etc. should be agreeable to relevant parties including Planning Department and Lands Department as per section 6.3, Annex 13 of EIAO-TM.

#### 4.5 Determination of Assessment Year

4.5.1 Section 5.1, Annex 13 of the EIAO-TM states that predictions shall normally be based on the design traffic conditions or the maximum traffic projections within 15 years upon operation of the road works or occupation of the noise sensitive receivers or uses, whichever appropriate. For example, for a Schedule 3 EIA Project consisted of planned roads and residential developments, the starting year of the 15 year period should be either the commencement year of the road operation or the latest occupation year of the planned NSRs, whichever is the later. Alternatively, assessment of noise impact may also be based on the maximum design traffic conditions/carrying capacity (*the*

*design/capacity flow is defined under Transport Planning and Design Manual as the maximum volume of vehicles using the road without the traffic density becoming such as to cause unreasonable delay, hazard or restriction to the drivers freedom to manoeuvre, the design/capacity flow should be consulted or discussed with the relevant authority to confirm its correctness.)* as the worst-case scenario according to section 4.3.1 (b) (v) of the EIAO-TM.

4.5.2 There may be concerns that a speed lower than the specified speed limit should be adopted for noise assessment, as the specified speed limit may not be reached for the design or maximum traffic flow because of the speed/flow characteristics for the concerned sections of the road project. For such situations, the appropriate speed limit, with the relevant supporting information on speed/flow relationship, should be adopted. In such circumstances, evaluations have to be made to assess whether there would be situations where the maximum traffic noise impact occurs at a time before the traffic reaching the maximum flow.

#### 4.6 **Validity of Traffic Data**

4.6.1 According to section 4.4.2(b) of EIAO-TM, one of the factors for determining whether the quality of the EIA report would be adequate is to consider whether the assumptions, information and descriptions in the EIA report are appropriate and factually correct. Hence, it is essential to ensure the traffic data adopted for noise assessment would be factually correct. In this connection, the project proponents or their consultants need to consult and demonstrate to the related authority, i.e. Transport Department, on the correctness of the traffic data for the application to the noise assessment. The project proponent is required to spell out clearly in the EIA report the assumptions made for the traffic modeling in deriving the predicted traffic data. The project proponent could also make reference to the previously approved EIA reports according to section 11 of the EIAO-TM, in particular for relevant traffic data adopted for other planned or committed roads when considering cumulative impact stipulated under section 4.3.1(c)(ii) of the EIAO-TM.

#### 4.7 **Consideration of Noise Mitigation Measures**

4.7.1 Section 4.3.1 (d) of the EIAO-TM states that priority should be given to avoidance of impacts before considering measures to reduce or remedy the impacts. In this connection, due regards should be given to explore alternative options such as alternative alignment, alternative siting, alternative land use arrangement or building layout, and other practical options etc.

4.7.2 Section 6.1, Annex 13 of the EIAO-TM states that where the predicted noise impacts exceed the applicable noise criteria, direct mitigation measures, such as alternative land use arrangement, alternative siting, alternative alignment and screening by noise tolerant buildings etc., shall be considered and evaluated in an appropriate manner. It should be noted that the road traffic noise impact can be alleviated or avoided by many approaches and the approach to avoid adverse environmental impacts through land use planning should be given priority. Examples of these approaches are:

- road alignment, i.e. providing distance separation between the noise receiver and the road;

- traffic composition and volume, i.e. using traffic planning and management to control vehicle movements and type of vehicles at different time of the day;
- line-of-sight, i.e. using noise-tolerant buildings and alternative building orientation to reduce the angle of view of receiver on road traffic and the exposed area of a development.

4.7.3 In evaluating the predicted noise impact, section 4.3.1(c) (ii) of the EIAO-TM requires the evaluation of the projected environmental conditions with the project in place and the sum total of the environmental impacts taking into account all relevant existing, committed and planned projects. According to section 3.4 of the EIAO-TM, the assessment shall be based on the best available information at the time of the assessment. Project proponents may need to consult relevant authorities, e.g. Planning Department, regarding the latest land use planning in the vicinity of their proposed project(s).

4.7.4 Section 4.3.1(c)(iii) of the EIAO-TM, requires the differentiation of the environmental impact caused by the project from other projects, and to what extent the project aggravates or improves the existing or projected environmental conditions.

4.7.5 According to section 4.4.3(a)(ii) of the EIAO-TM, it is also required to consider the extent to which the project would trigger or contribute to any cumulative environmental impacts when considered in conjunction with the existing or potential impacts from other projects.

4.7.6 Taking into the principles set out above, direct mitigation measures should be considered or proposed on the road project(s) under the subject DP if there would be adverse environmental impact. If the NSRs are affected by noise from other existing roads, direct mitigation measures are required to reduce the noise from the concerned road project(s) to a level that it

- (i) is not higher than the standard; and
- (ii) has no significant contribution to the overall noise from other existing roads, if the cumulative noise level, i.e. noise from the road project under the subject DP together with other existing roads, exceeds the standard.

4.7.7 With reference to section 6 of the Calculation of Road Traffic Noise (CRTN), it is considered that there will not be significant contribution to the cumulative traffic noise impact ( i.e. summation of road traffic noise from the road project under consideration and the road traffic noise level due to roads other than the concerned road project) if noise from the concerned road project would not cause the overall traffic noise level to increase by 1.0dB(A) or more. Some examples on the situations are as follows:

Example 1: noise level from other existing roads = 75dB(A)

Measures should be considered to mitigate the noise from the road project to a level of about 68dB(A) if the NSRs involved are residential premises.

Example 2: noise level from other existing roads = 78dB(A)

Measures should be considered to mitigate the noise from the road project to meet the planning standard of 70dB(A) for residential use.

4.7.8 The direct mitigation measures listed under Section 6.1, Annex 13 of the EIAO-TM should be fully explored and evaluated with a view to reducing the noise level at the

NSRs concerned to the level meeting the relevant noise criteria. Also, the feasibility, practicability, programming and effectiveness of the recommended mitigation measures should be assessed in accordance with section 4.4.2(k) of the EIAO-TM.

- 4.7.9 When considering barrier as noise mitigation measure, reference should be made to the “Guidelines on Design of Noise Barriers” jointly published by the Environmental Protection Department and the Highways Department. The project proponent should specify the details of the barrier, e.g. form, height and configuration (and colour scheme if possible) in the EIA report.
- 4.7.10 Following the guiding principles set out in the LC Paper (no. CB(1)755/02-03(01)) prepared by ETWB in January 2003, sections of barriers proposed to protect existing NSRs should be differentiated from those for protection of future NSRs as the latter is only required to be constructed before the occupation of the planned NSRs. To facilitate the phased implementation of the barriers under this principle, a barrier inventory showing intended NSRs (i.e. existing NSRs and different planned NSRs) to be protected by different barrier sections (by how many dB(A) reduction) should be provided.
- 4.7.11 Section 4.4.2 (f) and (k) of the EIAO-TM, also indicated that the mitigation measures considered should be practicable. In so far as practicality is concerned, consideration should be given to a number of factors including but not limited to engineering constraints; acoustic effectiveness (including noise levels and details with respect to the extent of the mitigation measure concerns and the NSRs intended to be protected); fire safety considerations; sightline and road safety considerations; landscape and visual impact; and public objections, etc.

#### 4.8 **Consideration of Indirect Mitigation Measures**

- 4.8.1 Section 6.2, Annex 13 of the EIAO-TM states that upon exhaust of direct mitigation measures, indirect mitigation measures in the form of window insulation and air-conditioning is often the “last resort” in an attempt to ameliorate the residual impact.
- 4.8.2 On the eligibility testing criteria for indirect noise mitigation measures, reference is made to the relevant procedures stipulated in CRTN (*paragraph 6 on Requirements for use with the Noise Insulation Regulations*) which is used for the assessment of road traffic noise as per section 5.1, Annex 13 of the EIAO-TM. The testing criteria are set out as below:
- (i) the predicted overall noise level from the road project together with other traffic noise in the vicinity must be above a specified noise level (e.g. 70 dB(A) for domestic premises and 65 dB(A) for education institutions, all in L10(1hr));
  - (ii) the predicted overall noise level is at least 1.0 dB(A) more than the prevailing traffic noise level, i.e. the total traffic noise level existing before the works to construct the road were commenced; and
  - (iii) the contribution to the increase in the predicted overall noise level from the road project must be at least 1.0dB(A).

#### 4.9 **Useful Points to Note in Conducting RTNIA**

Please refer to Annex I for limitations/practices to be observed in relation to CRTN calculation, and Annex II for useful points to note in carrying out traffic noise assessment. For some situations that site measurement is required to obtain the traffic noise level, the consultant is required to refer to Section III of the CRTN on the procedures and requirements. Annex III briefly summarises the procedures and requirement to be met.

Environmental Protection Department

Date of Issue: December 2010



## Limitations / Practices to be observed in relation to CRTN Calculation

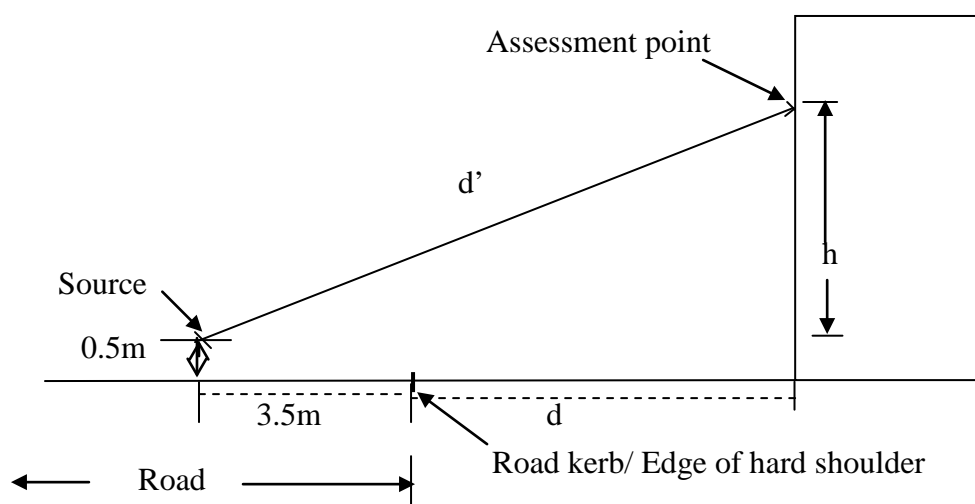
The following only highlights some of the observations in relation to noise assessments made in previous EIA reports and other noise studies. There may be situations that warrant use of other approaches or considerations to suit particular circumstances.

### 1. Determination of Line Sources

Section 5.1, Annex 13 of the EIAO-TM states that the commonly accepted method in Hong Kong for the assessment of road traffic noise is based on the procedures given in the UK Department of Transport document “The Calculation of Road Traffic Noise (CRTN)” which suggests to simulate a road of dual carriageways with one single line source unless the two carriageways are separated by more than 5m. However, some flexibility should be adopted for the Hong Kong situation, especially for roads with barriers abutting high-rise buildings. A realistic approach appropriate to the Hong Kong situation would be to use separate line sources to represent the traffic in each carriageway. This approach has been adopted in many road projects such as the Widening of Yuen Long Highway, Deep Bay Link, Route 7, Route 8, Route 9, Road T3 in Sha Tin, Improvement to Tuen Mun Road, and Improvement to Castle Peak Road.

### 2. Line Source Locations

- Road traffic noise is considered line source
- 0.5m above ground
- 3.5m from kerb. Kerb is the edge of the traffic lanes excluding hard shoulders, hard strips and bus lay-bys.
- $d'$  is the shortest slant distance from the effective source position  $d' = [(d + 3.5)^2 + h^2]^{1/2}$



### 3. Spatial scope of application

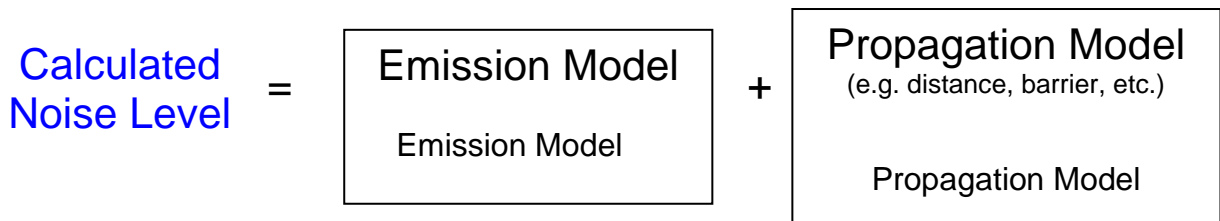
- Extrapolation outside the application ranges of the relevant charts in CRTN can lead to progressive and significant error.
- For example: for making distance correction in accordance with Chart 7 in CRTN, the application ranges of distance from edge of kerb are from 4m to 300m. Any assessment

at distance > 300m from a road would reduce accuracy.

#### 4. **Assessment**

- Calculations shall be worked to 0.1dB(A). Each step shall be rounded to the nearest 0.1dB(A).
- For comparison with specified noise level, the noise level is to be rounded to the nearest whole number.

#### 5. **Traffic Noise Model**



#### 6. **Basic Noise Level**

##### 6.1 **General**

- The basic noise level at a reference distance 10m away from the kerb.
- Basic Noise Level =  $f(Q, P, V)$ 
  - Q : flow veh/hr
  - P : percentage of heavy vehicle
  - V: speed kph
- Heavy vehicles ~ unladen weight > 1525kg
- As noted in Chart 4 of CRTN, the traffic noise corrections for speed and heavy vehicles is based on the equation (i.e. correction =  $33 \text{ Log}_{10} (V + 40 + (500/V)) + 10 \text{ Log}_{10} (1 + (5P/V)) - 68.8 \text{ dB(A)}$ ) and is explained in para. 6.1 and 6.2 below. It should be noted that, for traffic fleet with high percentage of heavy vehicles, lowering the average traffic speed would induce a higher traffic noise level as the major dominant noise source at low speed is from the engine noise of heavy vehicles, instead of tyre/road noise at higher traffic speed.

##### 6.2 **Change of speed**

Case 1

- 2000 veh/hr, 30% heavy vehicle, 70kph BNL=78.0
- 2000 veh/hr, 30% heavy vehicle, 100kph BNL=80.3

Case 2

- 2000 veh/hr, 80% heavy vehicle, 20kph BNL=81.7
- 2000 veh/hr, 80% heavy vehicle, 50kph BNL=80.3

##### 6.3 **Change of percentage heavy vehicle**

- 2000 veh/hr, 30% heavy vehicle, 70kph BNL=78.0
- 2000 veh/hr, 60% heavy vehicle, 70kph BNL=80.3

#### 7. **Gradient and Mean Traffic Speed**

- Road Gradient
  - $C_{\text{grad}} = 0.3 G \text{ dB(A)}$  where G is gradient in percentage
- G can be up to 15%

- Chart 5- Change in mean traffic speed in terms of % heavy vehicles and gradient to be used only when mean traffic speed is used (see para 14.3)
- **Note:** This does not apply to the situation where the posted speed is used all along the road sections concerned.

## 8. Road Surface

### 8.1 Road surface (impervious bituminous and concrete)

- speed < 75kph
  - Crs = - 1dB(A)
- speed >= 75kph and bituminous surfaces
  - Crs = 10log(20TD + 60) - 20dB(A), if TD = 1.2, Crs = -0.75 dB(A)
- speed >= 75kph and concrete road surfaces
  - Crs = 10log(90TD + 30) - 20dB(A) , if TD = 1.2, Crs = +1.40 dB(A)

*TD is the texture depth, normally = 1.2*

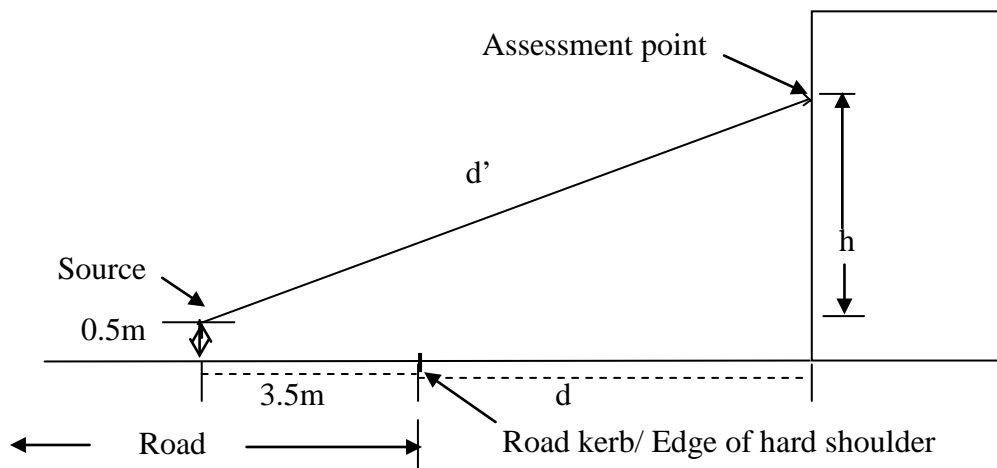
### 8.2 Road surface (low noise road surface)

- any speed
  - Crs = -3.5dB(A)

## 9. Distance Correction

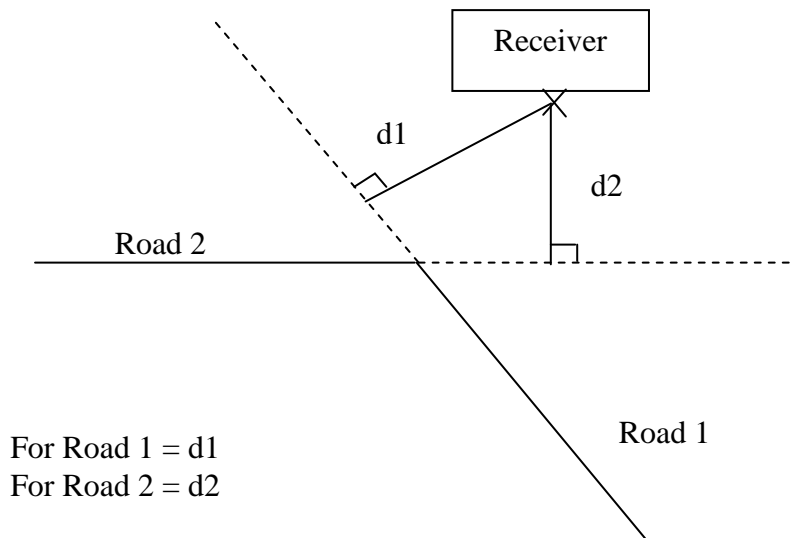
### 9.1 Definition

- The distance  $d'$  is the shortest slant distance from the effective source position
 
$$d' = [(d + 3.5)^2 + h^2]^{1/2}$$

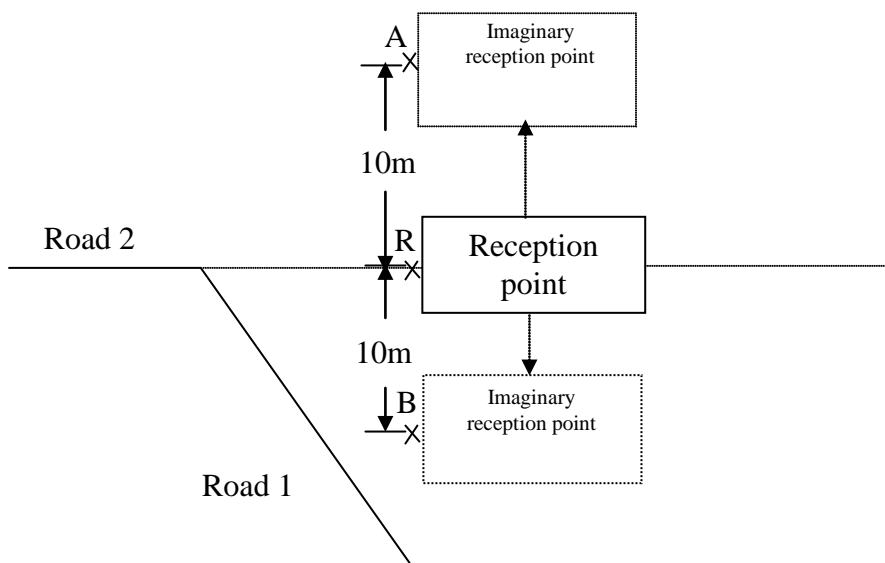


Note: For cases that the distance is less than 4m: distance correction should be determined with the assumption that the assessment point is located at 4m from kerb.

9.2 Geometrical dispersion – use of two-segment approximation for a curve road.



9.3 Extended source line passing close to reception point

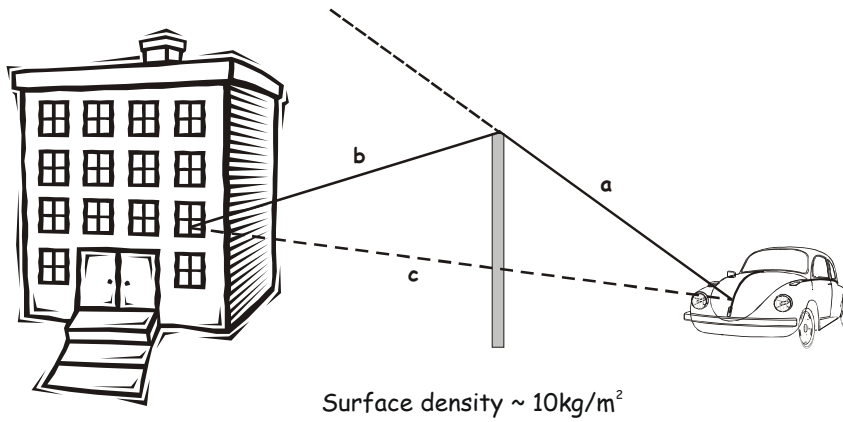


- The extended source line for Road 2 passes through the reception point R and precludes the use of Chart 7 in CRTN (valid for  $d \geq 4\text{m}$ ). Two imaginary reception points A and B are chosen close to and at either side of R so that this anomaly does not occur, i.e. at the reference distance  $d = 10\text{m}$ . The noise level at R is obtained by averaging the predicted values for sites A and B.

10. **Barrier**

10.1 Diffraction – barrier effect

- Noise reduction related to the path difference i.e.  $a+b-c$



- Barrier effect ( $C_b$ ) is a function of path difference ( $\delta$ ) (m)

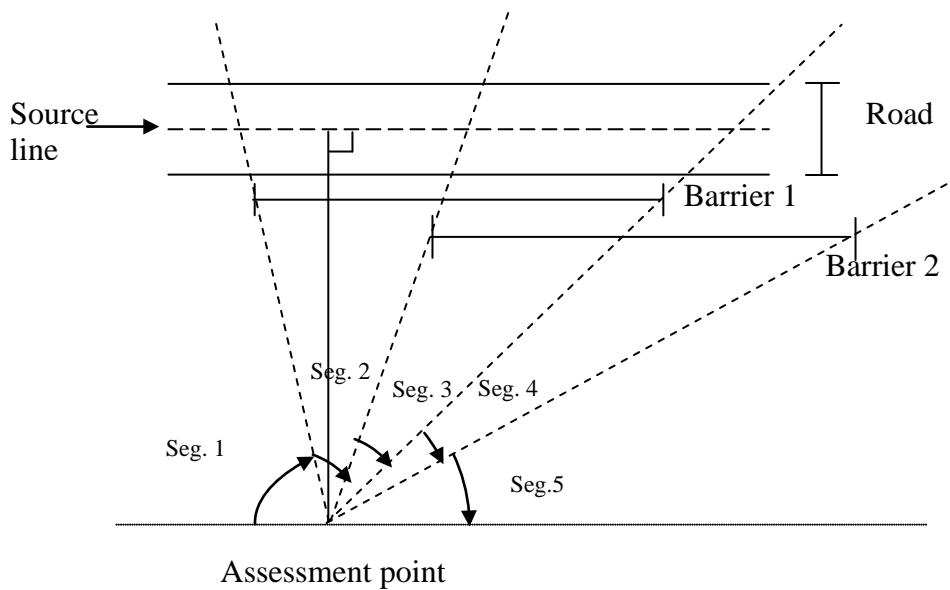
(a) Within Shadow Zone

- $C_b = f(\delta)$  where  $\delta = a + b - c$  (m)
- $C_b = 15.5 \text{ dB(A)}$  if  $\delta = 1$  (m)
- $C_b = 5 \text{ dB(A)}$  if  $\delta = 0$  (m)

(b) Outside Shadow zone

- $C_b = 0 \text{ dB(A)}$  if  $\delta = 1$  (m)

10.2 Screened by two noise barriers





## Points to Note for carrying out Traffic Noise Assessment

The followings are observations of common errors committed in road projects. The points mentioned are meant to serve as general reference only and is by no means an exhaustive list or to be construed as an approved approach.

### 1. Study Area and Cut-off Distance

In general, traffic noise prediction software would calculate the noise contribution from a road network within a certain distance from an assessment point. According to CRTN, the distance from a road segment is defined as the shortest horizontal distance (“d” show in Figure 1 below) between the assessment point and the edge of the nearside carriageway. Whilst some software follows CRTN definition to define the cut-off distance, some software would use the cut-off radius instead of cut-off distance. As the study brief would usually specify a spatial study scope of 300m, it would generally be acceptable for typical situation in Hong Kong to confine the road sections to be considered in the study to within 300m cut-off radius from the assessment point. However, there are situations which warrant the use of cut-off distance to demarcate the road sections to be studied. This should be considered on a case-by-case basis.

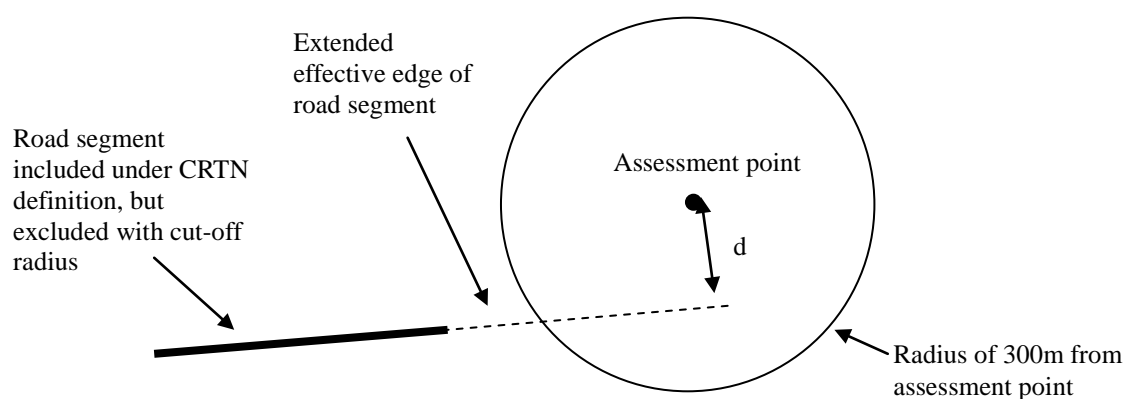
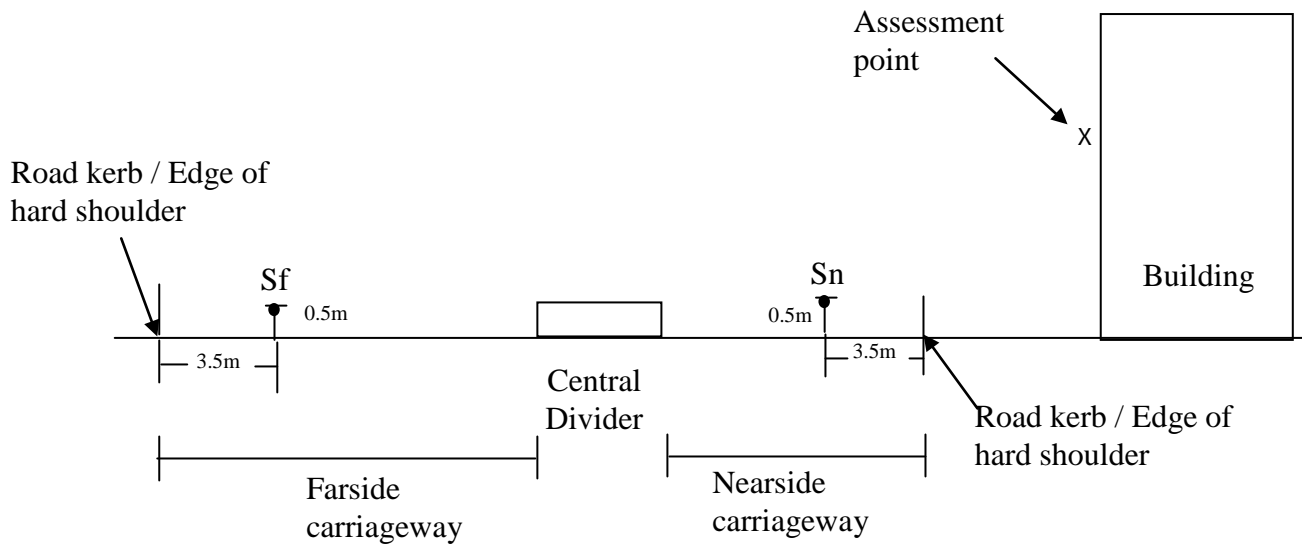


Figure 1

### 2. Location of Far-side Source Line

According to CRTN, the source line for the far-side carriageway is assumed to be 3.5 metres in from the far-side kerb (please see Figure 2 for details). It should be noted that, in some traffic noise prediction software, the source line for the far-side carriageway would be automatically assumed to be 3.5m away from the central divider after the road alignment and road width are specified. In such cases, the source line for the far-side carriageway, particularly for those with road width larger than 7 metres, may be mis-located.



Sn: nearside source  
Sf: farside source

### 3. Cantilevered Barrier

Whilst there are software supporting cantilevered barrier by defining the length ( $h$ ) of the barrier and an inclined angle ( $\theta$ ) to the vertical part as shown in Figure 3, some computation software would be limited to vertical barriers in their assessment. For those software only supporting vertical barrier, a virtual barrier is defined at the pseudo-location of a cantilevered barrier, i.e. the highest edge of the actual barrier (Figure 4).

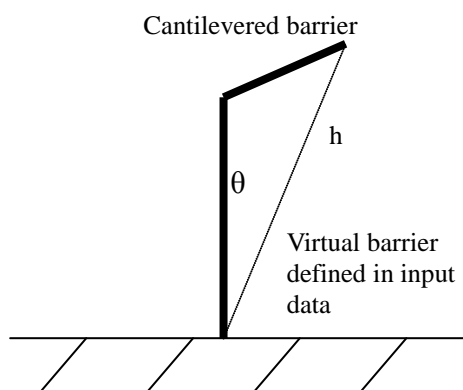


Figure 3

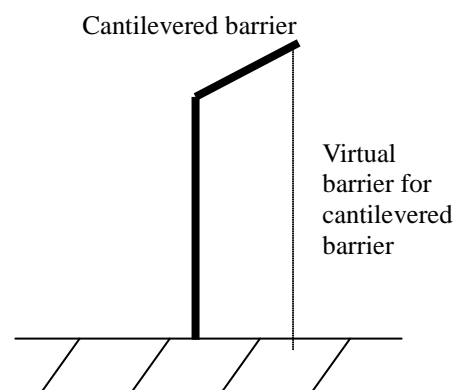


Figure 4



#### 4. Enclosure

Road segments may have to be deleted if those segments are covered by the enclosure as noise contribution from covered road segments is relatively small and generally negligible in comparing with that from other road segments. Nonetheless, care should be taken to determine which road segments could be deleted with different locations of barrier and assessment points.

#### 5. Barrier on flyover

A barrier on a flyover generally would only have screening effect to that particular flyover but not to other roads. However, for most of the prediction software available in market, a barrier would generally be defined to be erected from the at-grade road surface to a certain height in the prediction software. Therefore, the barrier on flyover defined in this way could lead to higher screening effect to other roads, especially those at-grade roads underneath (as shown in Figure 5 below). To cater for this kind of situation, in some software, a barrier could be defined to be acoustically effective to one or more designated road segments only. In other words, the barrier is made “invisible” to other road segments. This feature is particularly useful for simulating complex road networks with barriers on elevated roads. For other software without this feature, the barrier on elevated road sections would be interpreted as an at-grade barrier, which would then have screening effect to other at-grade segments. To solve this problem, one of the approaches is to store the set of information of at-grade barriers, roads and flyovers and barriers on flyovers in separate files. The overall noise levels at an assessment point would be the summation of the noise levels calculated by each set of data.

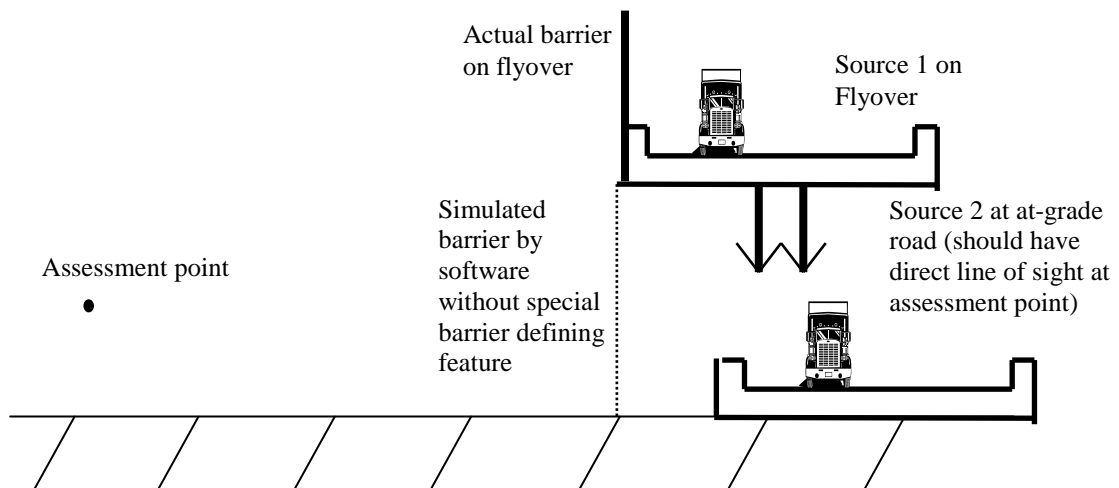


Figure 5

#### 6. Others

##### 6.1 Particularly high predicted noise levels

For assessment points with particularly high noise levels [e.g. > 83dB(A)], the assumptions

and input parameters should be checked to ensure accuracy.

## 6.2 Hard shoulder

When the subject road project consists of hard shoulders, the distance from kerb side in the assessment should be counted from the edge of hard shoulder at the boundary of the road lane.

### **Procedures and Requirement on Measurement of Road Traffic Noise**

The following only highlights the essential elements to be noted when measuring noise from an actual flow of traffic flow on a road. It is required to refer to Section III of the CRTN for details on the procedures and requirements.

#### 1. Physical or weather conditions

- Measurements are to be made when the road surface in the measurement area is dry;
- The average wind speed is not more than 2m/s in the direction from the road to the reception point;
- The wind speed at the microphone in any direction should not exceed 10m/s;
- Wind shield is to be used.

#### 2. Measuring equipment

- The equipment and the calibration device should meet the requirement specified in Appendices 1 and 2 of CRTN;
- Type 1 equipment complying with IEC 651 or 804 or the equivalent is required;
- Immediately prior to and following each session of work the overall sensitivity of the electroacoustical system should be checked using an acoustic calibrator generating a known sound pressure at a known frequency. Measurements may be accepted as valid only if calibration levels agree within 1dB.
- To ensure overall measurement precision, within twelve months immediately prior to the measurement the overall system should have been directly compared with an independent reference system. This comparison is most easily effected by using both to measure and analyse the same noise sample.
- Similarly, the output level of the acoustic calibrator should also have been checked by direct comparison with an independent reference device.

#### 3. Measurement location:

- It is to be close to the road or at the required locations and other traffic (i.e. traffic noise from road not under concern) or extraneous noise (e.g. construction noise) do not influence the measured noise;
- At 1.2m above the road surface and no reflecting surfaces (other than the ground) within 15m of the microphone position;
- Unobstructed to the road under concern and should normally be not less than 4m but not more than 15m from the nearside edge of the carriageway.

#### 4. Measurement period

- The minimum measurement period ( $T_{\min}$ ) to obtain a valid measurement of L10 is as follows:

$$T_{\min} = (4000/q + 120/r) \text{ min, where } q \text{ is traffic flow/hr and } > 100\text{veh/hr;}$$

$$\text{and } r \text{ is sampling rate and } > 5 \text{ samples/min}$$

and  $T_{\min}$  should not be less than 5 minutes

## 5. Traffic counts

- The measurements of traffic flow and composition should be concurrent with measurements of the traffic noise;
- The following data should be obtained for each bound of the carriageway;
- The total no. of vehicles;
- % of heavy vehicles (i.e. with unladen weight exceeding 1525kg, e.g. lorry, container truck, public light bus and bus);
- Average traffic speed for each bound of carriageway (in case of different traffic speed limits for heavy vehicles, the average traffic speed for heavy vehicles should also be included).

## 6. Measurement report

This requirement is not specified in the CRTN. However, to ensure the proper record and quality measurement, a report shall contain the following information:

- Date and time of the measurement;
- Personnel carrying out the measurement and the equipment used;
- Weather conditions (e.g. wind speed, any fog, rain, etc.);
- Locations of the measurement points;
- Traffic data, i.e. no. of vehicles passing over the measurement period, hourly traffic flow, % of heavy vehicles and average traffic speed, for each bound of each of the carriageway under consideration;
- Result of the measurement, in terms of  $L_{10}$  attaching the printout of the noise measurement result from the sound level meters (SLM) with the serial number and model number of the SLM;
- Site survey photos showing the measurement points and surrounding environment;
- Survey maps showing the noise measurement point; and
- Any observation made by the personnel taking the measurement.