Rail Groundborne Noise Assessment

Rail Noise Impact Assessment Methodology

A.1.1.1.1 The current prediction methodology recommended by the "High-Speed Ground Transportation Noise and Vibration Impact Assessment", 1998 is used in this EIA study. The manual is issued by the US Department of Transportation and is intended to provide guidance in preparing and reviewing the noise and vibrations sections of environmental submittals to the US Government.

A.1.1.1.2 The basic equation describing the model, in decibels, is:

L = VIL + BCF + BVR + CTN + TOC + SAF,

Where the prediction components are:

- L: Ground borne vibration or noise level within the structure, re: 1μ-in/sec or 20μ-Pascal
- VIL: Vibration level measured at grade for underground TCL trains in Tung Chung Town Centre under normal operation
- BCF: Vibration coupling loss factor between the soil and the foundation, relative level
- BVR: Building vibration reduction or amplification within a structure from the foundation to the occupied areas, relative level
- CTN: Conversion from floor and wall vibration to noise, 1μ-in/sec to 20μ-Pascal
- TOC: Turnout and Crossover Factor
- SAF: Safety Factor

A.1.1.1.3 Predictions are in most cases based on assuming the closest distance from the track centreline to the building foundation of the receiver; however, if a particular facility within a structure is the sensitive receiver, the setback distance is assumed to be from the track centreline to the closest part of the affected receivers. Where curved track occurs the track is considered to be straight and perpendicular to the closest setback point of the venue or receiver.

Vibration Level (VIL)

A.1.1.1.4 The vibration level for normal TCL train operation is measured at grade above the MTRCL TCL railway tunnel in Tung Chung Town Center. The measurement location and vibration level results are shown in **Appendix 4.22a**.

A.1.1.1.5 According to "High-Speed Ground Transportation Noise and Vibration Impact Assessment" Section 9.3.2, the vibration level VIL:

$VIL = L_F + TM_{line} + C_{build}$

Where,

- VIL: RMS vibration velocity in 1/3 octave band,
- L_F: force density for a line vibration source such as a train,
- TM_{line}: line source transfer mobility from the tracks to the sensitive site,
- C_{build}: adjustment to account for ground-building foundation interaction and attenuation of vibration amplitudes as vibration propagates through buildings.

A.1.1.1.6 The current groundborne vibration measurement as shown in **Appendix 4.22a** above the existing tunnel directly about 6m which represent $L_v = L_F + TM_{line}$. The measurement location is with similar track depth as the proposed railway alignment extension for TCW station. Also, as Tung Chung Town Center and the proposed TCW alignment are close to each other, it is expected similar railway tunnel construction method and railway operation details will be adopted. Distance attenuation will not be adopted in the calculation to represents the worst case scenario since all the proposed NSRs are not directly above the proposed alignment and separated by at least 5m horizontal distance.

A.1.1.1.7 Since design information including railway tunnel construction method and the operation speed are not available for the proposed TCW station alignment, the measurement results in Tung Chung Town Center is adopted as the vibration level source term for the groundborne noise assessment by considering the similarity as discussed above.

Building Coupling Factor (BCF)

A.1.1.1.8 The BCF represents the change in the incident ground-surface vibration:

Table A1.1 Loss factor for coupling into building foundation

Frequency	Octave Band Frequencies, Hz							
	20	25	32	40	50	63	80	100
Loss coupling factor, dB	-7	-7.5	-8	-9	-10	-11	-12	-13
Frequency	**125**	**160**	**200**	**250**	**315**	**400**	**500**	
Loss coupling factor, dB	-14	-14.5	-14.5	-14.5	-14.5	-14.5	-14.5	

Building Vibration Response (BVR)

A.1.1.1.9 The BVR is introduced to account for the floor-to-floor vibration attenuation. The corrections for resonance amplification due to floor, wall and ceiling spans for all buildings are presented in the table below. The correction adopted was the case for WIL EIA Report. A -2dB attenuation per floor is adopted for the first 5 floors. This is in line with the FTA Manual.

Table A1.2 Building amplification values to be adopted

Corrections	Octave Band Frequencies, Hz					
	20	**25**	**32**	**40**	**50**	**63**
BVR	6.0	6.0	6.0	6.0	5.8	5.6
Corrections	**80**	**100**	**125**	**160**	**200**	**250**
BVR	5.4	5.2	5.0	4.0	3.0	2.0
Corrections	**315**	**400**	**500**			
BVR	1.3	0.7	0			

Conversion To Noise (CTN)

A.1.1.1.10 A +2dB correction is assumed for conversion of vibration (re.: 10^{-6}in/sec) to noise (re.: 20μPa). This is in line with previously approved EIA report.

Turnout and Crossover Factor (TOC)

A.1.1.1.11 At points and crossings, where the wheel transitions from one rail to another, the sudden loading/unloading of the leading and trailing rails results in increased broadband vibration levels over that of plain line continuous rail. In addition, it is not possible to machine grind the rails through either the points or crossings, so surface deterioration compared with that of the placed track, is often evident.

A.1.1.1.12 The increase in vibration level at turnouts and crossings is not easily characterized. For standard level turnouts and crossings receiving average maintenance, the FTA handbook recommends a correction of 10dB. For modern inclined turnouts in good condition, where impact loads are lessened, it was found through measurement that a correction of 5dB is often more appropriate.

Safety Factor (SAF)

A.1.1.1.13 A +10 dB(A) is assumed as safety factor for conservative assessment.