

This section describes the five types of direct technical remedy which have been included in the study. In addition, the consultation with Government to identify constraints and special requirements which apply to the flyovers are summarised.

4.1

DIRECT TECHNICAL REMEDIES

Direct technical remedies which are considered in the Study are:

- vertical roadside barrier;
- cantilevered barrier;
- semi-enclosure; and
- full enclosure.

In general, barriers and enclosures are classified under two main categories, reflective and absorptive. Common types of reflective materials include plexi-glass, pre-cast concrete sections and steel/aluminium panels; and types of absorptive materials include durisol acoustic panels (pre-cast soft wood aggregate/portland cement), aluminium sandwich/mineral wool acoustic panels and coustone (resin bonded granite aggregate). It has been considered that the choice of materials will depend on the existing noise environment and other constraints and requirements for each specific case.

It is considered that central barriers must be installed in combination with roadside barriers to provide effective noise reduction, the amount of fine-tuning required for a roadside & central barrier combination is considered more appropriate for the Stage 2 Study. Therefore, the application of central barriers will be recommended in the Stage 2 Study.

Sample configurations of generic direct technical remedies on existing flyovers are illustrated in *Figures 4.1a to 4.1e*. The characteristics and selected application examples of these generic direct technical remedies are summarised in *Table 4.1a*.

Table 4.1a

Summary of Characteristics and Application of Generic Direct Technical Remedies for Road Traffic Noise

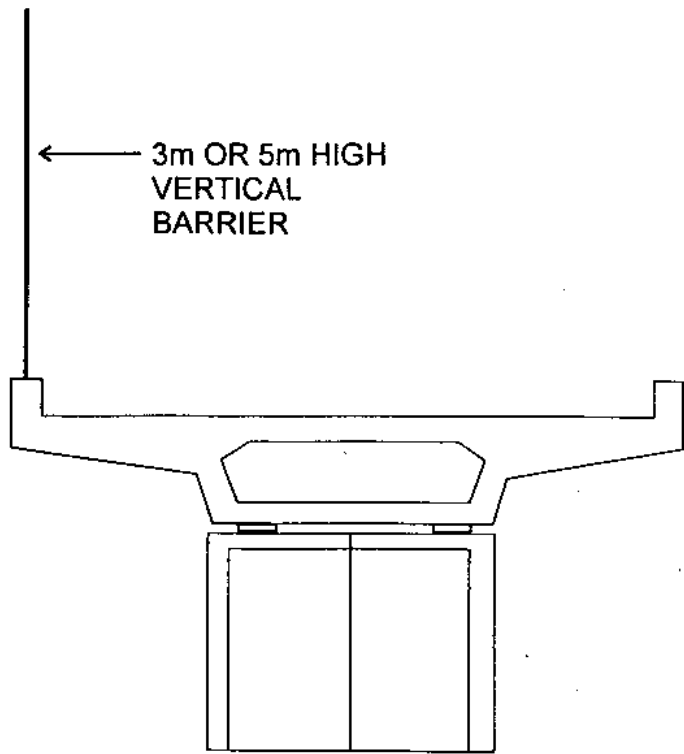
Description of Remedy	Characteristics	Application
Vertical roadside barrier (Figure 4.1a)	<ul style="list-style-type: none"> simplest form of noise screening structure effective in protecting low-level sensitive receivers can be installed on one side or both sides of carriageway 	<ul style="list-style-type: none"> Route 5 - Shatin approach near Mei Lam Estate
Cantilevered barrier (Figure 4.1b)	<ul style="list-style-type: none"> effective in protecting low to mid-floor sensitive receivers can be installed on one side or both sides of carriageway 	<ul style="list-style-type: none"> West Kowloon Expressway - near Lai King
Central barrier (Figure 4.1c)	<ul style="list-style-type: none"> vertical barrier installed located in the central reserve of dual carriageway effective for protecting low to mid floor sensitive receivers from wide dual carriageways 	<ul style="list-style-type: none"> West Kowloon Expressway - near Mei Foo Sun Chuen and Nam Cheong Estate
Semi-enclosure (Figure 4.1d)	<ul style="list-style-type: none"> effective in protecting high-rise sensitive receivers 	<ul style="list-style-type: none"> Tate's Cairn Tunnel approach at Choi Hung Estate and Richland Gardens
Full enclosure (Figure 4.1e)	<ul style="list-style-type: none"> effective in protecting high-rise sensitive receivers located on both sides of carriageway 	<ul style="list-style-type: none"> Wong Chu Road proposed in the EIA Study on Reclamation and Servicing of Tuen Mun Area 38 for Special Industries - Improvements to Roads & Junctions within Tuen Mun

4.2

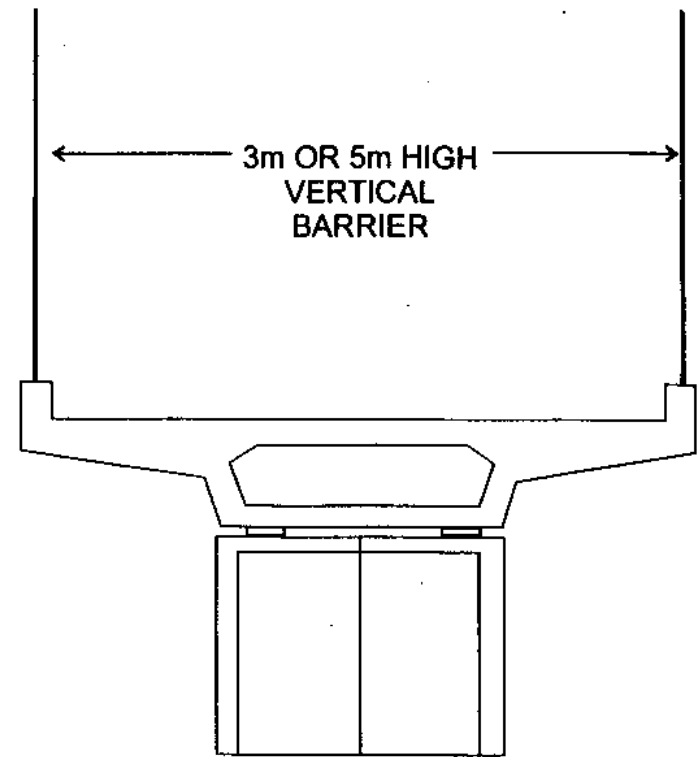
CONSTRAINTS FOR IMPLEMENTATION

Based on ERM's previous experience in traffic noise assessment and comments from HyD obtained during the consultation for this Study, dead loading and wind loading are the key factors governing the size of the barrier. In designing the bridge or separate structure to carry high noise barriers, structural members increase in size substantially. It is therefore considered that 5m high cantilevered noise barriers are the highest realistic barriers that would be feasible for flyovers in engineering terms. For the purpose of this Study, the safety constraints and noise benefits of 3-m high roadside barrier, which is the mean barrier height between a typical flyover parapet wall (1m) and the highest realistic barrier (5m), 5-m cantilevered barrier, semi-enclosure and full enclosure have been considered.

As indicated in Section 2.1, it is possible that the implementation of direct technical remedies on certain flyovers would lead to the violation of safety requirements of FSD, TD and HyD. Knowledge on some of these constraints and special requirements, has been gained from ERM's previous experience in traffic noise assessment. A list of the known constraints, or special requirements, of the



VERTICAL ROADSIDE BARRIER

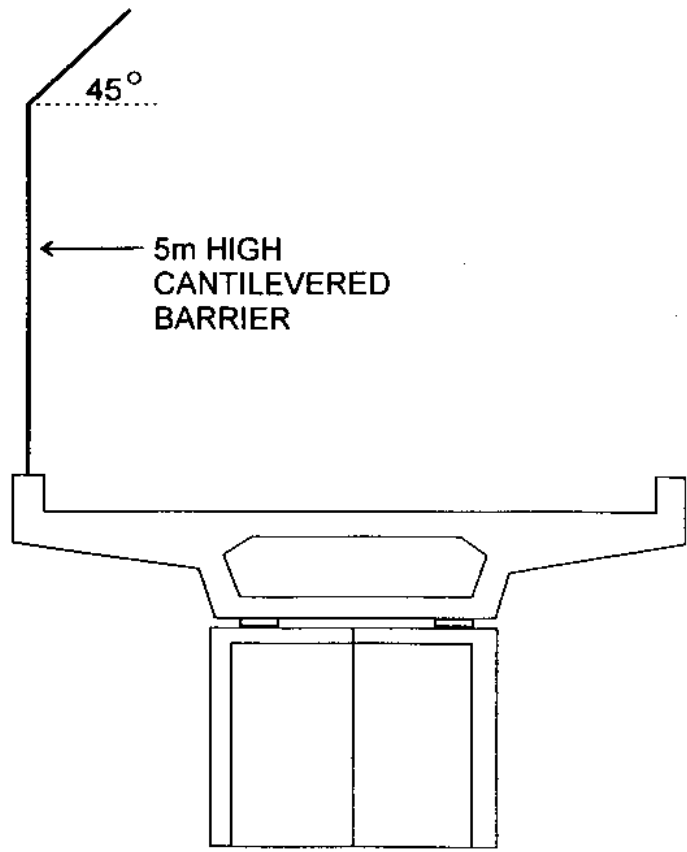


VERTICAL ROADSIDE BARRIER ON BOTH SIDES OF CARRIAGEWAY

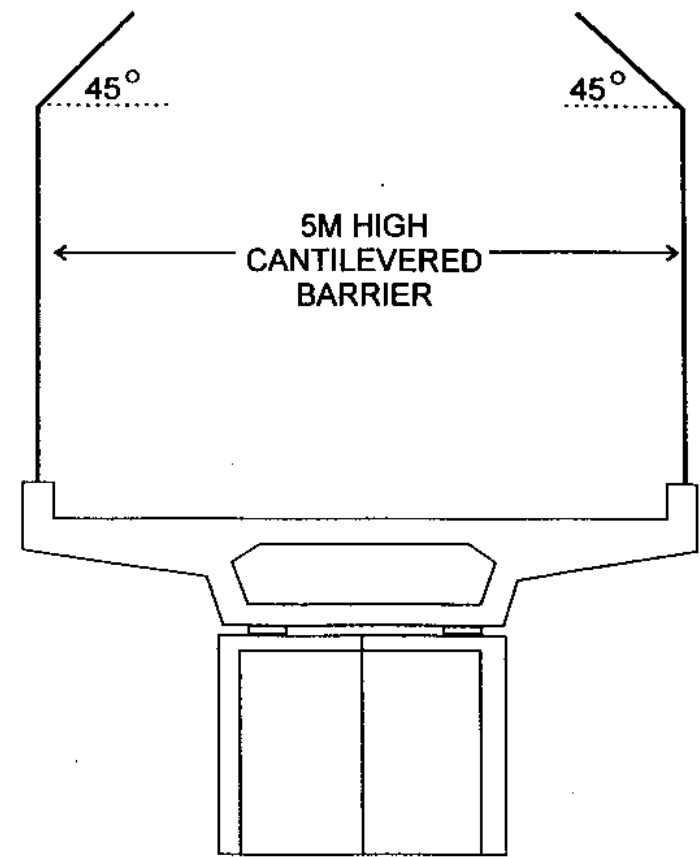
FIGURE 4.1a - GENERIC DIRECT TECHNICAL REMEDIES FOR ROAD TRAFFIC NOISE ON FLYOVERS - VERTICAL BARRIERS

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CANTILEVERED BARRIER



CANTILEVERED BARRIER ON BOTH SIDES OF CARRIAGEWAY

FIGURE 4.1b - GENERIC DIRECT TECHNICAL REMEDIES FOR ROAD TRAFFIC NOISE ON FLYOVERS - CANTILEVERED BARRIERS

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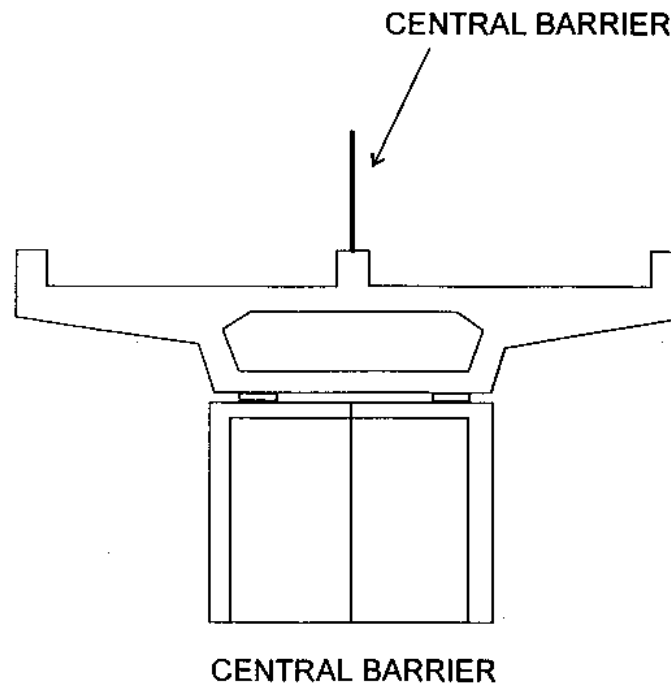


FIGURE 4.1c - GENERIC DIRECT TECHNICAL REMEDIES FOR ROAD TRAFFIC NOISE ON FLYOVERS - CENTRAL BARRIER

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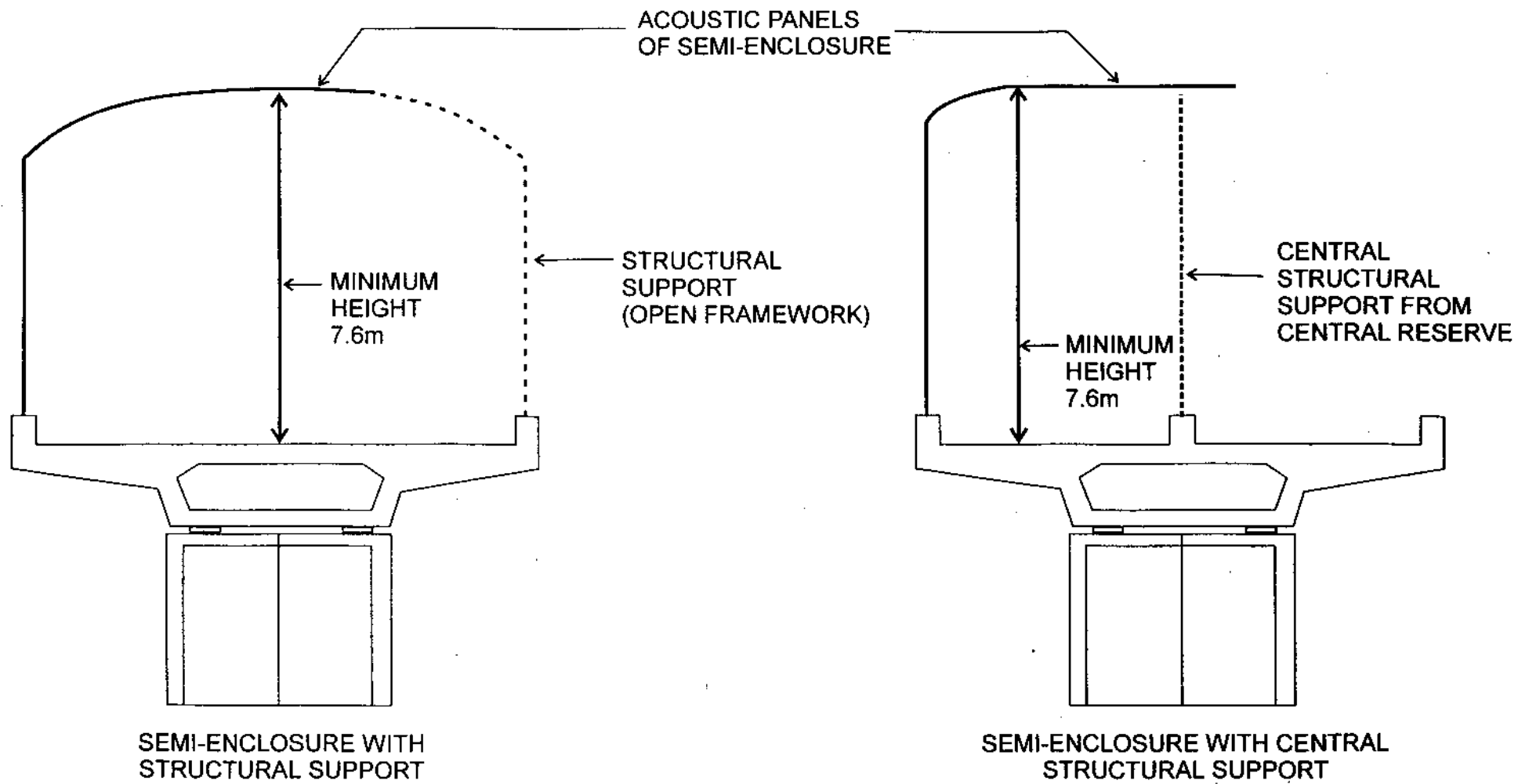
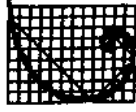


FIGURE 4.1d - GENERIC DIRECT TECHNICAL REMEDIES FOR ROAD TRAFFIC NOISE ON FLYOVERS - SEMI-ENCLOSURE

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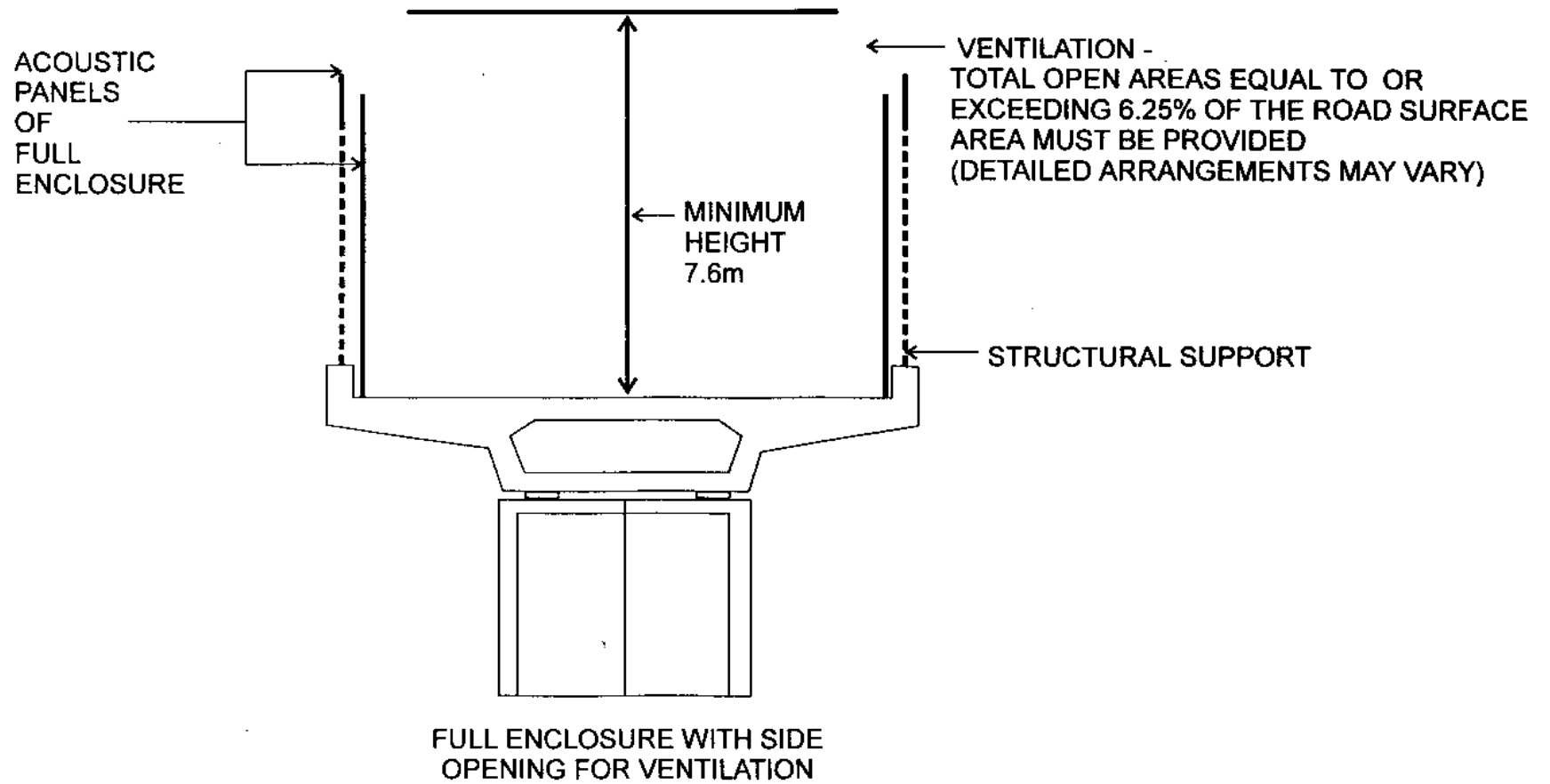


FIGURE 4.1e - GENERIC DIRECT TECHNICAL REMEDIES FOR ROAD TRAFFIC NOISE ON FLYOVERS - FULL ENCLOSURE

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relevant Government departments is presented in *Table 4.2a*.

Typical road-receiver configurations, taking into account the list of known constraints, are presented graphically in *Figures 4.2a to 4.2d*. Examples of some of these constraints are shown in *Figure 4.2e to 4.2g*.

Table 4.2a *List of Constraints / Special Requirements Related to Direct Technical Remedies for Road Traffic Noise on Existing Flyovers*

Direct Technical Remedy	Known Constraints/Special Requirements	Government Department Concerned
Cantilevered noise barrier/noise barrier	The distance between the kerbline and the surface of a noise barrier on a flyover must comply with requirements in Tables 26 and 27 of HyD's <i>Structures Design Manual</i> and the <i>Transport Planning & Design Manual (TPDM)</i> .	HyD
Central reserve noise barrier	The provision of emergency crossing/openings is required for the central barrier.	FSD
Noise barrier	The minimum clearance between wall and road kerb should comply with requirements in HyD's <i>Structures Design Manual</i> and the TPDM.	TD & HyD
Noise barrier, full/semi- enclosure	Visibility splays and sight lines at road junction must comply with the requirements in Chapters 3 & 4 of the TPDM. A minimum sight line of 70m is required for junctions or a curved section with a speed limit of 50 kph, and a minimum sight line of 125m for a speed limit of 70kph.	TD & HyD
Noise barrier, full/semi- enclosure	If a flyover is considered to be the only access to the building facade, installation of noise barrier or enclosure is not preferred.	FSD
Noise barrier, full/semi- enclosure	The design of any barriers and enclosures has to be approved by the <i>Advisory Committee on the Appearance of Bridges and Associated Structures (ACABAS)</i> .	HyD
Noise barrier, full/semi- enclosure	Structures and materials of direct technical remedies should have fire resisting capability.	FSD
Full enclosure	Openings for natural ventilation with an open area equal to or exceeding 6.25% of the road surface area must be provided.	FSD
Full Enclosure	Length of full enclosure with natural ventilation should be less than 230m.	FSD
Full/semi-enclosure	The minimum height of a full or semi-enclosure should not be less than 7.6 m to allow for the provision of overhead signage and emergency recovery of vehicles.	FSD & HyD
Full/semi- enclosure	Under the circumstances whereby fire at the nearby building could be tackled from both ground level and from the elevated road, full or semi-enclosure could not be installed (PWDTC No 31/73) (see <i>Figure 4.2d</i>)	FSD

A Working Paper/Consultation Paper presenting the selection criteria for this Study and specific operational requirements of relevant Government departments that include FSD, TD and HyD (as indicated in *Table 4.2a*) was issued on 19 December 1996 for review by these Government departments.

Views and comments from each of the departments were received in January 1997. The greatest concern was voiced by HyD concerning structural engineering implications that would arise from the implementation of direct technical remedies. As HyD indicated, most of the existing flyovers are not designed to take up additional dead and wind loads imposed by noise barriers or enclosures erected directly on the them, it is therefore most likely that independent structures would have to be provided to support the barriers or enclosures at ground level. In addition, an alternative means to cater for the additional loadings brought about by mitigation measures would be to strengthen the structure of the existing flyovers, subject to the detailed engineering design and the fulfilment of other indispensable constraints. Although the concerns of HyD are justified, it would be more appropriate to take these into consideration during the following Stage 2 Study.

The concerns of TD were related to road safety in terms of clearance, sightline distance and provisions for other roadside facilities (eg road signage, emergency telephones and CCTV, etc) whilst FSD's major concerns were on the clearance between building facade and flyover and the provision of sufficient smoke ventilation if enclosures were used. It is anticipated that sufficient considerations would be given to these requirements during the detailed design of the direct technical remedies to be carried out separately in the Stage 2 Study that follows.

A copy of the views from the Governments departments consulted and the corresponding responses from ERM is presented in *Annex B*.

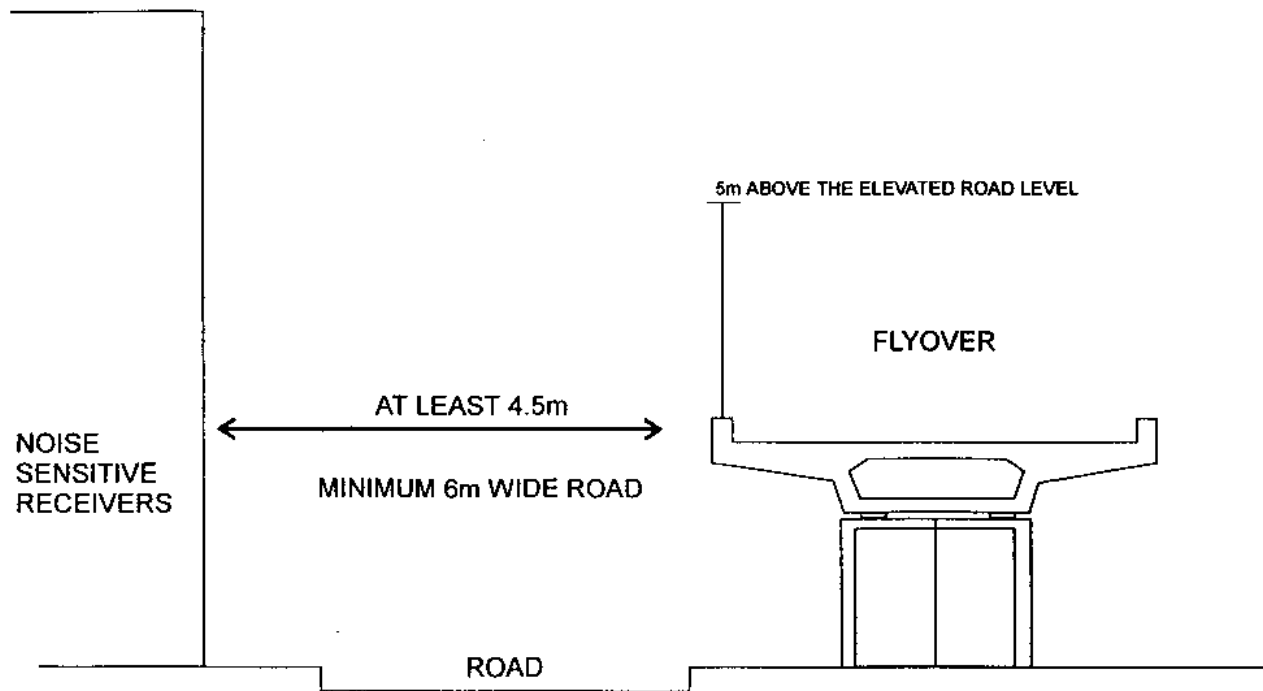
Subsequent to a review of the list of constraints presented in *Table 4.2a* and the concerns expressed by HyD, FSD and TD during the above consultation, it is considered that some of the known constraints/special requirements could be overcome by detailed engineering design. However, insurmountable constraints still exist and these are listed as follows:

- insufficient clearance between flyover & NSRs;
- sight line safety;
- obstruct fire fighting operations; and
- insufficient space for barrier structure support.

4.3

HONG KONG ISLAND

As discussed in *Section 3.2*, 30 flyovers on Hong Kong Island were identified as being suitable for further consideration in the study. Of these, 14 are found to be seriously constrained by special requirements such as those described above, such that direct technical remedies can not be installed. Details of these constraints are presented in *Annex A*. These 14 flyovers, which have not been considered further in the Study, are listed in *Table 4.3a*. It should be noted that insufficient clearance or space for structural support, as indicated in the last column of *Table 4.3a*, is always due to the presence of other insurmountable constraints (e.g. supports erected on/beside the at-grade road underneath a flyover could violate traffic safety, fire-fighting and emergency access requirements, etc). Further details are also presented in *Annex A*.



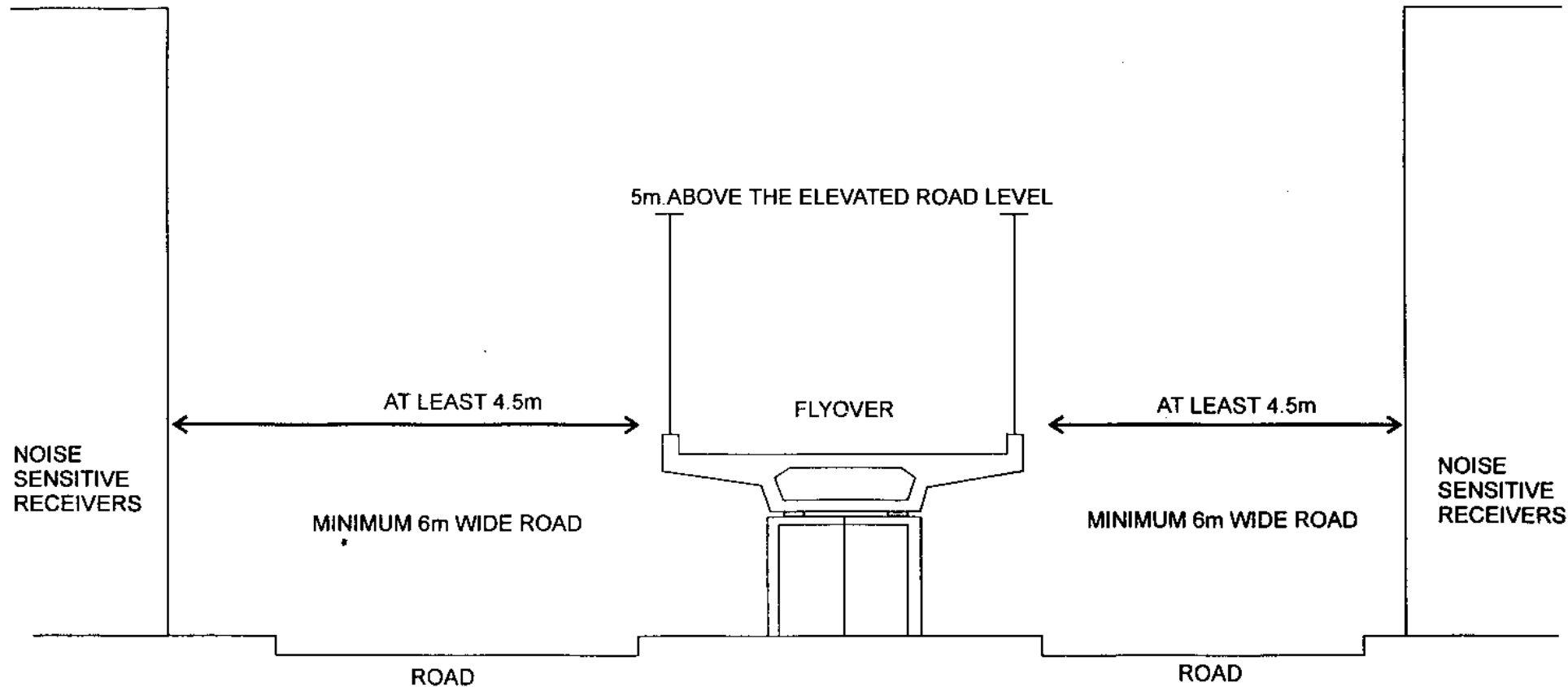
DIRECT TECHNICAL REMEDIES SUCH AS BARRIER AND NOISE ENCLOSURE ON THE FLYOVER IS CONSIDERED FEASIBLE

- FLYOVER IS NOT THE ONLY ACCESS TO BUILDING FACADES
- CLEARANCE BETWEEN THE OUTER EDGE OF THE FLYOVER STRUCTURE AND BUILDING FACADE IS GREATER THAN 4.5m
- FIRE FIGHTING OPERATIONS WOULD NOT BE OBSTRUCTED BY THE ERECTION OF NOISE BARRIER OR NOISE ENCLOSURE

FIGURE 4.2a - TYPICAL ROAD - RECEIVER CONFIGURATION (EXAMPLE ONE)

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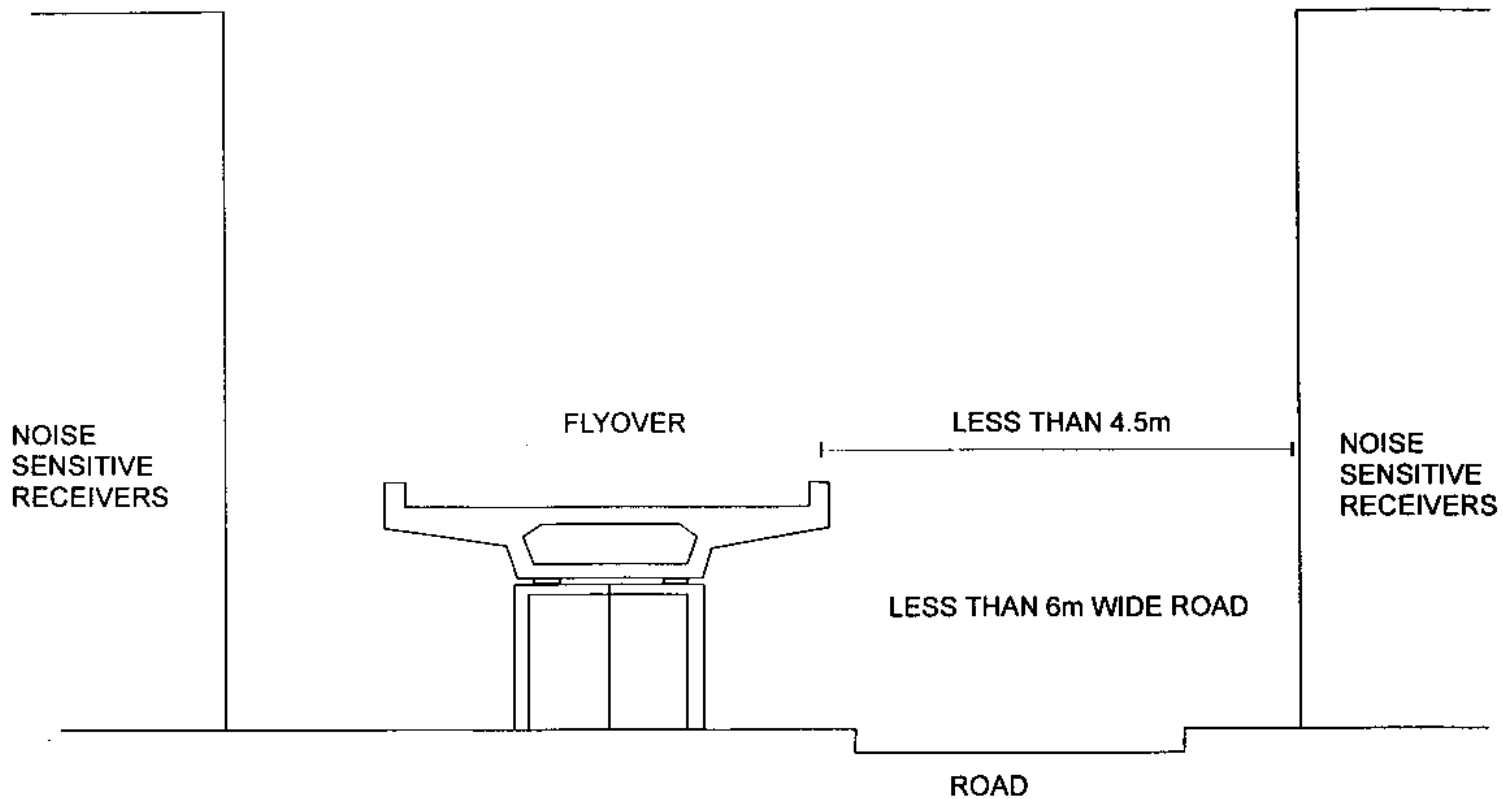
DIRECT TECHNICAL REMEDIES SUCH AS BARRIER AND NOISE ENCLOSURE ON THE FLYOVER IS CONSIDERED FEASIBLE

- FLYOVER IS NOT THE ONLY ACCESS TO BOTH BUILDING FACADES
- CLEARANCE BETWEEN THE OUTER EDGE OF THE FLYOVER AND BUILDING FACADES IS GREATER THAN 4.5m
- FIRE FIGHTING OPERATIONS WOULD NOT BE OBSTRUCTED BY THE ERECTION OF NOISE BARRIER OR NOISE ENCLOSURE

FIGURE 4.2b - TYPICAL ROAD - RECEIVER CONFIGURATION (EXAMPLE TWO)

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NOISE BARRIER ERECTED ALONG THE LEFT HAND CARRIAGE WAY, OR SEMI OR FULL ENCLOSURE IS NOT CONSIDERED FEASIBLE

- FIRE FIGHTING OPERATIONS FROM THE FLYOVER FOR THE LEFT HAND SIDE BUILDING WOULD BE OBSTRUCTED BY THE ERECTION OF NOISE ENCLOSURE OR NOISE BARRIER ALONG THE LEFT HAND CARRIAGEWAY

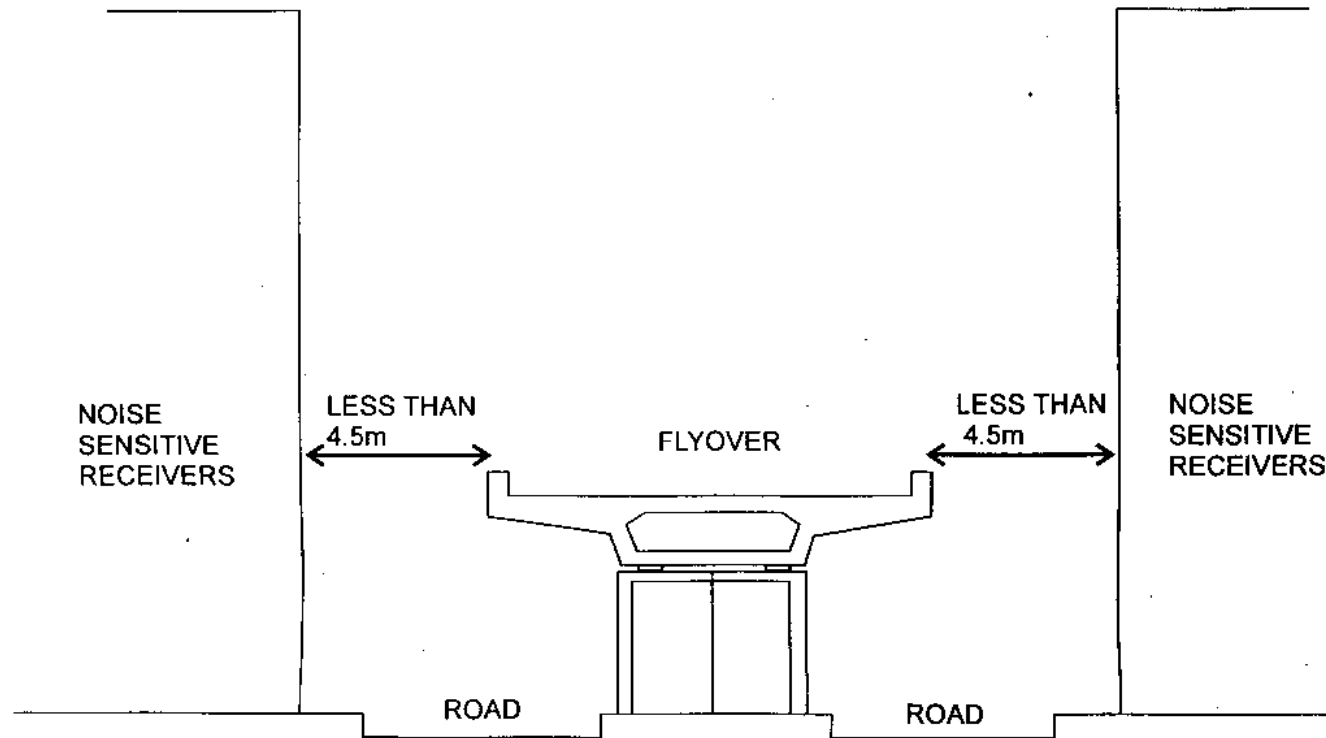
FIGURE 4.2c - TYPICAL ROAD - RECEIVER CONFIGURATION (EXAMPLE THREE)

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- NOISE BARRIER ON EITHER SIDE OF THE HIGHWAY, SEMI OR FULL ENCLOSURE ARE NOT CONSIDERED FEASIBLE
- INSUFFICIENT CLEARANCE BETWEEN FLYOVER AND BUILDING FOR ACCESS TO HIGER FLOORS OF BUILDING FACADE FROM THE AT-GRADE ROAD DURING FIRE FIGHTING OPERATIONS
 - FIRE FIGHTING OPERATIONS AT HIGHERS FLOORS WOULD ALSO BE OBSTRUCTED BY THE ERECTION OF NOISE BARRIER OR NOISE ENCLOSURE ON FLYOVER

FIGURE 4.2d - TYPICAL ROAD - RECEIVER CONFIGURATION (EXAMPLE FOUR)

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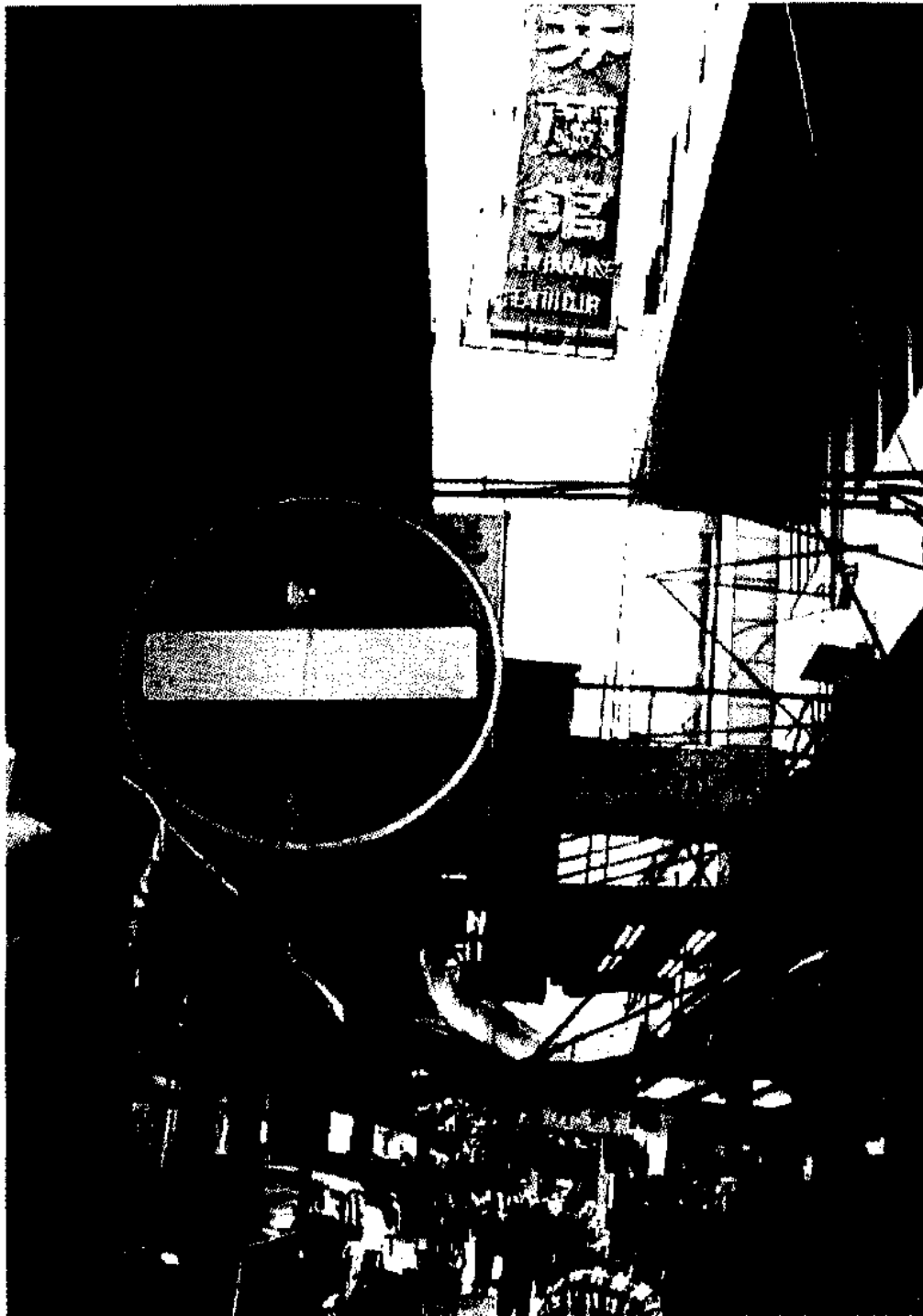


FIGURE 4.2e - CLEARANCE BETWEEN THE OUTER EDGE OF THE ELEVATED ROAD AND THE BUILDING LESS THAN 4.5m- FERRY STREET

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FIGURE 4.2f - THE DISTANCE BETWEEN THE KERBLINE AND THE SURFACE OF A NOISE BARRIER ON A FLYOVER
LESS THAN 0.46m - ARGYLE STREET

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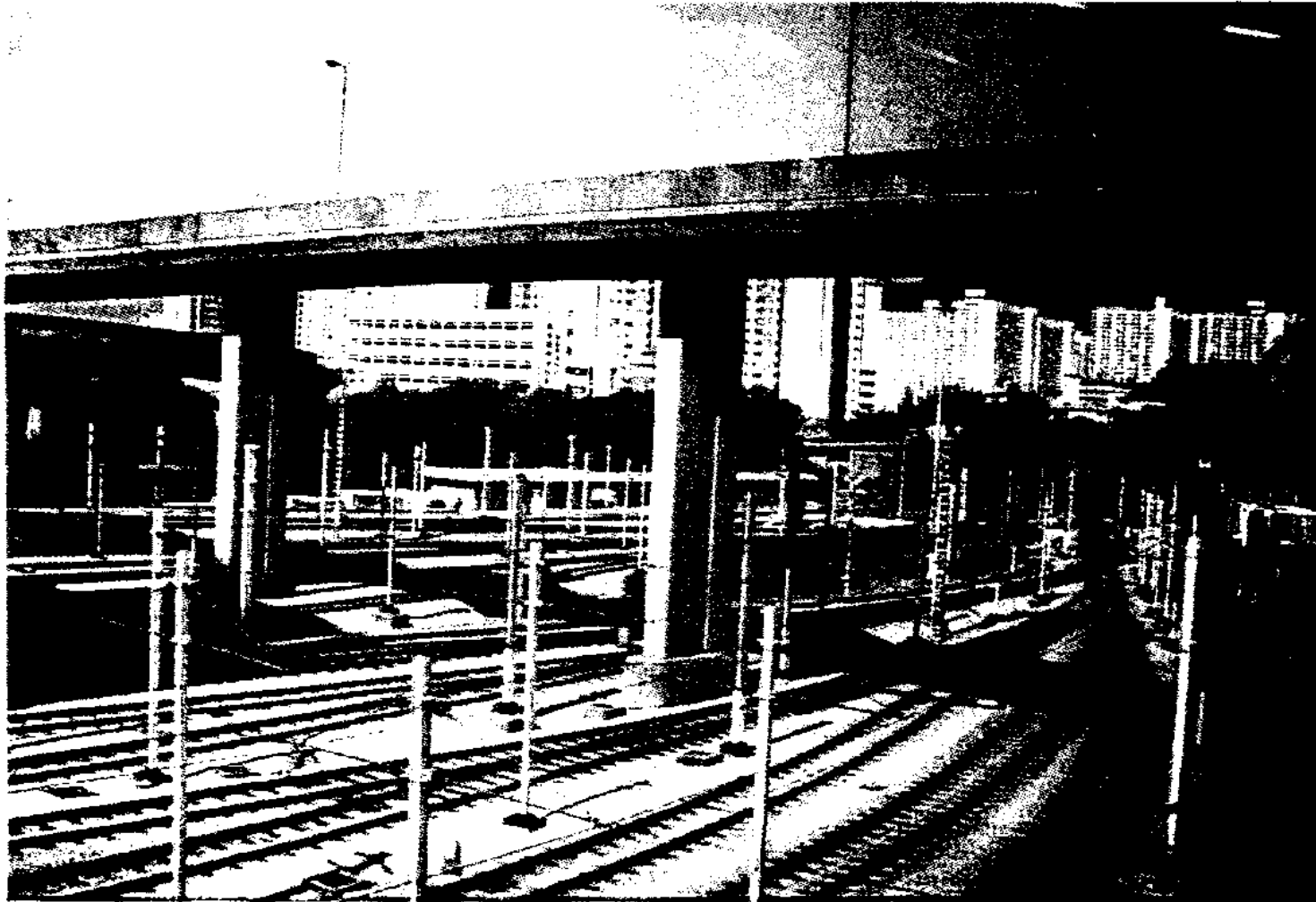
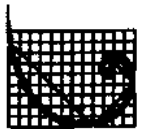


FIGURE 4.2g - STRUCTURALLY INFEASIBLE OVER THE MTRC RAILWAY - K40 NGAU TAU KOK ROAD

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Table 4.3a Hong Kong Island Flyovers with Insurmountable Constraints or Special Requirements

Flyovers Candidates	Insufficient clearance between flyover & NSRs (FSD)	Sight line safety (TD)	Obstruct fire fighting operations (FSD)	Insufficient space for barrier structure support (HyD)
H1 Hill Road	✓	✓		✓
H2 Bonham Road				✓
H3 Conduit Road		✓		
H4 Robinson Road (next to Canossa Hospital)	✓	✓		
H15 Fleming Road				✓
H17 Canal Road (above Canal Road East)			✓	
H18 Canal Road (above Canal Road West)			✓	
H21 Marsh Road			✓	
H24 Tsing Fung Street	✓		✓	✓
H30 IEC (Tai On St. to Hoi Keung St.)	✓			
H31 IEC (Branch to Nam On St.)	✓			✓
H32 IEC (Branch to Chai Wan Road)	✓			
H33 IEC (Tung Hei Rd. to A Kung Ngam Village Rd.)	✓			✓
H35 Shun Tai Road		✓		

After consideration of the special requirements, 16 flyovers as listed below, on Hong Kong Island remain suitable candidates for further investigation. The impacts that these flyovers may have on nearby NSRs are discussed in *Section 5*.

- H5 Robinson Road - over Magazine Gap Road;
- H8 Upper Albert Road - over Albany Road;
- H9 Cotton Tree Drive - near St. Joseph's College;
- H16 Canal Road - over Morrison Hill Road;
- H22 Gloucester Road - turning from Victoria Road to Causeway Bay;
- H23 Gloucester Road - near Moreton Terrace;
- H26 IEC - Oil Street to Tin Chui Street;
- H27 IEC - branch to King's Road;
- H34 IEC - near Heng Fa Chuen;
- H37 Aberdeen Main Road - Aberdeen Main Road to Aberdeen Praya Road;
- H38 Wong Chuk Hang Road - near HK School of Motoring;
- H41 Ap Lei Chau Bridge;

- H43 Stubbs Road - over Wong Ngan Chung Road;
- H45 Repulse Bay Road - above South Bay Road;
- H46a Chi Fu Road - Pok Fu Lam Road to Chi Fu Road; and
- H46b Chi Fu Road - Chi Fu Road to Pok Fu Lam Road.

As discussed in Section 3.3, 84 flyovers in Kowloon and the New Territories were identified as being suitable for further consideration in the study. Of these, 19 are found to be seriously constrained by special requirements, such that direct technical remedies cannot be installed. Details of these constraints are presented in Annex A. These 19 flyovers, which have not been considered further in the Study, are listed in Table 4.4a. It should be noted that insufficient clearance or space for structural support, as indicated in the last column of Table 4.4a, is always due to the presence of other insurmountable constraints (e.g. supports erected on/beside the at-grade road underneath a flyover could violate traffic safety, fire-fighting and emergency access requirements, etc). Further details are also presented in Annex A.

Table 4.4a *Kowloon and New Territories Flyovers with Insurmountable Constraints or Special Requirements*

Flyovers	Insufficient clearance between flyover & NSRs (FSD)	Sight line safety (TD)	Obstruct fire fighting operations (FSD)	Insufficient space for barrier structure support (HyD)
K5 West Kowloon Corridor (Tai Kok Tsui Rd to Cherry St)			✓	✓
K11 Waterloo Road (over Argyle Street)				✓
K12a Prince Edward Road West (Lai Chi Kok Rd. - Yuen Ngan St.)	✓			✓
K12b Prince Edward Road West (Prince Edward Rd. West)	✓			✓
K13 Boundary Street (Maple Street to Sai Yee Street)	✓			
K15 Argyle Street (above at grade Argyle Street)				✓
K17 Gascoigne Road (to Ferry Street)	✓			
K22 East Kowloon Corridor (above Chatham Rd. and Kowloon City Rd.)	✓		✓	
K23 San Ma Tau Street		✓		
K24 Fat Kwong Street	✓			
K27 Princess Margaret Road (to Waterloo Road, over Argyle Street)				✓
K28 Hong Chong Road				✓

Flyovers	Insufficient clearance between flyover & NSRs (FSD)	Sight line safety (TD)	Obstruct fire fighting operations (FSD)	Insufficient space for barrier structure support (HyD)
K40 Ngau Tau Kok Road (Kai Cheung Road to Ngau Tau Kok Road)				✓
K45 Ferry Street (over Tong Mei Road)			✓	✓
K47 Siu Yip Street				✓
NT19 Sha Tin Rural Committee Road				✓
NT37 Hung Mui Kuk Road	✓			
NT43 Long Yip Street & Yuen Long On Lok Road			✓	
NT64 Tai Ho Road	✓			

After consideration of the special requirements, 65 flyovers as listed below, in Kowloon and the New Territories remain suitable candidates for further investigation. The impacts that these flyovers may have on nearby NSRs are discussed in *Section 5*.

- K2 Kwai Chung Road - Mei Foo Sun Chuen;
- K3 West Kowloon Corridor - near Lai Chi Kok;
- K4 West Kowloon Corridor - between Willow Street & Tong Mi Road (near Nam Cheong Estate);
- K8 Lung Ping Road - near Beacon Heights;
- K9 Waterloo Road - between Ede Road and Suffolk Road;
- K10 Waterloo Road - over Prince Edward Road;
- K14 Boundary Road - College Road up to Prince Road West;
- K16 Argyle Street - near Olympic Park;
- K18 Chatham Road South - beneath Wylie Court;
- K26 Dyer Ave;
- K30 Chuk Yuen Road - Lung Yin Road;
- K31 Fung Mo Street;
- K32 Po Kong Village Road;
- K34 Prince Edward Road East - near Choi Hung Estate;
- K39 Wai Yip Street - access road to Telford Garden;
- K41 Ngau Tau Kok Road - near Ngau Tau Kok Upper Estate;
- K42a Shun Lee Tsuen Road - near Shun Lee Estate;
- K42b Shun Lee Tsuen Road - near Shun Tin Estate;
- K43 Lee On Road;
- K48 Kwun Tong Road - near Kai Tai Court;
- K53 Kwun Tong Bypass - near Laguna City;
- K54 Kwun Tong Bypass - parallel to Wang Kwong Road;
- K56 Tseung Kwan O Road - near Tsui Ping South Estate;
- K57 Lin Tak Road;
- K58 Sceneway Road;
- NT3 Pak Wo Road - over Fanling Highway and next to Tai Ping Estate;
- NT4 So Kwun Po Road Network - link to Fanling Highway;

- NT5 Jockey Club Road - adjacent to Wo Hop Shek;
- NT6 Tai Po Tai Wo Road - near Kam Shek San Tsuen;
- NT7 Po Heung Street - over Lam Tsuen River;
- NT9 Tai Po Road Yuen Chau Tsai - near Wang Fuk Court;
- NT10 Tai Po Road Yuen Chau Tsai - link to Tolo Highway;
- NT11 Yuen Shan Road - join Tlo Highway;
- NT14 Tsun King Road;
- NT15 Ma On Shan Road Network;
- NT16 Sai Sha Road - link to Hang Tak Street;
- NT17 Hang Tak Street;
- NT18 Tai Po Road Sha Tin - near Hilton Centre;
- NT23 Sha Tin Road - near KCRC House;
- NT24 Sha Tin Road - near Sha Tin Wai;
- NT25 Sha Tin Road - near City One Shatin;
- NT27 Tai Chung Kiu Road - near Ravana Garden;
- NT28 Sha Tin Wai Road - near Chap Wai Kon New Village;
- NT29 Shek Mun Roundabout;
- NT34 Lion Rock Tunnel Road - over Shing Mun River;
- NT35 Lion Rock Tunnel Road - near Hung Mui Kuk;
- NT38 Tseung Kwan O Road - near Hong Sing Garden;
- NT39 Tai Po Road Tai Wo - near Hong Lok Yuen;
- NT40 Hong Lok Yuen Road;
- NT41 San Tin Road;
- NT42 Ling Tin Road;
- NT46 Tsing Tin Road;
- NT47 Castle Peak Road - San Hui Section;
- NT48 Pui To Road - over nullah and San Fa Estate;
- NT49 Pui To Road - over Tuen Mun Road;
- NT56 Tuen Hing Road;
- NT59 Tuen Mun Road - Castle Peak Bay to Siu Lam;
- NT60 Tuen Mun Road - Sham Tseng Section;
- NT62 Tsuen Wan Road - Tuen Mun Road to Tsing Tsuen Road;
- NT65 Texaco Road North - near Shek Wai Kok Estate;
- NT69 Kwai Chung Road - near Kwai Fong Estate;
- NT71 Tsing Tsuen Road - to Tsing Yi Bridge
- NT74 Lai King Hill Road Network - next to Kwai Fong Garden;
- NT75 Ching Cheung Road - near Ching Lai Court; and
- NT76 Wah Tai Road - near Lai Yiu Estate.