

## 10. CONCLUSION AND RECOMMENDATIONS

### 10.1 General

10.1.1 This Report has presented the preliminary engineering feasibility study and traffic noise impact assessment for the three existing flyovers, namely, Ap Lei Chau Bridge, Tsing Tsuen Bridge and Kwai Chung Road Flyover near Mei Foo Sun Chuen, and recommended any feasible mitigation measures to be provided.

10.1.2 Side effects of the recommended mitigation measures including environmental and visual impacts and air quality impacts have been examined. Cost effectiveness and implementation strategy were also explored in the study.

10.1.3 A priority ranking has been established for consideration by the government for the implementation of the proposed noise mitigation measures on the flyovers. The ranking is based on population exposure but may be changed if other considerations, e.g., political issues, take priority.

10.1.4 A set of working tools with simplified assessment procedures has been established to enable the initial assessment of any feasible mitigation options for existing flyovers. The applicability was verified from the findings of the three studied flyovers.

### 10.2 Ap Lei Chau Bridge

10.2.1 After completion of the noise assessment and engineering assessment for the above flyover at the Ap Lei Chau approach section, it was recommended that noise mitigation measures with 6m high bent-top vertical barriers would be required to provide the necessary protection to the receivers.

10.2.2 Structural assessment of the existing retaining wall has been carried out. It was found that neither provision was made in the original design nor there were sufficient spare capacities to cater for the additional loading from the proposed barriers. As the resulting overstress condition in the existing structure was found to be serious, independent structure with foundation at ground level was required to support the noise barriers.

10.2.3 The feasible extent and location of the independent structure in Ap Lei Chau Bridge was constrained by the presence of adjacent development, USD recreational grounds and subway access and only about 95m of barrier in length can be provided. The recommended location and cross section is shown in Fig. 4-2 & 4-3. About 44% of protection for the affected dwellings can be achieved.

10.2.4 It should be noted that if the recommended mitigation measures are to be implemented, USD in particular should be fully consulted as any proposed structure are required to be located outside their recreational grounds and the operation and use of their venues should not be affected during construction.

- 10.2.5 Side effects such as air quality and visual/landscape impacts have been assessed. It was considered that the recommended barriers would have no adverse impact on the local air quality. However, the massive steelwork appearance of the independent structure would have serious visual intrusion to the residents and disruption to the established landscaped environment.
- 10.2.6 Preliminary construction cost of the above mitigation works was estimated at about HK\$16.1M (Dec 98 Prices). Annual maintenance cost and annual staff cost as obtained from HyD/Str were estimated at HK\$0.15M and HK\$0.05M (Dec 97 Prices) respectively.
- 10.2.7 Sum of exposure level was found to be 389.5. Implementation priority based on the Population Exposure Ranking is the lowest comparing with Tsing Tsuen Bridge.

### **10.3 Tsing Tsuen Bridge**

- 10.3.1 After completion of the noise assessment and engineering assessment for the above flyover at the Tsing Yi approach section and Tsuen Wan approach section, it was recommended that noise mitigation measures with about 6m high partial enclosures would be required to provide the necessary protection to the receivers.
- 10.3.2 Structural assessment of the existing flyover has been carried out. It was found that neither provision was made in the original design nor there were sufficient spare capacities to cater for the additional loading from the proposed enclosures.
- 10.3.4 Structural assessment has been carried out on the flyovers. It was found that the resulting overstress condition of the structural members was serious. Strengthening of bridge deck to cater for the noise barrier installation has been examined but was not considered as practical because of the requirements of bridge closure for a substantial period of time and extensive alteration works. Therefore, independent structure with foundation at ground level was required to support these noise enclosures.

#### Tsing Yi Approach Section

- 10.3.5 The feasible extent and location of independent structure for the Tsing Yi approach of Tsing Tsuen Bridge was constrained by existing road, EVA underneath the bridge and the recreational facilities within Cheung On Estate lot boundary. In addition, it would be in conflict with existing utilities and drainage and require diversion.
- 10.3.6 Housing Department has indicated their general support for locating the independent structure within Cheung On Estate subject to consultation with the Housing Authority and owners of domestic units. The recommended location and cross sections are illustrated in Fig. 5-3(Sheet 1) and 5-5. Only about 12% of protection for the affected dwellings can be achieved. Although

the level of protection is low, it would still be a feasible option for noise reduction from engineering perspective, subject to the priority of project funding and future consultation with the public and concerned departments.

- 10.3.7 Side effects such as air quality and visual/landscape impacts have been assessed. It was considered that the recommended barriers would have no adverse impact on the local air quality. However, the massive steelwork appearance of the independent structure would have serious visual intrusion to the residents and disruption to the established landscaped environment.
- 10.3.8 Preliminary construction cost of the above mitigation works was estimated at about HK\$86M (Dec 98 Prices). Annual maintenance cost and annual staff cost as obtained from HyD/Str were estimated at HK\$0.54M and HK\$0.16M (Dec 97 Prices) respectively.
- 10.3.9 Sum of exposure level was found to be 3030. Implementation priority based on the Population Exposure Ranking is in the second position.

#### Tsuen Wan Approach Section

- 10.3.10 The feasible extent and location for the independent structure for Tsuen Wan approach of Tsing Tsuen Bridge was constrained by the adjacent boundary of development, RSD's recreational ground and staircase access. The recommended layout and cross section of the enclosures are given in Fig. 5-3 (Sheet 2), 5-4 & 5-5. RSD has indicated that the proposed independent structure might not intrude into their recreational ground as observed by them on site. However, during construction, some of their lands may be affected. Therefore, RSD should be fully consulted if the recommended mitigation measures are to be implemented.
- 10.3.11 With the above extent of mitigation measures, about 46% of protection for the affected dwellings can be achieved.
- 10.3.12 Side effects such as air quality and visual/landscape impacts have been assessed. It is considered that the proposed partial enclosures would have no adverse impact on the air quality. However, the massive steelwork appearance of the independent structure would have serious visual intrusion to the residents and disruption to the established landscaped environment.
- 10.3.13 Preliminary construction cost of the above mitigation works was estimated at about HK\$124.4M (Dec 98 Prices). Annual maintenance cost and annual staff cost as obtained from HyD/Str were estimated at HK\$1.57M and HK\$0.47M (Dec 97 Prices) respectively.
- 10.3.14 Sum of exposure level was found to be 5754. Implementation priority based on the Population Exposure Ranking is in the first position.

#### **10.4 Kwai Chung Road Flyover near Mei Foo Sun Chuen**

- 10.4.1 No noise mitigation measures can be recommended for this flyover. Practicality of erecting the noise barriers/enclosures on the flyover or independent structure at grade was the crucial concern in the study area.
- 10.4.3 Results of the structural assessment indicated that the existing bridge structure of Kwai Chung Road Flyover does not have adequate spare structural capacity to cater for additional vertical and lateral loads for the proposed noise mitigation measures. Strengthening of the existing structures were also not considered as feasible because the amount of works involved and disruptions to the public in terms of social impacts and all possible consequential effects on traffic and environment would be significant and should not be underestimated.
- 10.4.4 Independent structure was not considered as feasible because of the lack of space and the existence of drainage reserves at its location. In addition, it would obstruct the fire fighting operation. As advised by FSD in their letter ref. (13) in FSD/PG4/130/94III of 19.2.99, the following requirements should be complied before any mitigation measures were considered feasible:
- vehicular access with a minimum width of 6 metres should be provided adjacent to the flyover;
  - horizontal clearance of not less than 4.5 metres between the flyover and the building facade should be maintained;
  - the flyover should not be the only access to building facades; and
  - fire fighting operation should not be obstructed by the erection of direct technical mitigation measures.
- 10.4.7 Apart from the above constraints, the presence of recreational area and daily pedestrian movement and commercial activities in the vicinity of the flyover, in particular, the area below the flyover would pose another constraint for the erection of direct technical mitigation measures.
- 10.4.8 The presence of MTR Mei Foo Station and its protection boundary would further reduce the possibility of any implementation of direct technical mitigation measures on independent structure within these areas. Any construction works within the MTR protection zone would be subject to special scrutiny by Government and under strict monitoring requirement as stipulated in the Practice Note for AP/RSE No. 77 issued by the Building Authority.
- 10.4.9 In addition, the area to the west of Lai Wan Road adjacent to Kwai Chung Flyover would be confined by the proposed West Rail, Mei Foo station. This station was proposed to be a piled structure with lowest finished ground level at -2.0 mPD and highest finished ground level at +17.7mPD spanning underneath and across the flyover. Thus, the erection of noise mitigation measures in this area would be almost impossible.

10.4.10 In conclusion, no feasible extent and location of direct technical mitigation measure has been recommended for the existing Kwai Chung Road Flyover near Mei Foo Sun Chuen.

## 10.5 Overall Summary of Results and Recommendations

10.5.1 Based on engineering assessment on the studied flyovers and experience on other flyover projects, it would be in general unlikely practicable to install noise mitigation measures directly to existing flyovers as additional loading of the measures are usually not allowed in the flyover design. It is recommended independent support structure shall be adopted in retrofitting existing flyovers.

10.5.2 The feasibility/practicability, benefits and priority ranking of the implementation of the proposed noise mitigation measures with independent support structures at the studied flyovers are summarized as follows:

Flyover Location	Proposed Mitigation Measures	Feasibility/Practicability	No. of dwelling exposed	% of Protection	Sum of Exposure Levels (Priority Ranking)
Tsing Tsuen Bridge - Tsuen Wan Approach	Partial Enclosure Type I (125m) + Type II (160m)	Feasible & Practical	1545	46	5754 (1)
Tsing Tsuen Bridge - Tsing Yi Approach	Partial Enclosure Type II (150m)	Feasible. % of protection is low but exposure level is high	1061	12	3030 (2)
Ap Lei Chau Bridge	Bent top Vertical Barrier (95m)	Feasible & Practical	77	44	349.5 (3)
Kwai Chung Road Flyover near Mei Foo Sun Chuen	Bent top Vertical Barrier [as proposed in the Scoping Study]	Not feasible & Not practical	-	-	-

10.5.3 The implementation strategy, costs, side effects and land issues for the proposed mitigation measures on those flyovers which are concluded as feasible are summarized as follows:

Flyover Location	Implementation Strategy (Programme)	Total Construction Cost (HK\$)	Total Recurrent Cost (HK\$)	Air Quality Effects	Aesthetical Effects	Land Requirement
Tsing Tsuen Bridge - Tsuen Wan Approach	Phase I (Year 1 to 4)	124.4M	2.04M	Not Significant	Significant*	No Resumption of Private Land
Tsing Tsuen Bridge - Tsing Yi Approach	Phase II (Year 2 to 5)	86M	0.7M	Not Significant	Significant*	Resumption on "semi-government land within Cheung On Estate **
Ap Lei Chau Bridge	Phase III (Year 3 to 6)	16.1M	0.2M	Not Significant	Significant*	No Resumption of Private Land

Note : (1) Total Construction Costs are given at December 1998 price level.

(2) Total Recurrent Costs are given at December 1997 price level as obtained from HyD/Str.

\* - Aesthetical Effects are significant. Measures to reduce the impacts will be developed for the generic design of the noise mitigation measures and for submission to the ACABAS for in-principle approval.

\*\* - Resumption of land adjacent to Tsing Tsuen Bridge within Cheung On Estate Boundary is necessary. Consultation with the Housing Authority and the owners of the domestic units should be made before implementation of the proposed measures.

10.5.4 The specific criteria for retroactive noise mitigation on the studied flyovers are indicated as follows:

Flyover Location	Availability of Space for Installation of Proposed Measures	Emergency Access & Fire Fighting Not Obstructed	Road Safety such as Driving Visibility and Vehicular/ Pedestrian Access Not Affected
Tsing Tsuen Bridge - Tsuen Wan Approach	✓	✓	✓
Tsing Tsuen Bridge - Tsing Yi Approach	✓	✓	✓
Ap Lei Chau Bridge	✓	✓	✓
Kwai Chung Road Flyover near Mei Foo Sun Chuen	✗	✗	✗

10.5.5 A set of simplified assessment procedures is recommended for use as a Working Tool to enable an assessor such as EPD to perform a desk-top study without going through lengthy calculations to determine whether the required mitigation is at all feasible before committing to a detailed feasibility study.

## 10.6 Recommendations for Further Works

10.6.1 If the identified mitigation measures for Ap Lei Chau Bridge and Tsing Tsuen Bridge are put forward for implementation, the following further works are recommended to proceed:

- ground investigation and topographical surveys to confirm the actual ground condition and geological data;
- confirmation of land requirement with the Lands Department and relevant government departments/parties;
- consultation with the District Offices, the public and the utility undertakers;
- review of the socio-economic implications;
- environmental study review;
- engineering study review;
- detailed ACABAS submission;
- detailed design of mitigation structures;
- detailed cost estimation and cash flow analysis;
- detailed implementation programme.

10.6.2 Due consideration should be given to the maintenance requirements in the detailed design of the identified mitigation measures as follows:

- minimise the types of noise barriers/enclosures wherever possible; and
- allow access for inspection and maintenance.