UNTAR
Universitas Tarumanagara

TICATE

CERTIFICATE

OF APPRECIATION

This certificate is proudly presented to

Heru Budi Kusuma, S.Sn., M.Ds.

For the contribution as **Presenter**, with the title:

Noise Level Study of the National Museum of Indenesia, Central Jakarta

Tarumanagara International Conference on the Applications of Technology and Engineering (TICATE) 2024
"Sustainable Communities: ***Bridging Energy Efficiency and Environmental Stewardship for Achieving SDGs***"

Jakarta, October 23th, 2024

UNIVERSITAS TARUMANAGARA
KETUA LEMBAGA PENELITIAN DAN PKM

Assoc. Prof. Ir. Jap Tji Beng, MMSI., M.Psi., Ph.D., P.E., M.ASCE
Director of Institute for Research and Community Engagement.

TICATE

Assoc. Prof. Dr. Miharni Tjokrosaputro, S.E., M.M.
Chairperson TICATE 2024

UNTAR
Universitas Tarumanagara

TICATE

UNTAR untuk INDONESIA

NOISE LEVEL STUDY OF THE NATIONAL MUSEUM OF INDONESIA, CENTRAL JAKARTA

Heru Budi Kusuma
Angel Avrilia Lisni
Sharlene

FAKULTAS SENI RUPA DAN DESAIN
UNIVERSITAS TARUMANAGARA

INTRODUCTION

- According to **ISO (International Organization for Standardization)**, noise is defined as **a sound that interferes human or animal activities**.
- According to research, comfortable noise levels are in the range of **40 to 60 dB**. Above **70 dB**, individuals begin to feel discomfort, and at **85 dB**, the risk of hearing damage increases. In the context of a museum, it is important to keep noise levels below these comfort limits.
- Noise in museum environments can be caused by several factors. **First, high visitor numbers** can cause significant sound spikes. **Second**, **building materials that do not support acoustics** can worsen the noise. **Third, additional activities such as interactive exhibitions and audiovisual presentations** can increase noise levels.
- Noise levels at the National Museum of Indonesia, Central Jakarta, are an important issue that **must be considered for the comfort of visitors and the protection of the exhibited collections**.

LITERATURE REVIEW

- **Mayer's Cognitive Theory** explains that **every individual has different information processing channels for audio and visual information**, and each channel processes limited information at one time. Cognitive Load can only be reduced if the presentation of information is well designed, in accordance with the individual's cognitive processing habits, and reduces unnecessary or ineffective cognitive processing (Murwonugroho et al., 2023).
- **Noise level measurement (noise mapping)** is to determine the noise distribution pattern of an area based on the measured **Sound Pressure Level (SLP)**. By placing a sound source in the form of an active speaker that emits sound with a predetermined frequency, and the location of the sound source placed on the stage and measuring the SLP **every 3 meters** in the building hall, with the aim of being able to produce a more detailed noise graph changes and anticipate the accuracy of the sound level meter (Ramadhan et al., 2017).
- **Comfort in acoustics** is a comfortable atmosphere that is felt by someone in their hearing sensation, where **someone can clearly hear sounds without experiencing interference from other sounds**. The sounds heard are free from unwanted sounds and free from acoustic defects such as noise, hum, excessive echo and others (Sirait et al., 2019).

METHODS

The research method used is a qualitative research method in an area which includes the **permanent exhibition room on the 2nd floor of building B (Arca Building)** of the National Museum of Indonesia, Jakarta.

Method includes:

1. **Measurement with sampled points** with the Story Line of Information Technology, Economy, and Transportation.
2. **Measurement with Grid** is by making a sample of noise data at the desired location with distance intervals.
3. **Input data and data** processing with a logarithmic formula to obtain the magnitude of sound intensity per measurement point.
4. **The measurement results are made into a color code to describe the noise conditions**,

- Green = noise level below 80 dBA
- Orange = noise level above 90 dBA
- Yellow = noise level between 80 - 90 dBA.

The **research instruments** that will be used are:

- Manual Sound Level Meter
- Infra Red Length Meter
- Measuring tool
- Table to record the datas

RESEARCH RESULTS

Identification of noise sources in the 2nd floor exhibition room of the National Museum, are namely from:

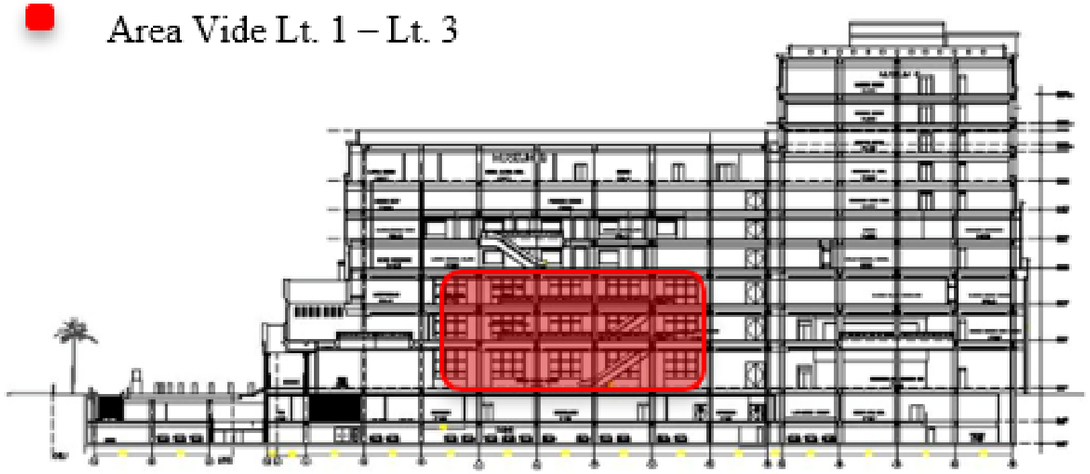
1. **Sound from the LCD TV on the 1st floor** that propagates vertically through the void atrium that connects from the 1st to the 3rd floor.
2. **Sound from the LCD TV** at the entrance on the 2nd floor that propagates horizontally throughout the room.
3. **Human voices or visitors** at the exhibition space on the 2nd floor.

No	Information	Theoritical Mean (μ)	Percentage (%)
1	Frequency of visits to the National Museum	2,53	50,55%
2	Frequency of visits to the Domestic Museum	2,43	49,51%
3	Frequency of visits to the Foreign Affairs Museum	1,70	33,96%
4	General Conditions of the National Museum	2,90	58,02%
5	Interest in Exhibition Collections	3,47	69,40%
6	Collection density at Showroom	2,82	56,43%
7	Collection density in the Exhibition Room	2,35	47,03%
8	General Collection Arrangement	2,47	49,34%
9	Exhibition Room Atmosphere	2,41	48,30%
10	Collection Care and Cleanliness	2,96	59,22%
11	Exterior Lighting	2,56	51,15%
12	Color	2,48	49,53%
13	Graphic Placement	2,86	57,24%
14	Collection label information	2,48	49,60%
15	Directions Information	2,45	49,01%
16	Vitrin Form	2,57	51,35%
17	Vitrines and Collection Sizes	2,50	50,00%
18	Arranging collections in Vitrin	2,50	50,00%
19	Interior Lighting	2,51	50,10&
20	Audio-Visual Presentation	2,45	48,98%
	Average	2,44	48,79%
	Mean Analisis	64,28	64,28%

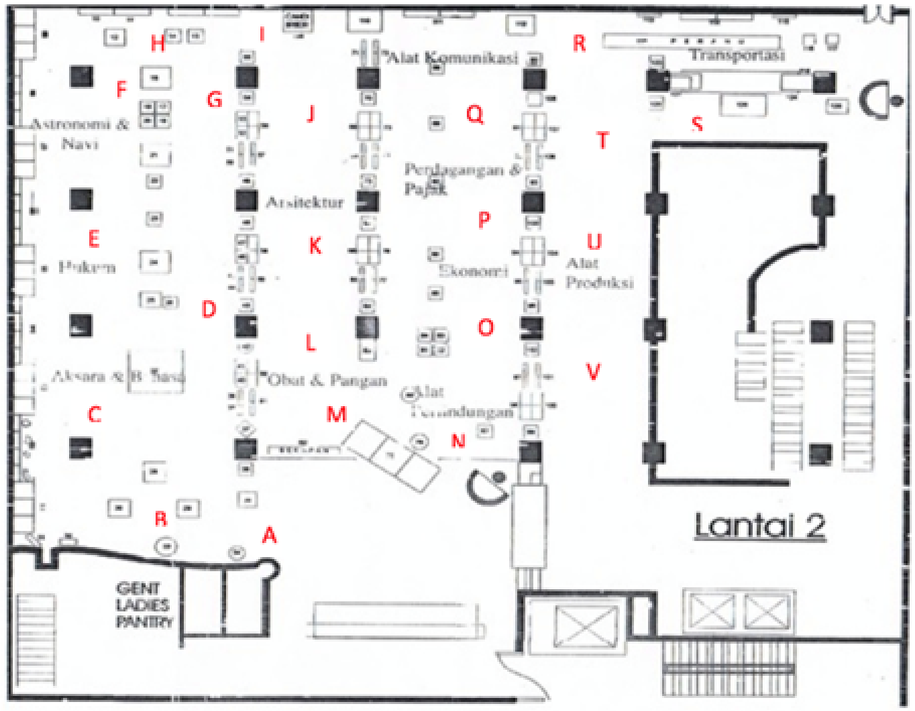
Table 1 Internal Research Results of the National Museum of Indonesia (Mardiana, 2013

RESEARCH RESULTS

The atmosphere of the exhibition space is **influenced by sound that experiences various events such as reflection, diffusion, absorption, diffraction, and refraction**. To achieve optimal acoustic conditions, there are several main factors, such as the use of material. **Materials have certain characteristics or properties, for example, there are materials that reflect and there are also materials that absorb** (Kho, 2014).



The exhibition space facilities on the **1st floor have an LED TV as a multimedia facility that provides information about humans and culture on the 1st floor right in the void** so that the sound can be heard up to the 3rd floor.



RESEARCH RESULTS

Data collection was conducted in the permanent exhibition room on the 2nd floor of Building B. The measurement points were mapped into 22 measurement points, marked with letters A to V. **One measurement point was taken 3 times to determine the average noise level at one point, which was taken as the lowest and highest numbers.** Measurement data was calculated using these formula:

Ls 1-22 = 10 Log 1/6 (10 0,1xL1+10 0,1xL2+…+10 0,1xL6)

Lsm = 10 Log 1/22 (22 x 10 0,1 x Ls1 x Ls2 x … x Ls 22)

As a conclusion from the measurement results at the 22 points, **all measurement points of noise levels were still above the recommended sound level, which was in the range of 45 dBA to 55 dBA.** Measurement point J (architectural collection) was the measurement point with the lowest average, which was 59.11 dBA.

No	Data Collection Area	Kode	Time	Sound Source	Distance	1st 3 minutes	2nd 3 minutes	3rd 3 minutes
1	Entrance Area	A	10:36-10:46	1st Floor LED TV	13 meters	62dBA-67dBA	62dBA-70dBA	65dBA-81dBA
2	Hall Area	B	10:39-10:49	2nd Floor LED TV	7 meters	56dBA-67dBA	58dBA-61dBA	58dBA-61dBA
3	Menhir Area	C	10:42-10:52	2nd Floor LED TV + People	17 meters	58dBA-72dBA	58dBA-64dBA	58dBA-61dBA
4	Area of Literacy and Language	D	10:45-10:55	2nd Floor LED TV + People	6 meters	57dBA-65dBA	58dBA-64dBA	57dBA-63dBA
5	Law	E	10:48-10:58	2nd Floor LED TV	4 meters	61dBA-65dBA	56dBA-63dBA	57dBA-59dBA
6	Astronomy and Navigation	F	10:51-11:01	People	2 meters	55dBA-60dBA	58dBA-61dBA	58dBA-62dBA
7	Astronomy and Navigation	G	10:54-11:04	People	2 meters	53dBA-59dBA	58dBA-63dBA	58dBA-64dBA
8	Astronomy and Navigation	H	10:57-11:07	People	2 meters	56dBA-60dBA	58dBA-63dBA	52dBA-62dBA
9	Architecture	I	11:00-11:10	People	2 meters	58dBA-62dBA	58dBA-64dBA	56dBA-61dBA
10	Architecture	J	11:03-11:13	People	2 meters	56dBA-61dBA	54dBA-62dBA	55dBA-64dBA
11	Architecture	K	11:06-11:16	People	2 meters	55dBA-62dBA	56dBA-61dBA	60dBA-65dBA
12	Medicine and Food	L	11:09-11:19	People	1 meter	54dBA-60dBA	56dBA-63dBA	57dBA-72dBA
13	Medicine and Food	M	11:12-11:22	People	1 meter	56dBA-66dBA	60dBA-65dBA	59dBA-70dBA
14	Protection Tools	N	11:15-11:25	People	1 meter	63dBA-70dBA	60dBA-71dBA	59dBA-70dBA
15	Economy	O	11:15-11:25	People	1 meter	63dBA-70dBA	60dBA-71dBA	59dBA-70dBA
16	Trade and Taxes	P	11:18-11:28	People	1 meter	53dBA-65dBA	57dBA-67dBA	59dBA-61dBA
17	Communication Tools	Q	11:21-11:31	People + Speaker	5 meters	57dBA-61dBA	58dBA-81dBA	73dBA-81dBA
18	Communication Tools	R	11:24-11:34	People + Speaker	3 meters	64dBA-73dBA	73dBA-86dBA	77dBA-95dBA
19	Means of Transportation	S	11:27-11:37	1st Floor LED TV + People	5 meters	66dBA-74dBA	72dBA-79dBA	84dBA-87dBA
20	Trade and Taxes	T	11:30-11:40	1st Floor LED TV + People	7 meters	69dBA-71dBA	76dBA-80dBA	81dBA-89dBA
21	Production Equipment	U	11:33-11:43	1st Floor LED TV + People	8 meters	70dBA-74dBA	80dBA-89dBA	81dBA-89dBA
22	Production Equipment	V	11:33-11:43	1st Floor LED TV + People	9 meters	66dBA-71dBA	78dBA-89dBA	80dBA-87dBA

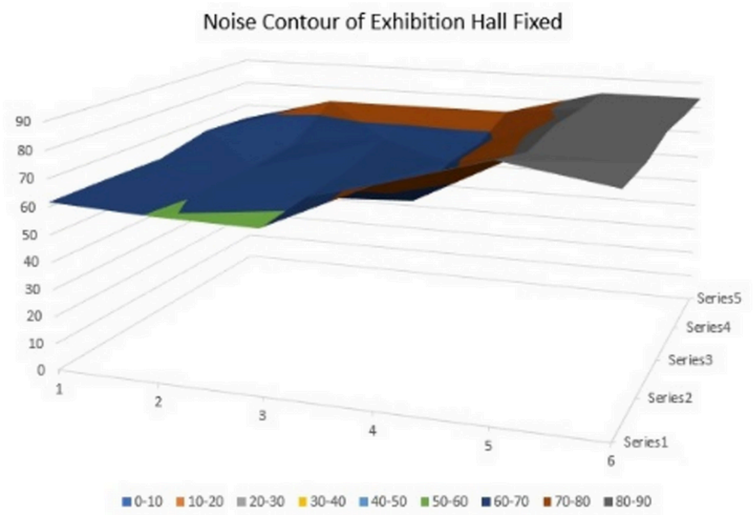
Table 2 *Field Data Measurement Results*

RESEARCH RESULTS

Here is a brief explanation of noise levels in permanent exhibition spaces:

1. 50 dB - 60 dB : This noise level is equivalent to normal conversation. Still within the comfortable range for most people.
2. 60 dB - 70 dB : The noise level indicates a busy environment. Some people may start to feel disturbed.
3. 70 dB - 80 dB : Quite loud noise, from conversations and music coming from TVs. Prolonged exposure can start to affect hearing and cause stress.
4. 80 dB - 90 dB : Quite high noise levels, such as the sound of chainsaws or airplanes taking off. Prolonged exposure to this level can cause hearing damage.

61,69 F	59,85 I	59,11 J	76,6 Q	87,65 R	81,65 S
61,69 F	60,08 H	60,75 K	62,6 P	82,56 T	81,65 S
61,31 E	60,52 G	62,03 L	67,83 O	84,89 U	84,89 U
65,55 C	61,91 D	66,98 M	67,83 N	83,91 V	83,91 V
64,23 B	73,9 A	73,9 A	73,9 A	83,91 V	83,91 V



RESEARCH RESULTS

Indonesian National Standard (SNI) 03-6386-2000 concerning sound level specifications for buildings and housing, stated that the recommended sound level for exhibition spaces in museums is **45 dBA as a good sound level and 55 dBA as the maximum recommended sound level** (National, 2000).

Acoustic comfort in museum exhibition spaces is essential to **creating a pleasant visitor experience**. Here are some factors to consider:

1. **Noise Control**: Use sound-absorbing materials, such as acoustic panels and carpeting, to reduce echo and background noise. This helps keep conversations and explanations clear.
2. **Space Design**: Consider the shape and size of the space. Spaces with high ceilings may require special treatment to avoid excessive echo.
3. **Sound Zoning**: Divide the exhibition space into zones with different noise levels. For example, interactive areas may be louder, while art display areas should be quieter.
4. **Sound Lighting**: Use sophisticated audio technology, such as directional sound systems, to ensure that information is heard only by visitors who are nearby.
5. **Visitor Amenities**: Provide quiet rest areas for visitors who may feel overwhelmed by noise.

Jenis Hunian	Tingkat Bunyi Yang Dianjurkan		Waktu Dengung (T) Yang Dianjurkan
	Baik [Ma]	Maksimum [Dbal	[detik.]
1	2	3	4
* Dengan sistem tata suara			
- s/d 250 orang	35 NR	40 NR	Kurva 1
- Lebih dari 250 orang	25 NR	35 NR	Kurva 1
Ruang teater drama	20NR	25NR	Catatan 4
Ruang pameran	40	50	Catatan 4
Ruang bioskop	25NR	30NR	Catatan 4
Ruang opera	20NR	25NR	Kurva 4
Ruang pertunjukan opera dan musik	25NR	30NR	Kurva 4
Gedung tempat ibadah			
- s/d 250 orang	30	35	Kurva 5
- lebih clari 250 orang	25	30	Kurva 5
- dengan sistem tata suara	35	40	Kurva 5
Balai kota			
- Ruang administrasi	35	40	0,6 — 0,8
- Ruang kantor umum	40	45	0,4
- Ruang Umum	45	50	0,4
- Ruang dewan perwakilan	25	30	Kurva 1
Pengadilan			
- Ruang pengadilan / sidang			
- Ruangtranskrip & pelaporan	25	30	Kurva 1
- Ruang hakim	35	40	0.6 — 0,8
- Ruang pengacara & wawancara	30	35	0.4 — 0,6
- Ruang tunggu	40	40	0,6 — 0,8
Perpustakaan			
- Ruang administrasi	40	40	-
- Ruang baca	35	40	-
- Ruang buku	40	45	-
- Ruang, seminar / lokakarya	45	50	-
Musium / ruang pameran	45	55	-
Ruang parkir	40	45	-
Kantor pos & Bank v"	55	65	-
Koridor dan lobi	45	50	-
Stasiun Kereta api & Terminal bis	45	50	-
Ruang penjualan kareis	45	55	-

CONCLUSION

The measurement results at each measurement point by paying attention to the sound source, the distance from the sound source to the measuring point, and measurements per point carried out 3 times, are concluded as follows:

1. Noise sources in the room are **dominated by Plasma TV located on the 1st floor and connected to the 2nd floor via the Vide Atrium and the voices of visitors**, especially student visitors.
2. **The sound intensity from 22 measurement points shows that the lowest sound intensity is 59.11 dBA**, which is at point "J" in the Architecture collection material display area, and the highest is 87.85 dBA, which is at the measurement point "R" in the Communication Equipment collection area.
3. **The average sound intensity in the Permanent Exhibition Room on the 2nd Floor is 69.87 dBA**. The noise level scale is "Loud", because based on the Sound Level Standard it is recommended for exhibition spaces in museums to be 45 dBA, with a maximum of 55 dBA.
4. **The presence of Column Vitrines is one of the agents that can limit the frequency of sound waves between measurement point A to measurement point Q**.

REFERENCES

1. Batubara, J., Marbun, J., Samosir, H. T. G., & Galingging, K. (2022). Pemanfaatan terapi musik sebagai pengobatan alternatif korban penyalahgunaaan narkoba di Panti Rehabilitasi Mutiara Abadi Binjai. *Panggung*, *31*(4), 519471.
2. Hidayat, S. (2003). *Kenyamanan Audio Pada Ruang Kuliah Dengan Kasus Ruang Kuliah Klasikal Ukuran Sedang Di Lingkungan UII*.
3. Kho, W. K. (2014). Studi material bangunan yang berpengaruh pada akustik interior. *Dimensi Interior*, *12*(2), 57–64.
4. Mardiana, I. (2013). *Laporan Kajian Tata Pamer (Material Pameran) Museum Nasional* (I. Mardiana (ed.); 2013th ed.). Museum Nasional Indonesia, Direktorat Jendral Kebudayaan, Kementrian Pendidikan dan Kebudayaan. https://doi.org/-
5. Mardiana, I. (2017). *Pengembangan Museum Nasional Indonesia* (I. Mardiana (ed.)). Museum Nasional Indonesia, Direktorat Jendral Kebudayaan, Kementrian Pendidikan dan Kebudayaan. https://doi.org/-
6. Murwonugroho, W., Septiani, W., Djuana, T. E., & Julianto, I. N. L. (2023). Interaktivitas User Objek Imersif dalam Multiplayer Virtual Tour Museum Bank Indonesia. *Panggung*, *33*(1), 88–100.
7. Nasional, B. S. (2000). SNI 03-6386-2000–Spesifikasi Tingkat Bunyi dan Waktu Dengung dalam Bangunan Gedung dan Perumahan (Kriteria desain yang direkomendasikan). *BSN. Jakarta (Indonesia)*.
8. Nasional, B. S. (2009). SNI 7231: 2009. *Metoda Pengukuran Intensitas Kebisingan Di Tempat Kerja*.
9. Ramadhan, A. N., Adhitama, M. S., & Nugroho, A. M. (2017). *Optimalisasi Kenyamanan Akustik Ruang pada JX International Surabaya*. Brawijaya University.
10. Sirait, D. H., Suprayogi, S., & Prawirasasra, M. S. (2019). Identifikasi Tingkat Kenyamanan Akustik Di Taman Balai Kota Bandung. *EProceedings of Engineering*, *6*(1).
11. Widiastuti, S., Purwanto, L., & Widjaja, R. R. (2024). Research Design Impact of Sound Intensity and Traffic Vibratons on Cultural Heritage Building. *Jurnal ArsitekTa Jurnal Arsitektur*, 1 - 9.
12. Zahrani, F., Kinasih, L. R., Pamungkas, U. R., & Yanitama, A. (2022). Analisis kebisingan pada ruang kuliah dan lingkungan kampus Universitas Negeri Semarang. *Proceeding Seminar Nasional IPA XII "PISA melalui Sains Masa Depan Untuk Generasi Berwawasan Lingkungan* (pp. 254-261). Semarang: Universitas Negeri Semarang.

THANK YOU