

# Noise Mitigation Potential of PolyU Green Deck Proposal

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# The Green Deck

- Green Deck will cover the toll area of Cross Harbour Tunnel – an area between Hung Hom Railway station and PolyU
- **Noise trapped underneath the deck**
- **Restricted radiation -> powerful noise radiation at any opening**
- Affect PolyU, people under the deck and nearby buildings



# Objectives of Investigation

- Understand the possible acoustical effects
- Propose mitigation measures
- Acoustic modelling

# Procedure

- Site measurement to quantify the sound power from vehicles
- Rule-of-thumb estimation of acoustical effect after the completion of the Green Deck
- Detailed acoustical modelling for deriving mitigation measures. The method of ray tracing is adopted.

# Site Measurement

- Noise measurements were carried out at polyU podium areas and the roof-top of the Library and P core of PolyU.



# Site Measurement



# Site Measurement Results

Pt.	Slant Distance (m)	Date	Period	Noise Levels (dBA)		Traffic Condition		
				L <sub>A10</sub>	L <sub>Aeq</sub>	No. of Vehicles/hr	Speed (km/hr)	% Heavy Vehicle
A	23.0	18/11/13	16:42 – 17:42	75.4	73.7	9439	42	30.3
B	12.5	21/11/13	11:14 – 12:14	80.2	78.1	7900	27.8	23.0
C	12.5	13/11/13	15:57 – 16:57	78.9	76.5	7445	35	21.5
D	31.2	20/11/13	15:24 – 16:24	77.9	76.0	9120	11.1*	17.2

# Rule-of-thumb calculation & Results

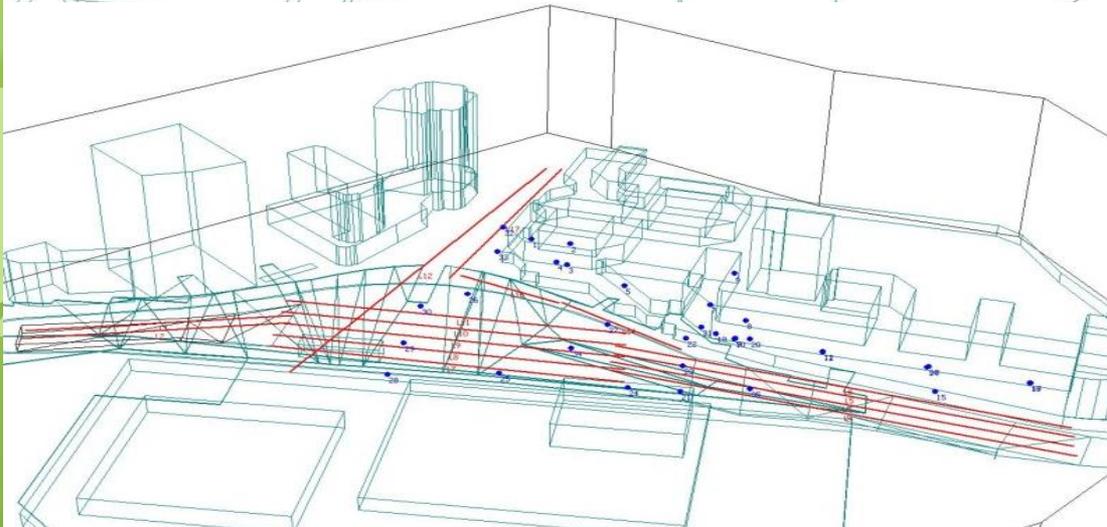
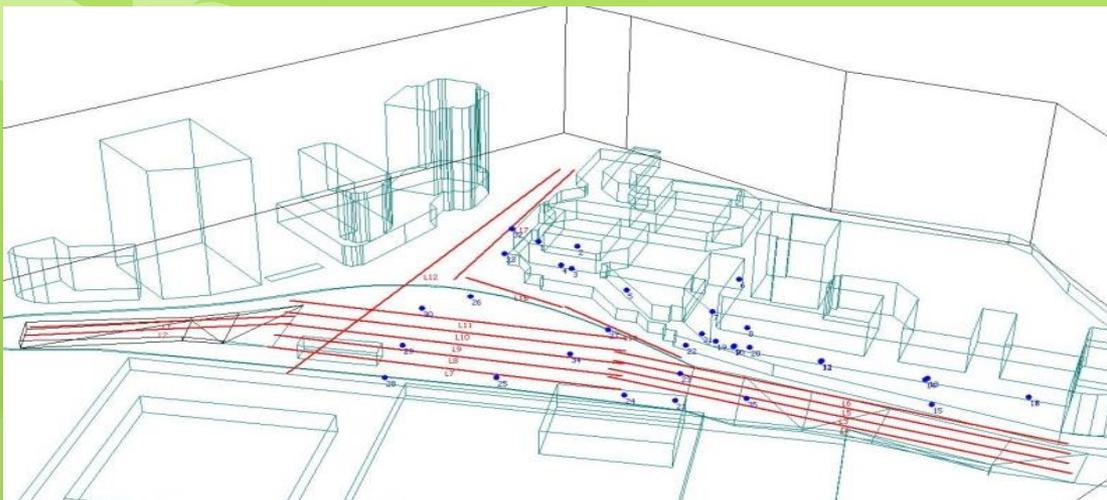
- Assume traffic is a line source
- Sound intensity  $\sim 1/\text{distance}$
- All the sound power will be radiated out through all the openings uniformly
- Sound intensity at openings in term of decibel is estimated to be **87.6** dBA.
- Average deck height is slightly higher than the podium level of PolyU, noise levels at PolyU entrance, along PQ podium (or even that of QT) and at the PolyU library façade can be **over 85** dBA **after the completion of the proposed Green Deck.**
- Noise levels at higher height levels are likely to be reduced by the proposed Green Deck

# Acoustic Modelling

- ODEON v.8 was carried out for the octave bands from 125Hz to 4kHz
- Two simulations : with and without Green Deck
- Absorption data

Surface	Material	Sound Absorption Coefficient					
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
<b>Roads, outdoors</b>	Rough concrete	0.02	0.03	0.03	0.03	0.04	0.07
<b>Windows, Curtain wall</b>	Glass, large panes of heavy plate glass	0.18	0.06	0.04	0.03	0.02	0.02
<b>External wall, PolyU tiles</b>	Marble or glazed tiles	0.01	0.01	0.01	0.01	0.02	0.02
<b>Buildings façade</b>	smooth painted concrete	0.01	0.01	0.02	0.02	0.02	0.05
<b>Poly podium ceiling</b>	smooth concrete painted or glazed	0.01	0.01	0.02	0.02	0.02	0.02

# The models



Source	Location	Sound Power (dB)
L1	At Cross Harbour Tunnel Entrance	120
L2	At Cross Harbour Tunnel Entrance	120
L3	Hong Chong Road towards Ho Man Tin	100
L4	Hong Chong Road towards Ho Man Tin	100
L5	Hong Chong Road towards Ho Man Tin	100
L6	Hong Chong Road towards Ho Man Tin	100
L7	Cross Harbour Tunnel Toll Gate Area	98
L8	Cross Harbour Tunnel Toll Gate Area	98
L9	Cross Harbour Tunnel Toll Gate Area	98
L10	Cross Harbour Tunnel Toll Gate Area	98
L11	Cross Harbour Tunnel Toll Gate Area	98
L12	Hong Chong Road towards Toll Gate	98
L14	Hong Chong Road (near lane to PolyU)	98
L15	Hong Chong Road (near lane to PolyU)	98
L16	Hong Chong Road (near lane to PolyU)	98
L17	Hong Chong Road (near lane to PolyU)	98

# Results

One can observe that there is a considerable level of noise level increase at locations on PolyU podium facing the proposed Green Deck.

The presence of the Green Deck, as it currently designed, will increase the noise levels on PolyU podium by ~ 5dBA on average : agrees with the rule-of-thumb predictions.

At location at PolyU entrance landing connecting to the footbridge (Check point #22), the noise level will increase by 8 dBA.

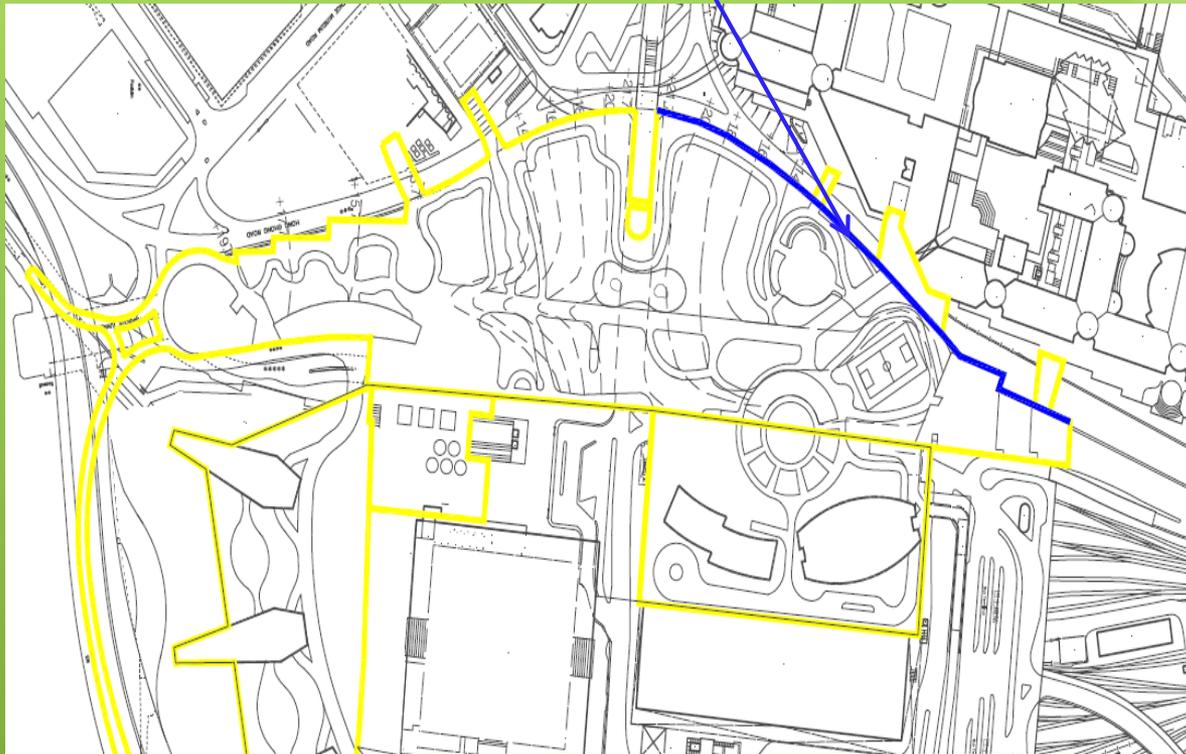
Under the Deck, the noise level increase can be above 12 dBA.

The corridor connecting PolyU and the HungHom MTR station needs careful design to shield off noise

Check Point	Location	Noise Level Increase (dB)						
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	Weighted*
1	CD podium	4.4	4.1	4.0	3.9	3.5	2.4	3.4
2	DE courtyard	5.9	5.6	5.7	5.9	5.8	5.0	5.5
3	DE podium	4.9	4.6	4.6	4.5	4.1	3.0	4.0
4	DE façade	6.3	5.8	5.7	5.5	4.8	2.7	4.8
5	Library façade	2.6	2.2	2.2	2.0	1.4	0.3	1.5
6	Library entrance	-0.3	-0.8	-0.8	-0.7	-0.8	-0.8	-1.0
7	Library	5.5	4.5	4.3	4.0	2.8	0.4	3.2
8	Lawn	3.3	2.6	2.5	2.3	1.7	0.5	1.8
9	P Podium	9.3	8.3	8.1	7.8	6.6	3.6	6.9
10	P Façade	1.4	0.8	0.7	0.5	0.0	-0.7	0.1
11	PQ podium	9.8	8.5	8.2	7.6	5.9	2.5	6.4
12	PQ façade	1.8	1.5	1.4	1.2	0.8	-0.1	0.8
13	QT podium	6.2	5.2	5.0	4.5	3.4	0.8	3.7
14	QT façade	1.5	1.2	1.1	1.0	0.7	0.3	0.6
15	QT podium	2.7	2.3	2.0	1.7	1.0	0.2	1.2
16	TU Podium	4.1	3.6	3.4	3.0	2.0	0.5	2.4
17	TU façade	1.2	0.8	0.5	0.2	0.2	0.2	0.1
19	Entrance to podium	9.8	8.5	8.2	7.7	6.0	2.7	6.5
20	P podium	9.1	8.0	7.7	7.3	5.8	2.9	6.3
21	Footbridge	13.6	12.7	12.4	12.0	10.5	6.9	10.8
22	PolyU Entrance, Bridge	10.3	9.5	9.3	9.0	7.8	5.1	8.1
23	Footbridge	10.8	9.9	9.6	9.2	7.7	4.9	8.2
24	Bus stop area	14.9	13.9	13.6	13.2	11.5	7.2	11.8
25	Bus stop area	16.1	15.1	14.9	14.4	12.7	7.9	12.9
26	Bus stop area	11.9	11.1	10.9	10.5	9.3	6.5	9.6
27	Bus stop area	10.9	10.0	9.8	9.4	7.9	4.5	8.3
28	MTR Exit D bridge	14.2	13.3	13.1	12.9	11.9	9.5	12.1
29	MTR Exit D bridge	13.6	12.6	12.3	12.1	10.8	7.7	11.1
30	MTR Exit D bridge	11.7	10.8	10.6	10.3	9.0	6.4	9.4
31	Entrance to podium, around security desk	3.3	2.5	2.4	2.2	1.7	1.0	1.8
32	Hong Tai Path	2.1	1.9	1.7	1.6	1.1	0.4	1.2
33	Hong Tai Path	4.6	4.2	4.0	3.9	3.3	1.9	3.4

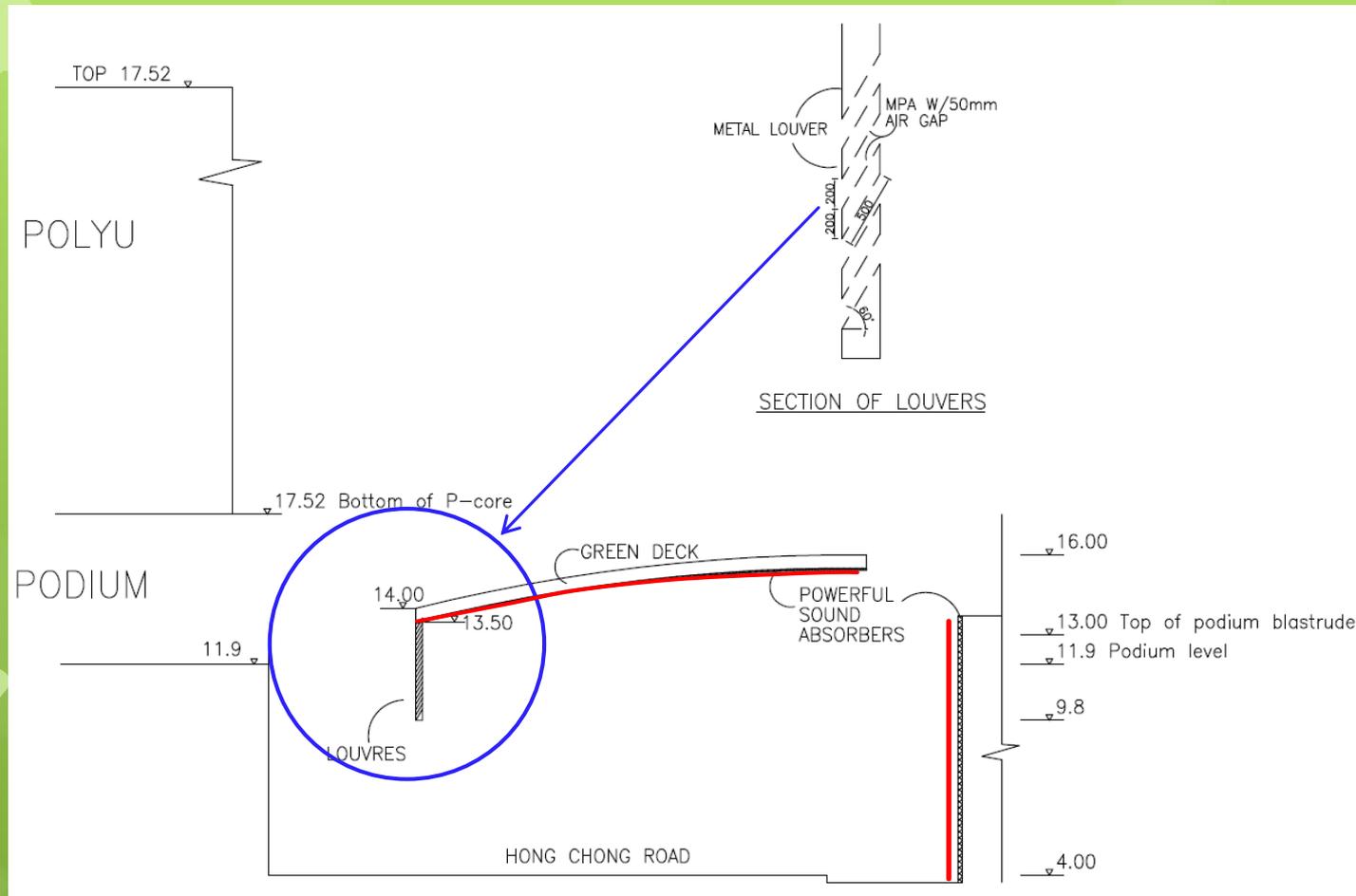
# Noise Mitigations

- Adding louvres & Micro-perforated absorbers on the edge and sound absorbers at deck bottom & on MTR wall

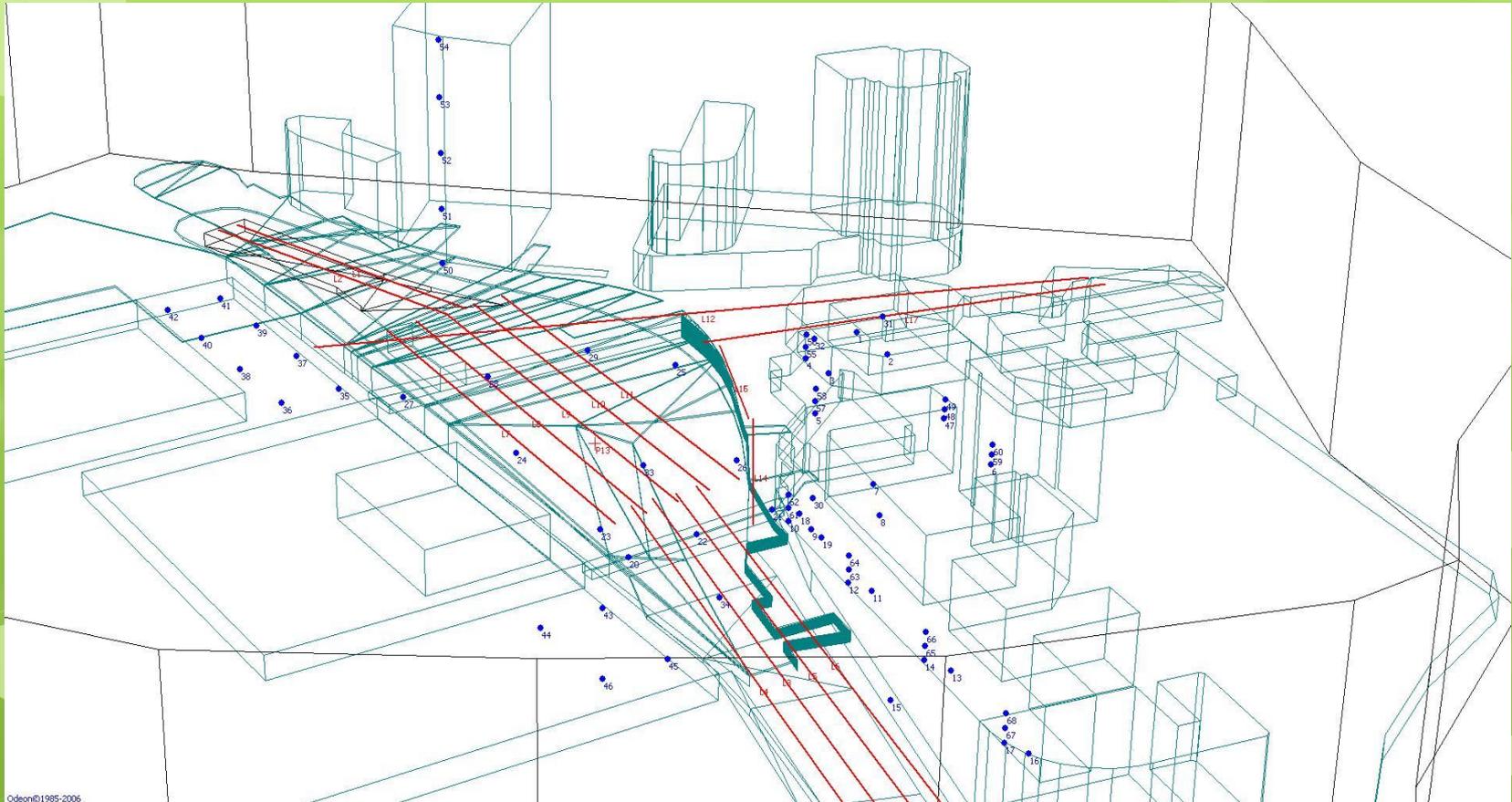


- The footbridges between Hung Hom Station Exit A and PolyU to be enclosed

# Noise Mitigations



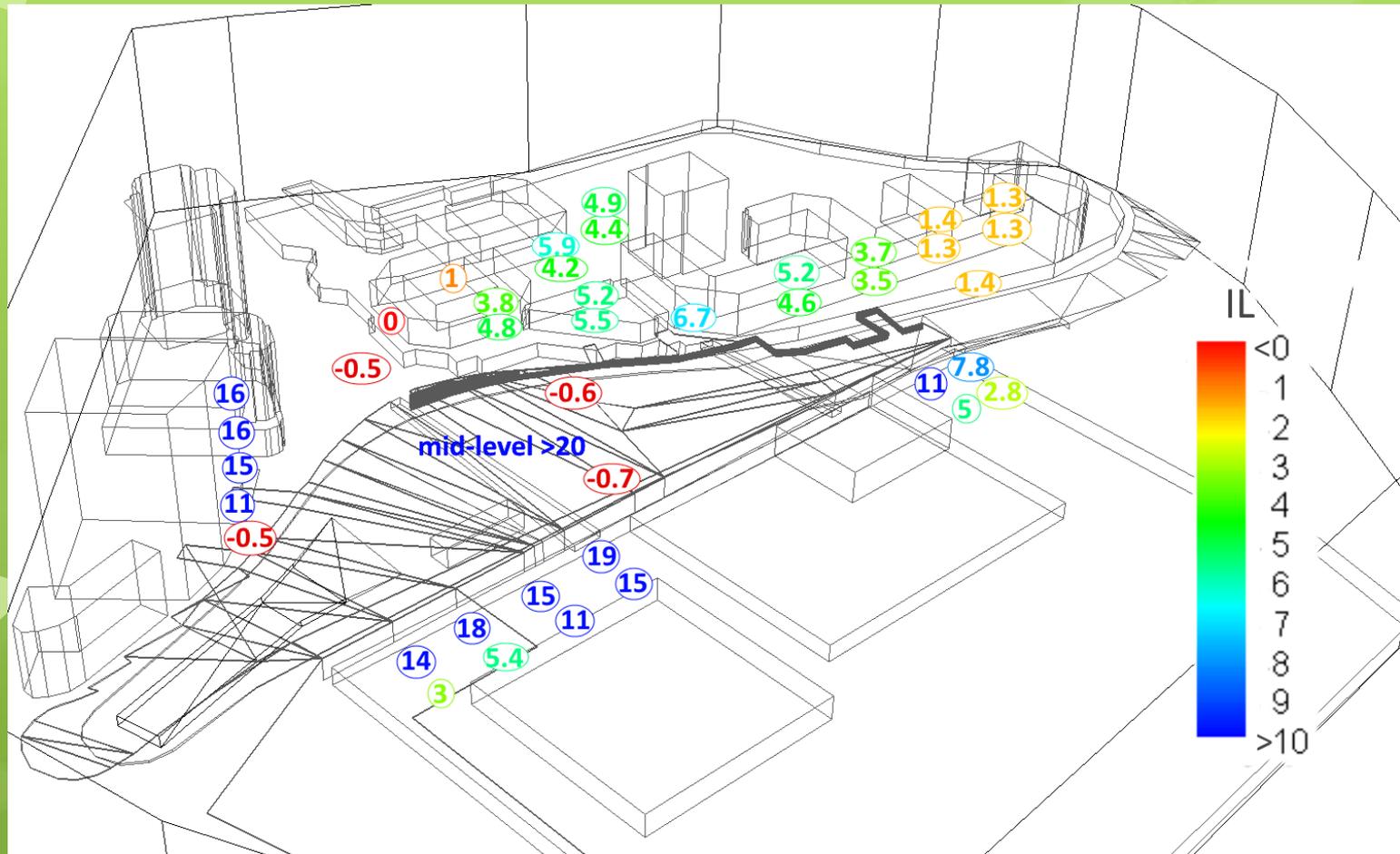
# New Model



# Material Absorption

Surface	Material	Sound Absorption Coefficient					
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
<b>Roads, outdoors</b>	Rough concrete	0.02	0.03	0.03	0.03	0.04	0.07
<b>Windows, Curtain wall</b>	Glass, large panes of heavy plate glass	0.18	0.06	0.04	0.03	0.02	0.02
<b>External wall, PolyU tiles</b>	Marble or glazed tiles	0.01	0.01	0.01	0.01	0.02	0.02
<b>Buildings façade</b>	smooth painted concrete	0.01	0.01	0.02	0.02	0.02	0.05
<b>Poly podium ceiling</b>	smooth concrete painted or glazed	0.01	0.01	0.02	0.02	0.02	0.02
<b>Micro-perforated panel absorbers (MPA)</b>	Micro-perforated member mounted with 50mm air gap with attaching surface	0.00	0.05	0.15	0.50	0.60	0.40
<b>Fibreglass, 2-inches thick</b>	2 inches thick 48kg/m <sup>2</sup> fibreglass blanket without backing	0.17	0.86	1.00	1.00	1.00	0.98

# Change in noise level after completion of Green Deck



# Summary of Results

- Lourves & MPAs are added along the deck facing PolyU
- Strong sound absorbers are needed to be installed at the deck bottom and Hung Hom Station external wall
- Bridges linking PolyU & Hung Hom station should be enclosed, thus noise is shielded off, and the users are protected.
- Compared to the “No Deck” results, the proposed measure will result in at least 1.5 - 2dBA noise reduction at locations in PolyU,
- Those under the Deck nearly unchanged.
- Noise reductions at locations at higher height level of PolyU and Hotel ICON and the open area of the Hong Kong Coliseum are between 5 to ~20 dBA.