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The Effectiveness of Noise Barrier on Reduction of Traffic Noise at Middle Ring Road II (MRR2) Kuala Lumpur

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ENVIRONMENT AND ENERGY EFFICIENCY BRANCH

PWD

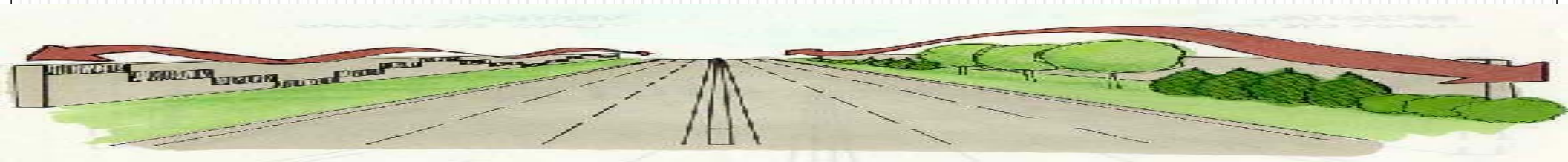
OUTLINE

- Introduction
- Background of the Study
- Objectives of the Study
- Study Methodology
- Results & Discussion
- Conclusions & Recommendations

INTRODUCTION

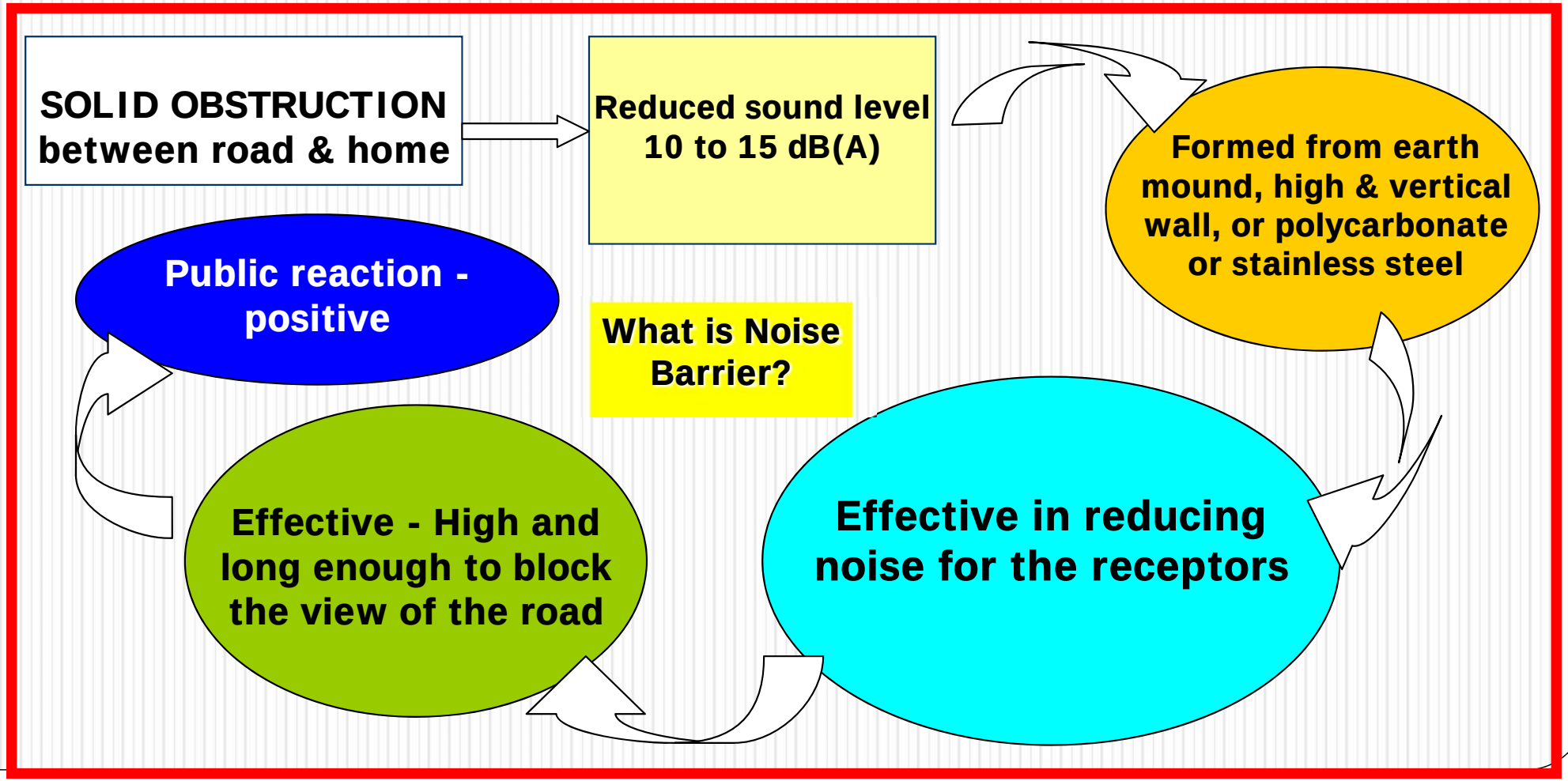
Traffic and Vehicle Noise

- **Vehicle noise is a *combination* of the noise produced by the *engine, exhaust, and tires***
- ***Reduced by distance, terrain, vegetation*, and natural or manmade *obstacles*.**
- **The noise level increased by *heavier traffic* volumes, *higher speeds*, and greater numbers of heavy vehicles.**



INTRODUCTION

Traffic Noise Barrier



BACKGROUND OF THE STUDY

- From **Malaysian Road Transport Dept.** – The number of registered vehicles was ***28.2 million (2017),*** an average increase of 1.2 million since 2010
- ***Caused major noise pollution*** problems to city dwellers – area becoming not suitable to reside in
- ***Only few studies*** - noise is not a quite major public concern in Malaysia.
- ***Awareness is still low*** compared to others developed countries –United States and the European Countries.

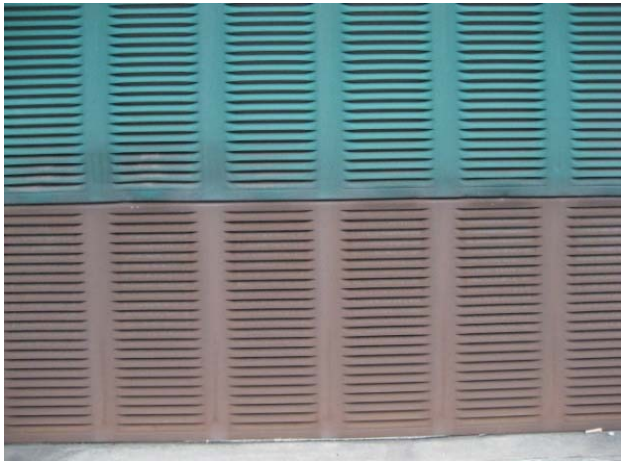
OBJECTIVE OF THE STUDY

- To **determine the effectiveness of noise barrier** in reducing urban highway traffic noise complying with the existing legislation;
- To **determine public perception** on the effectiveness of the noise barrier used

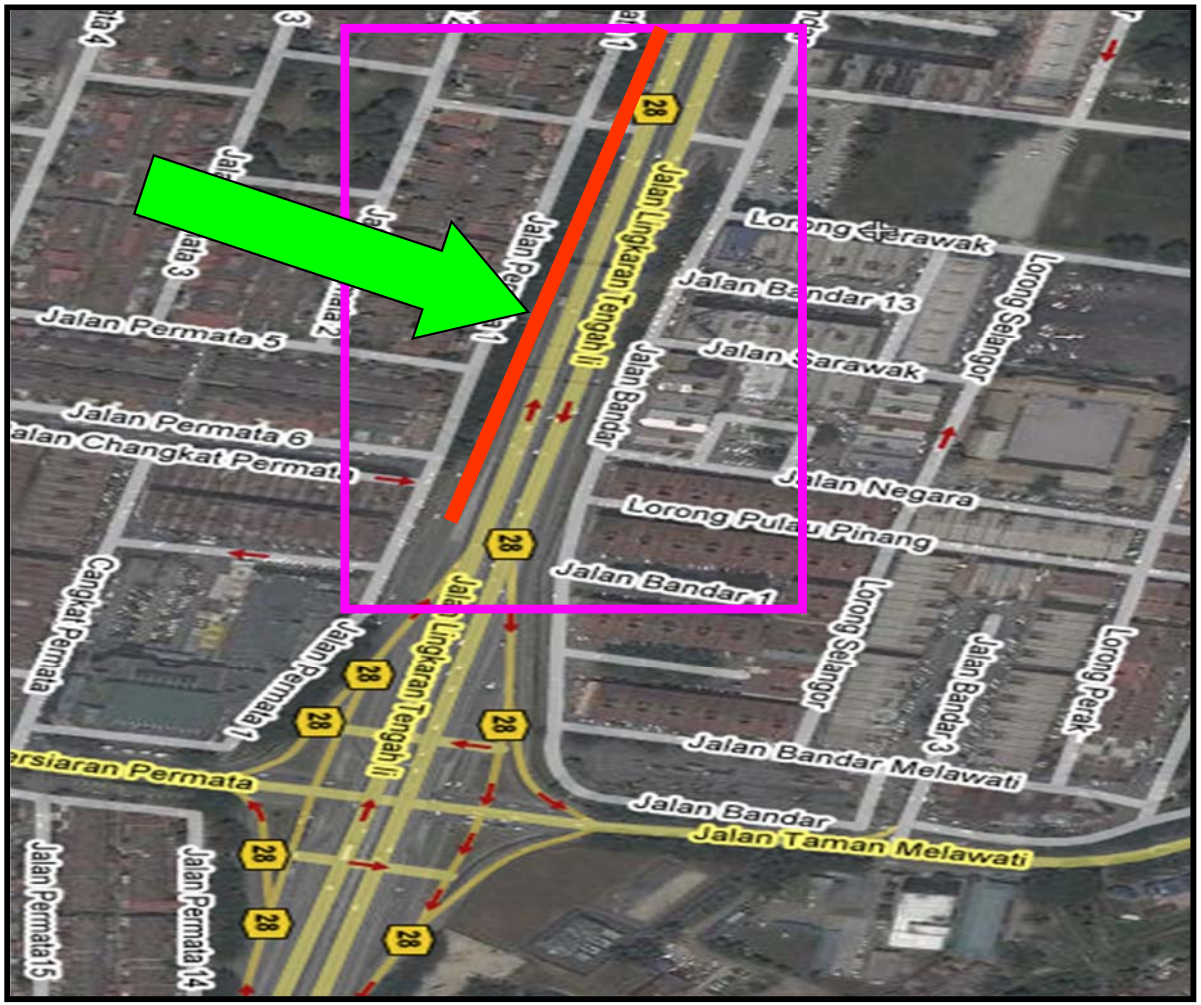


Research Methodology

Pandan Perdana



Taman Permata



Sek. Keb. Cheras Indah

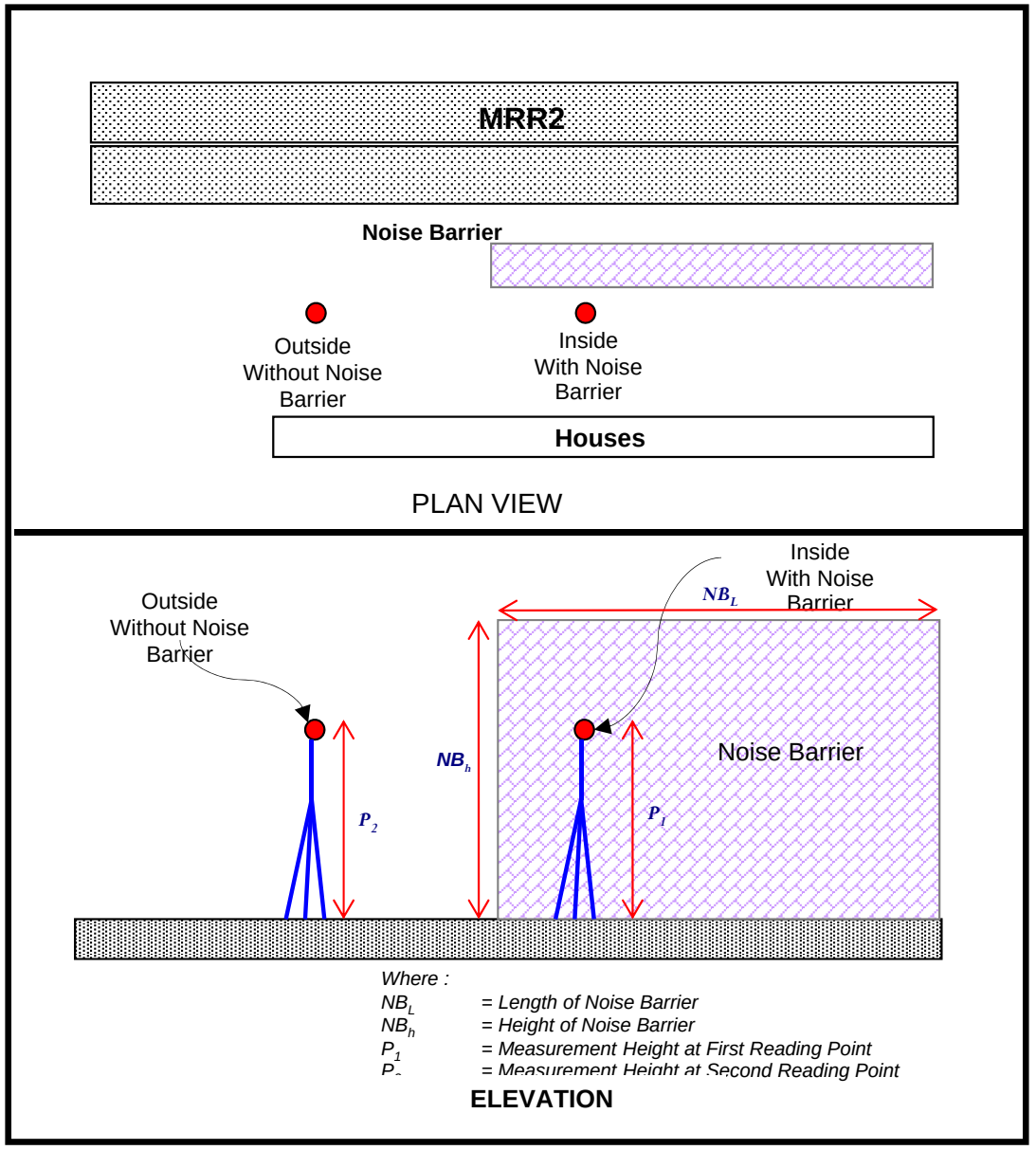
Noise Level Monitoring Configuration

Conducted **three days in the week** :

- The early week - Monday,
- The mid-week - Wednesday; and
- The weekend - Saturday.

Conducted at **four (4) time periods**:

- Morning : 7.30 a.m. – 8.30 a.m.
- Afternoon : 1.00 p.m. – 2.00 p.m.
- Evening : 5.30 p.m. – 6.30 p.m.
- Midnight : 12.00 a.m. – 1.00 a.m.



Noise Level Meter

Questionnaire Survey

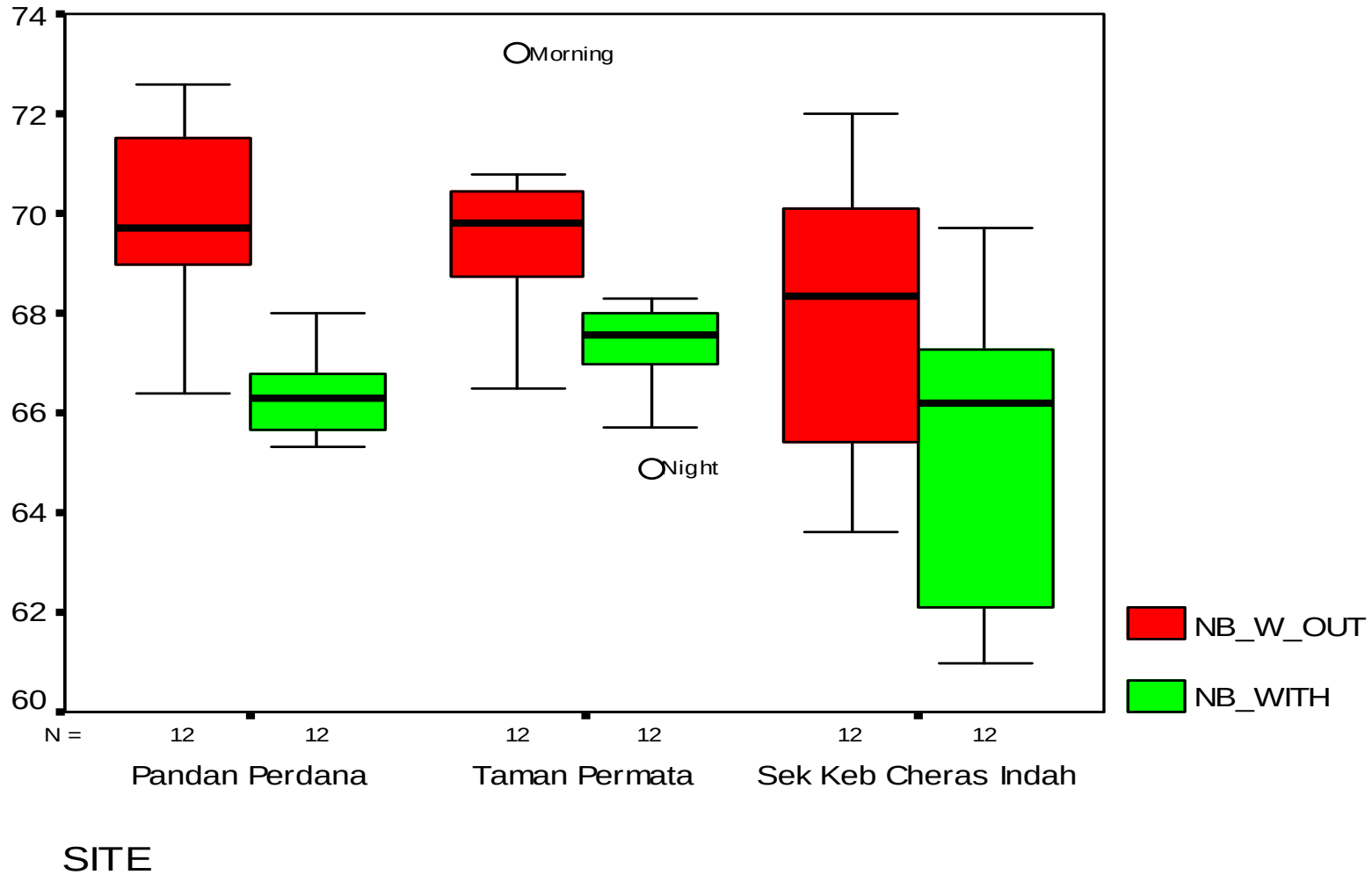
Several studies (Roslan Md. Taha 1999, Sumiani Yusof & Asila Ishak 2005, N.Mansouri et.al 2006, Öhrström et.al 2006) – had employed the questionnaire method to ***evaluate how the public perceive traffic noise and the effect on their health***.

This study however proposed to ask how the local residents ***perceive the effectiveness of the noise barrier***. The questionnaire used was divided in two parts:

- **PART A** : Demographic Information of the Residents
- **PART B** : Questions on the effectiveness of Traffic Noise Barrier

Results & Discussion

Comparison of Noise Level Measurement



T-test Results

- One-sample T-test - to ***compare average noise level*** with the use of noise barrier for the three sites with the existing recommended requirements → **65 dB(A) for day-time & 60 dB(A) for night-time**
  - For Pandan Perdana & Taman Permata:
    - ***The study hypothesis is accepted*** - noise barrier is effective in reducing the traffic noise to less than or equal to 65 dB(A) for day-time and to 60 dB(A) for night-time.
  - For SK Cheras Indah:
    - ***The study hypothesis rejected*** - results were not significant at $p=0.763 > 0.05$ and $p=1.08 > 0.05$ respectively for day-time and night-time
- **Conclusion - Noise barrier in SK Cheras Indah is not effective in reducing the road traffic noise to 65 dB(A) - day time and to 60 dB(A) - night-time.**

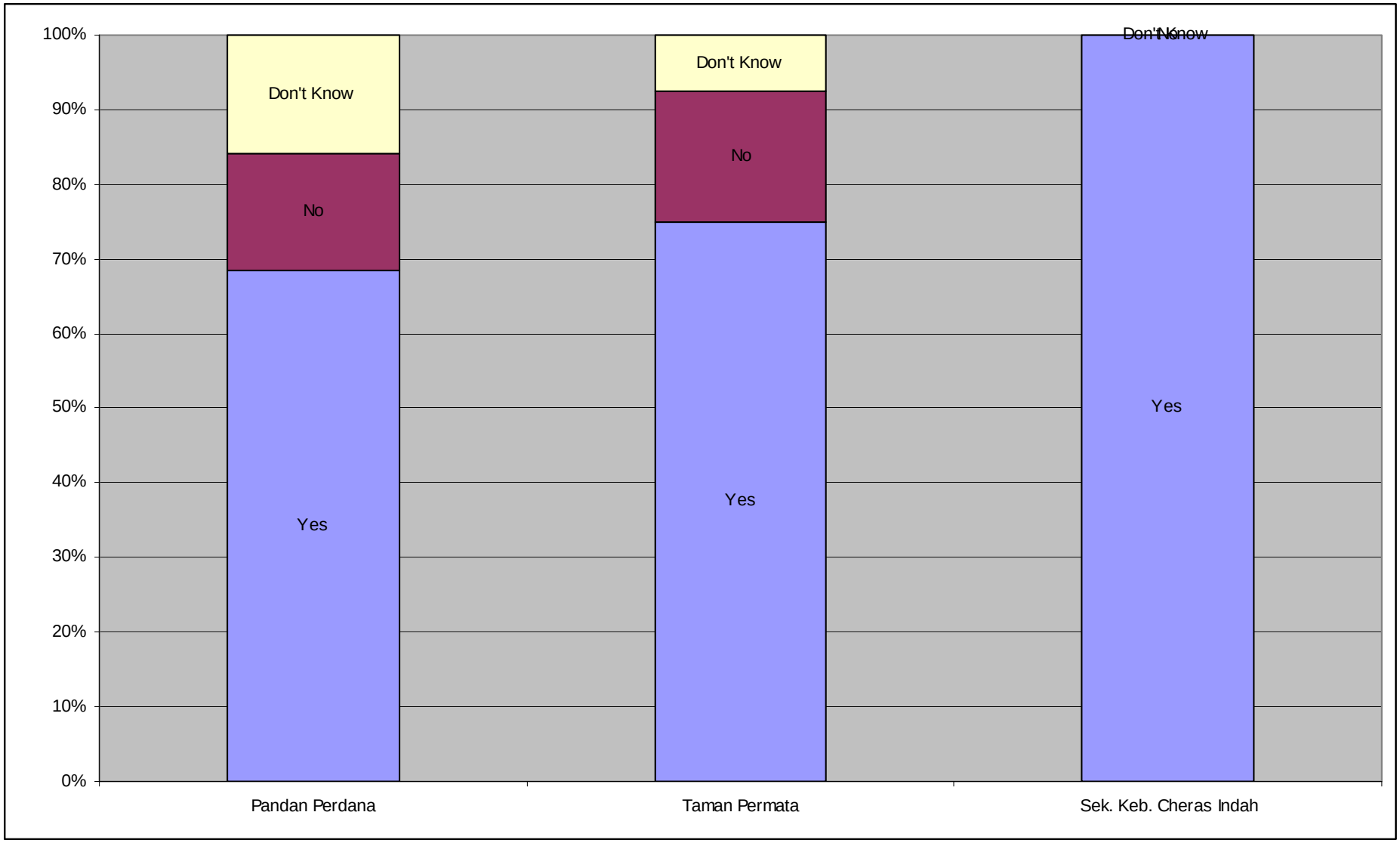
Paired T-test Results

- A paired-samples t-test was conducted to ***evaluate the impact of the noise barrier on the average noise level for the three sites***
- There is a significant difference at 95% confidence level with $p=0.000 < 0.05$ for three study sites.
- **Conclusion** - Null hypothesis is rejected but the study hypothesis accepted that **noise barrier in the three sites is effective in reducing traffic noise both during day-time and night-time**

ANOVA Results

- One-way between-groups ANOVA with planned comparisons - ***determine the most effective noise barrier*** in reducing traffic noise between the three sites
- The average noise level measured was analyzed - statistically significant difference at $p<0.05$ for the three sites [$F=3.48$, $p=0.043$].
- **Indication - Noise barrier used in Taman Permata [$F=3.48$, $p=0.043<0.05$) better than noise barrier in Pandan Perdana & SK Cheras Indah**

Respondents' Responses on Traffic Noise Reduction Using Noise Barrier



Impact of Respondents' Gender and Age

- Factorial ANOVA - two-way between-group ANOVA - to determine the impact of respondents' age and gender on the various questions in the questionnaire.

- **SK Cheras Indah** - Significant effect of ***gender***

  >> **Traffic noise conditions**

- **Pandan Perdana** - Significant interaction effect of ***age group and gender***

  >> **Agreement of local authority to seek the resident's consent**

- **Taman Permata** - Significant interaction effect of both ***age group and gender***

  >> **Agreement of local authority to seek the resident's consent**

DISCUSSION

- Residents - Pandan Perdana and Taman Permata, and also teachers in SK Cheras Indah - exposed to average - ***68.7 dB(A), 69 dB(A)*** *and* ***70 dB(A)*** respectively - **higher than 65dB(A) !!!**

- A similar study by Sumiani Yusof and Asila Ishak (2007) - Damansara Puchong Expressway (LDP) found that the urban residents along LDP were exposed to noise levels exceeding the legislation.

- Belojevic et.al (2008) introduced a term ***'black acoustical zone'*** to people living in an area with equivalent noise level exceeding 65 dB(A).

- In the same context, the three selected sites can be categorized to be in the black acoustical zones.

DISCUSSION

- Surveys - (Li et.al 2015, Ali and Tamura 2012, McNulty 1987) - ***most urban cities (e.g. China, Egypt, Singapore, Tehran) faced with traffic noise higher than the country's legal limits.***

- The results from Tyagi et.al (2006) - ***vegetation belts*** could be used as ***effective barriers*** for traffic noise control - which is the case in Taman Permata which has been proven to be the most effective noise barrier in reducing the traffic noise among the three sites.

- Sumiani Yusof and Asila Ishak (2007) - roadside vegetation acts as a '***psychological relief***'.

- However the **current study has proved that vegetation belts play a vital role in reducing traffic noise in combination with the artificial noise barrier.**

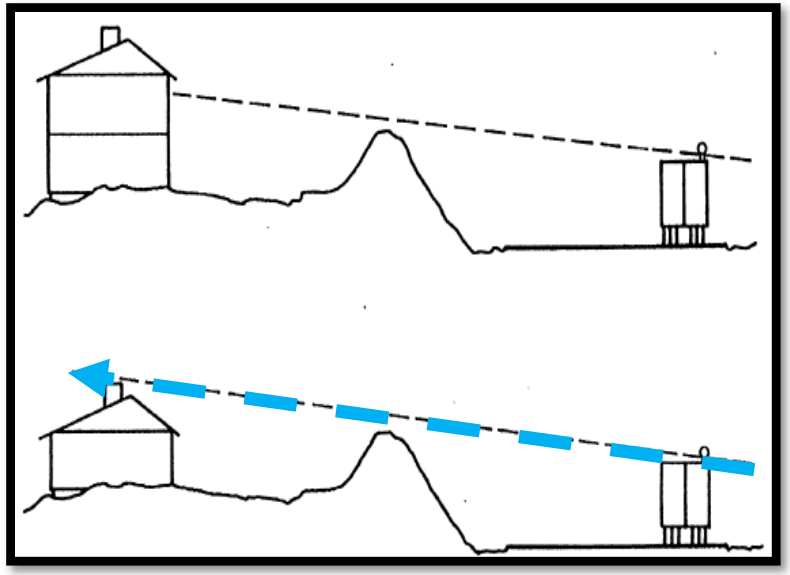
CONCLUSIONS & RECOMMENDATIONS

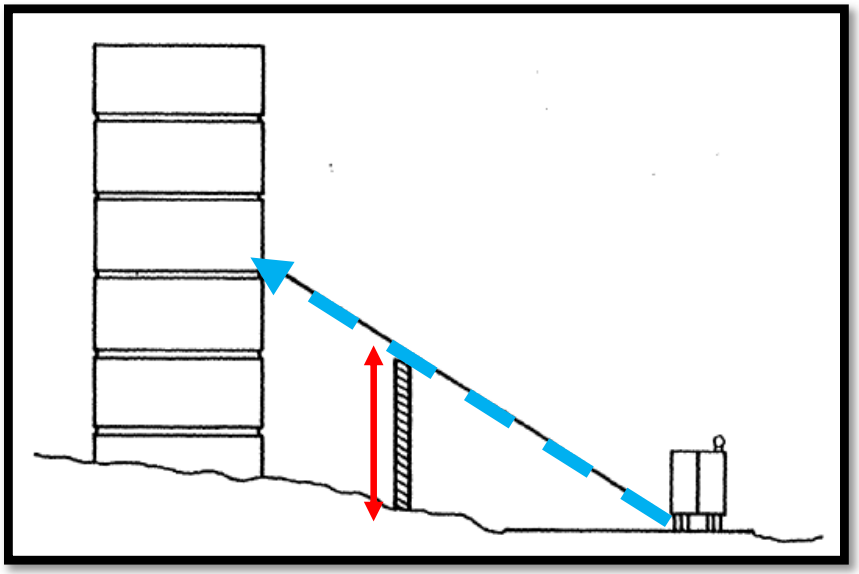
CONCLUSIONS

- ***Noise barrier is effective*** in reducing the traffic noise
- Further analysis - the noise barrier - Pandan Perdana & Taman Permata is effective in reducing the traffic noise to less than or equal to 65 dB(A) for day-time and to 60 dB(A) for night-time
- By comparison - The noise ***barrier in Taman Permata*** which is a combination of aluminum and 3-m wide green belts was ***the most effective*** in traffic noise reduction.
- ***Public perceived that noise barrier is effective*** in reducing traffic noise & agreed with the use of noise barrier in reducing the traffic noise.

RECOMMENDATIONS

- **Improvement of Design**
  - Height (H) of the barrier to be increased

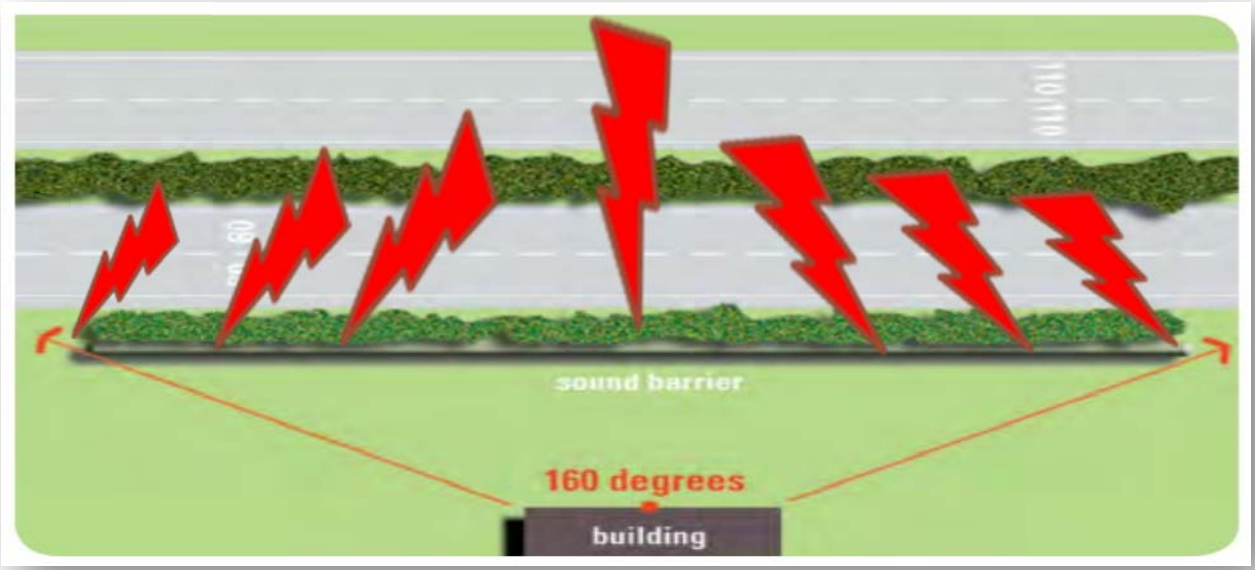




  - The H of the barrier needs to be increased ***to block the lines of sight*** of the noise, this may be the case for SK Cheras Indah as the school blocks are 4-storeys building – to increase H

RECOMMENDATIONS

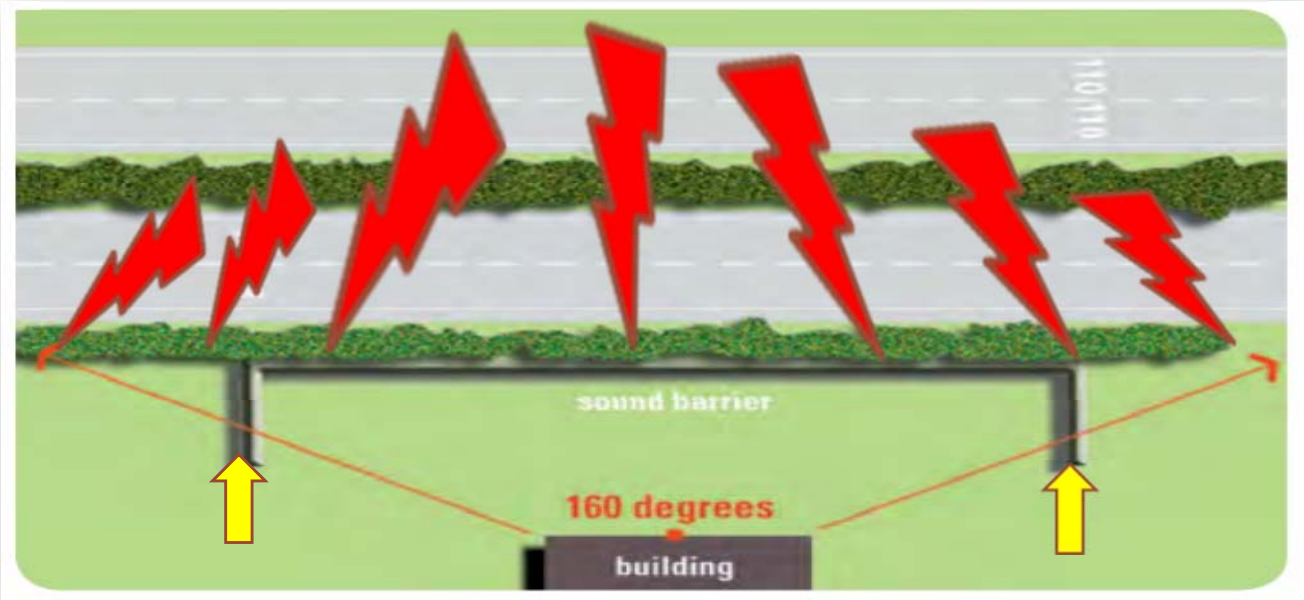
- **Improvement of Design**
  - Sufficient length



- Noise barriers ***must be continuous*** to have a mitigating effect, since sound will still travel to the listener unimpeded, albeit from a distance.
- The generally accepted approach is that the barrier should extend to cover an angle of ***160 degrees*** from the receiver

RECOMMENDATIONS

- **Improvement of Design**
  - Sufficient length



- Where there is insufficient space to construct a barrier long enough [to provide attenuation] the effect can be enhanced by ***returning the ends of the walls***

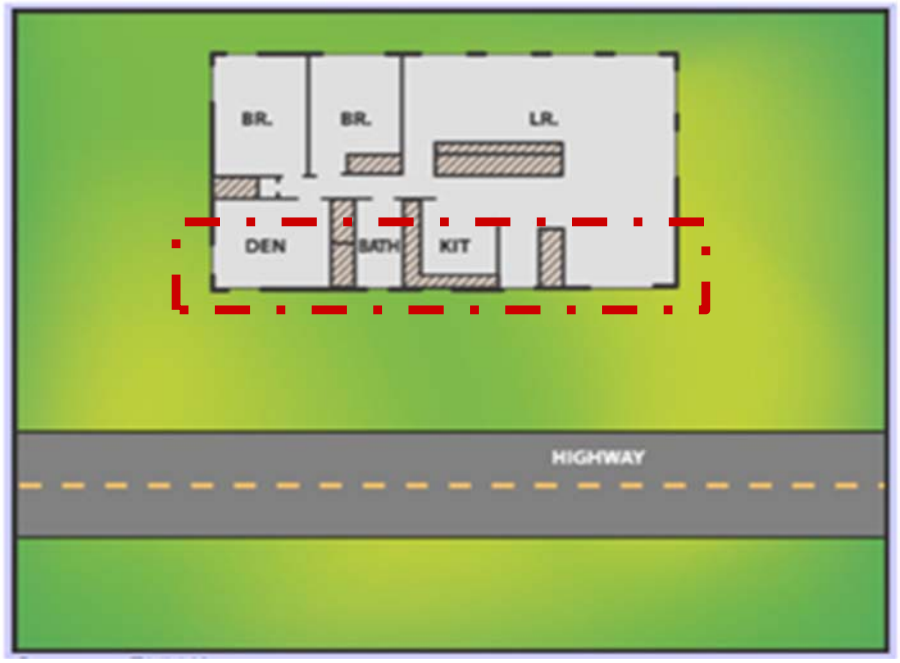
RECOMMENDATIONS

- **Strategic Land-use Planning**
  - ***Zoning*: controlling development, such as *preventing noise-sensitive land-uses*** (e.g. residential buildings, hospitals) near to a highway
  - ***A buffer area*** for non noise sensitive use ***between the two zones*** can reduce noise impact to the residents arising from the traffic or industrial operation. E.g. Approach taken by Government of Hong Kong

RECOMMENDATIONS

- **Strategic Land-use Planning**
  - Residents, planners, and developers must work cooperatively in addressing the problem – design concept element

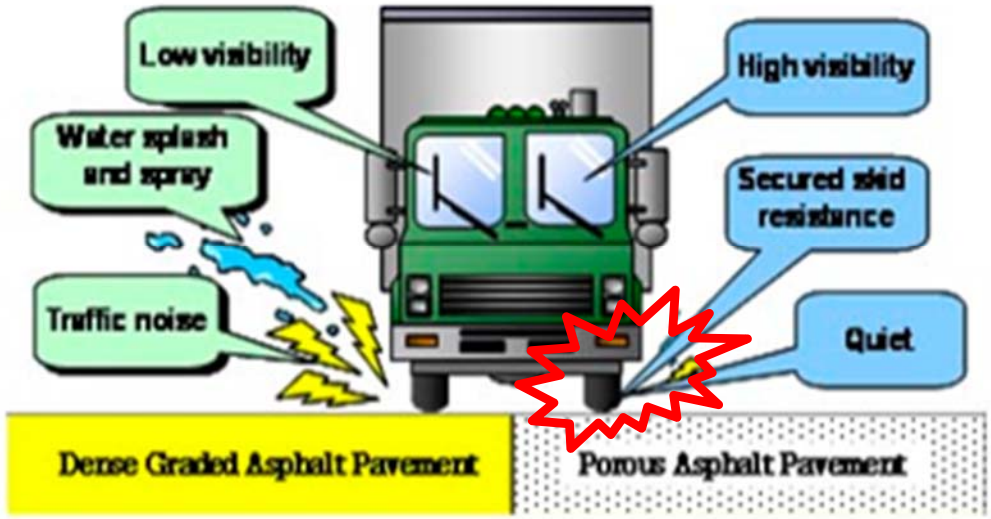
Garage can **shield residential areas from highway**



Place less noise-sensitive rooms, closest to the highway

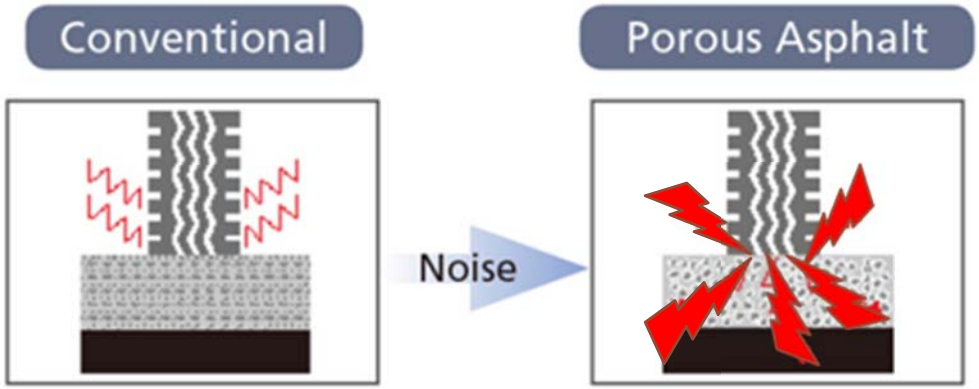
RECOMMENDATIONS

- **Road Geometrics and Pavement Design**
  - Should not be any ramp – particular (sensitive) area
  - Low-noise road surfaces - The most effective road surfaces for reducing traffic noise pollution are **porous asphalt** (Murphy and King, 2014) which **can reduce noise from vehicles by 3 dB** (Gibbs et al., 2005)
  - Euro. countries have shown that **porous mixes can effectively reduce noise.** E.g. Netherlands where it is used on at least 60% of roads.



RECOMMENDATIONS

- **Road Geometrics and Pavement Design**
  - The voids in porous asphalt **absorb roadway noise.**
  - Improving driving comfort and driver confidence
    - By reducing roadway spray on rainy days, porous asphalt ensures **better roadway visibility, and reduces headlight glare**.
    - Reduces roadway noise inside the vehicle.
  - **Enhance Durability (will sustain more !!!)**
    - Due to high viscosity materials, porous asphalt provides **improved aggregate bonding**, resulting in a 50% **lower rate of rutting and a longer lifespan** than conventional pavement.



Recommendations

- **Aesthetic Improvement and Maintenance of Noise Barriers**
  - Psychologically give a better feeling to the residents that exposed to a readily hectic environment

Noise barrier dominating the landscape

Noise barrier blending with the landscape

Noise barrier blending with the landscape

Recommendations

- **Properly maintained** noise barrier may improve the barrier performance and extend its lifespan

- **Provision of Green-belts**
  - Effectiveness can be increased in combination with artificial noise barriers
  - However, unless there is a substantial width of vegetation the benefit is generally psychological – ***if you can't see the traffic it reduces the perception of noise – but does not reduce measured noise levels.***

Barrier with simple planting

Barrier blends into the immediate environs

Thank You