

Domestic sonic boundaries under intermittent railway noise invasion in an Urban Kampung

Nurma Fathia Alisyah, Dewi Septanti*^{ID}, FX Teddy Badai Samodra^{ID}

Department of Architecture, Faculty of Civil, Planning, and Geo Engineering,
Institut Teknologi Sepuluh Nopember Kampus ITS Sukolilo, Surabaya, Indonesia



ARTICLE INFO	ABSTRACT
<i>Article history:</i> Received January 09, 2026 Received in revised form Mar. 01, 2026 Accepted July 15, 2026 Available online September 01, 2026 <i>Keywords:</i> Domestic sonic boundaries Intermittent Privacy invasion Spatial element Urban kampung *Corresponding author: Dewi Septanti Department of Architecture, Faculty of Civil, Planning, and Geo Engineering, Institut Teknologi Sepuluh Nopember Kampus ITS Sukolilo, Surabaya, Indonesia Email: dewi_septanti@its.ac.id ORCID: https://orcid.org/0000-0002-3598-9395	<i>Railway-adjacent urban kampung settlements constitute densely populated residential environments that are continuously subjected to intermittent train noise. This recurring acoustic exposure creates a form of domestic privacy intrusion, as external sound penetrates interior living spaces and interferes with residents' everyday activities, thereby prompting an investigation into how domestic privacy is spatially negotiated in Kampung Gubeng, Surabaya. This study aims to examine both the distribution of railway noise within domestic environments and the ways residents mediate such exposure through spatial configurations and architectural elements. Employing a concurrent embedded mixed-methods design, the research combines qualitative-spatial data obtained through home tours and in-depth interviews with quantitative acoustic data derived from Sound Analyzer measurements and I-SIMPA simulations. The analytical framework explores the relationship between patterns of acoustic exposure and domestic spatial organization, interpreting residents' adaptive responses through the architectural categories of fixed, semi-fixed, and non-fixed elements. The findings demonstrate that domestic sonic boundaries emerge through an ongoing negotiation between environmental noise conditions and everyday household practices. In mixed-use dwellings, the front portion of the house remains intentionally open to accommodate socio-economic activities, whereas in purely residential dwellings, greater acoustic protection is achieved through increased spatial depth and more controlled management of openings. Consequently, domestic sonic boundaries can be conceptualized as an adaptive spatial zoning strategy that gradually transitions from acoustically exposed areas to progressively more protected interior spaces.</i>

Introduction

In contemporary high-density urban settings, the distinction between private and public domains is becoming increasingly obscured by various forms of environmental pressure, including intermittent noise intrusion characterized by fluctuating intensities and abrupt acoustic peaks (Murphy and King 2022). Such exposure influences not only the physical environment but also the

psychological well-being and comfort of residents. When external sound penetrates the interior of the home, it may be conceptualized as sonic privacy invasion, referring to the unauthorized intrusion of outside information into personal domestic space (Kang and Schulte-Fortkamp 2018; Lang and Moleski 2010). Consequently, sound within dense urban environments should be interpreted not merely as an acoustic phenomenon but also as a fundamentally spatial issue (Fleming et al. 2023;

Blesser and Salter 2007). The vulnerability of Indonesian urban kampungs is particularly pronounced because these settlements are typically organic in form, highly compact, spatially porous, and frequently located adjacent to critical infrastructure without adequate acoustic mitigation (Husin 2026; Sunjoto 2023). This condition is clearly observable in Surabaya, particularly in Kampung Gubeng, where the recurrent passage of trains has become embedded within the rhythm of everyday domestic life and

has encouraged residents to modify and negotiate their spatial arrangements (Tan and Nguyen 2024; Suhartini and Jones 2023; Kerr, Klocker, and Gibson 2021; Ramadhani, Fatimah, and Wartaman 2021). Accordingly, this study advances the proposition that the intrusion of railway noise is determined not solely by proximity to the tracks but is also mediated through spatial configuration, domestic architectural elements, and the adaptive responses of residents.



Figure 1. Intermittent railway noise exposure in Kampung Gubeng

Existing scholarship on domestic acoustic environments generally follows two principal directions. The first investigates sound propagation through variables such as sound pressure level, frequency, distance, and the performance of building components as acoustic barriers, whereas the second examines residents' adaptation to domestic soundscapes and sonic territoriality through spatial reorganization and the displacement of everyday activities (Sompie, Sulistiani, and Sompie 2022; Badai Samodra, Irvansyah, and Erwindi 2018). Nevertheless, studies that explicitly integrate railway-generated sound pressure with dwelling spatial configuration and residents lived experiences remain relatively scarce. Addressing this gap, the present research explores how railway noise contributes to the formation of domestic privacy through the mediation of dwelling spatial elements by combining outdoor and indoor acoustic measurements, spatial observation, and interviews with residents. Specifically, the study investigates how intermittent train noise is distributed throughout domestic spaces in

railway-edge urban kampung dwellings and how occupants negotiate such exposure through fixed, semi-fixed, and non-fixed elements to organize domestic activities and establish distinct sonic privacy zones. The principal contribution of this research lies in its integration of measured railway noise exposure, domestic spatial organization, and residents' adaptive practices to explain the formation of sonic privacy zones within railway-edge urban kampung housing.

Literature review

Research on sound environments demonstrates that acoustic conditions within dense settlements are inherently heterogeneous because sound distribution is shaped by the relationship between source and receiver as well as by the surrounding spatial configuration (Kang and Schulte-Fortkamp 2018). Likewise, the concept of soundscape cannot be interpreted exclusively through the magnitude of sound, since human perception is strongly conditioned by spatial context and environmental experience (Kang 2023; LaBelle 2020). Within residential

settings, the experience of sound emerges through the interaction among acoustic exposure, spatial organization, and everyday domestic activities. Consequently, sound in railway-edge urban kampung housing should be understood simultaneously as a condition of acoustic exposure and as a dimension of spatial experience.

The mediation of sound within domestic interiors can be interpreted through environment-behavior theory, which classifies environmental

components into fixed-feature, semi-fixed-feature, and non-fixed-feature elements (Rapoport 2005). Fixed elements consist of permanent architectural structures, including walls, floors, and roofs, whereas semi-fixed elements encompass movable furnishings, partitions, and other interior components that may be rearranged. Within urban kampung dwellings, these architectural elements possess the capacity to amplify, attenuate, or redirect sound transmission into different parts of the house.



Figure 2. Boundary and transitional spaces

When physical boundaries alone are insufficient to resist acoustic intrusion, residents employ non-physical strategies through behavioral, cognitive, and territorial adaptations (Altman and Wohlwill 2012; Rapoport 2005). Under conditions of intermittent noise, these responses frequently follow the temporal rhythm of disturbance, such as suspending conversation during peak train passages and resuming interaction once sound levels decline (Chernysheva 2024; LaBelle 2020). The interplay among physical, behavioral, and cognitive strategies is closely associated with the hierarchical organization of privacy extending from public to private space (Altman and Werner 2013; Lang 1987). Accordingly, domestic sonic boundaries should be understood as spatial boundaries produced through the interaction of sound exposure, architectural elements, and mechanisms of privacy regulation rather than as an isolated concept detached from theories of soundscape, environment-behavior relationships, and territoriality.

Methods

Research method

This study adopts a concurrent embedded mixed-method design, in which qualitative-spatial data constitute the primary dataset while quantitative acoustic data are embedded within a single phase of investigation (Creswell 2009). This methodological approach was selected because acoustic measurement does not represent the principal objective of the study but instead serves to support the spatial interpretation of railway noise distribution within domestic environments. Consequently, the research is neither a purely quantitative acoustic investigation nor a grounded theory study; rather, it seeks to examine the interrelationship among sound exposure, spatial configuration, residents' perceptions, and the regulation of domestic privacy.

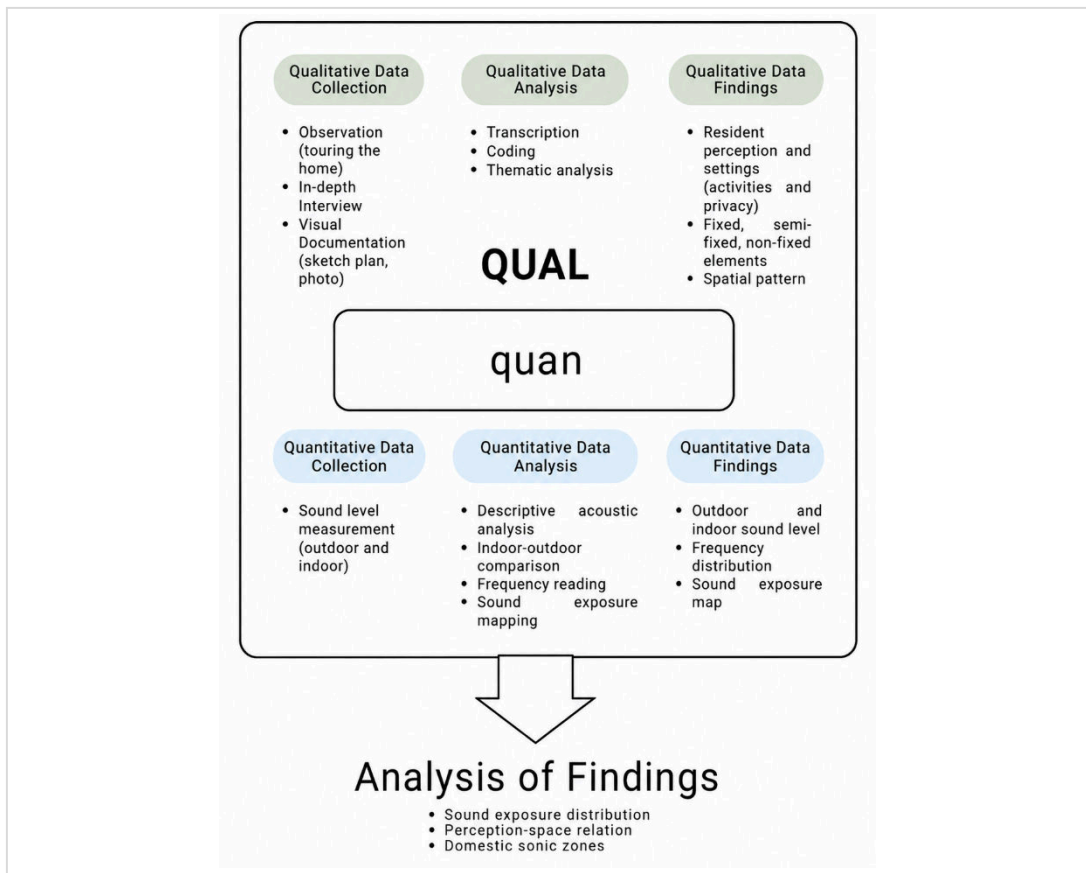


Figure 3. Concurrent embedded mixed method

As illustrated in [figure 3](#), qualitative information was collected through touring the home, visual documentation, and in-depth interviews concerning perceived disturbances, affected activities, and residents' responses during train pass-by events. Quantitative information was obtained through outdoor and indoor Sound Analyzer measurements of sound pressure levels and frequency characteristics. These acoustic data were subsequently mapped

using I-SIMPA software to examine the relationship between spatial configuration and exposure patterns. Both qualitative and quantitative datasets were integrated through narrative interpretation, dwelling plans, exposure mapping, and analysis of spatial elements. The interpretive framework employed the categories of fixed, semi-fixed, and non-fixed elements to identify public-facing, transitional buffer, and private sonic zones.

Table 1. Acoustic measurement and spatial mapping procedure

Tools	Measured parameters	Noise source	Condition
• Sound Analyzer App • I-SIMPA Software	• Sound Pressure Level, dBA • Frequency bands, 125–4000 Hz	• Outdoor facing the railway • Indoor 0.6 m to 1.5 m as reference height of occupant's sitting/standing	• Measured during train pass-by • Sound data overlaid with spatial configuration

Selection of research objects

The research objects were selected through purposive sampling, as the objective was to understand variations in dwelling spatial characteristics rather than to achieve statistical

generalization ([Groat and Wang 2013](#); [Niezabitowska 2018](#)). Kampung Gubeng, Surabaya, was chosen because it represents a railway-edge urban kampung where repeated intermittent train noise forms an integral

component of everyday domestic life. Four dwellings were selected as observation units based on their distance from the railway, façade orientation, dwelling function, and the nature of their physical boundaries. These variables were considered essential because the distribution of

domestic sound is influenced by proximity to the railway, building orientation, façade characteristics, openings, dwelling function, and intermediary spatial elements (Kang and Schulte-Fortkamp 2018; Almusawi et al. 2025).

Table 2. Characteristics of selected dwelling samples

Housing sample	Distance to railway	Façade orientation	Dwelling function	Boundary
R-1	7 meters	Facing Railway (West)	Domestic	Massive Concrete Railway Fence and Permanent Dwelling Wall
R-2	5 meters	Facing Railway (West)	Domestic + <i>Warung</i>	Metal Railway Fence and Corrugated Metal Canopy Extending over Alley
R-3	13 meters	Side-facing (South)	Domestic + <i>Warung</i>	Open Terrace (No Massive Fence)
R-4	15 meters	Facing Railway (West)	Domestic	Permanent Wall (Shielded, Second-row Position)

Results and discussion

Distribution of intermittent train noise across domestic spaces

The distribution of sound was investigated by analyzing both sound pressure levels and frequency-band characteristics to explain the mechanisms through which railway noise penetrates, attenuates, or persists across domestic spatial configurations. As illustrated in figure 4, the relationship between railway proximity and the outdoor–indoor sound pressure level demonstrates an overall tendency for acoustic exposure to decline within the immediate railway-edge environment. This gradient can be observed from R-2, the dwelling located closest to the railway corridor, toward R-1, R-3, and R-4, which are positioned at progressively greater setbacks from the tracks. Nevertheless, the observed pattern also indicates that proximity alone does not determine the degree of acoustic exposure.

Although R-2 is the nearest dwelling, its open front boundary and mixed residential-commercial function allow it to remain highly vulnerable to railway noise. In contrast, R-1 exhibits a more substantial reduction between outdoor and indoor sound levels due to the presence of a concrete railway barrier, permanent enclosing walls, and a deeper sequence of interior spaces. Similarly, R-3 continues to experience considerable exposure because its open *warung* terrace permits greater sound transmission, whereas R-4 benefits from enhanced acoustic protection provided by the surrounding building mass and more controlled openings. The comparatively lower indoor sound pressure levels therefore suggest that domestic interiors are capable of mitigating a portion of incoming railway noise; however, the effectiveness of this reduction is simultaneously influenced by façade orientation, dwelling function, boundary configuration, openings, spatial depth, and the shielding effect of adjacent building masses.

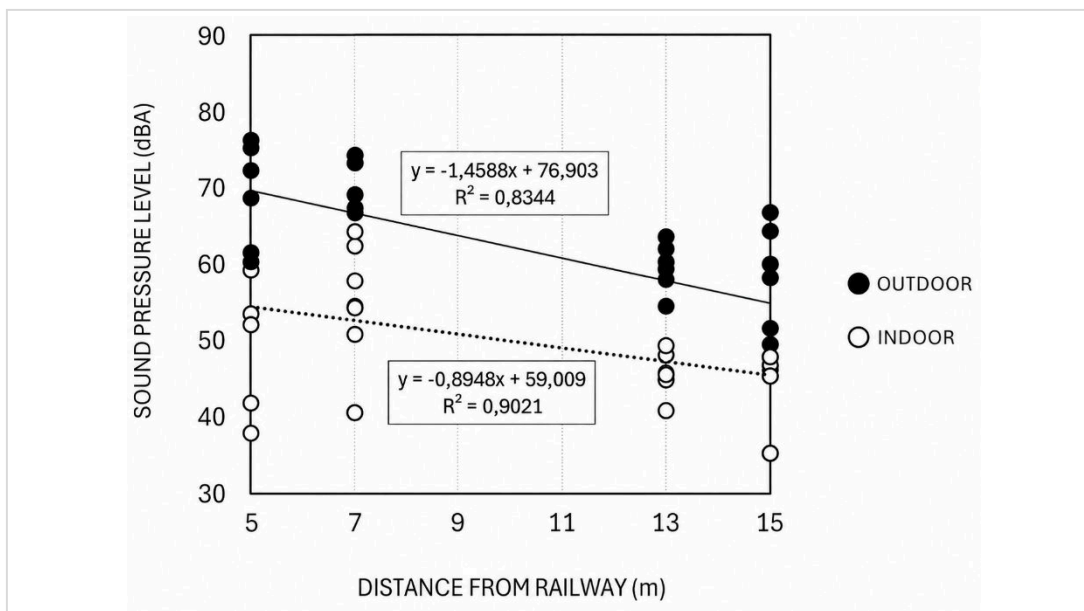


Figure 4. Graph of outdoor and indoor sound pressure levels by railway distance

The frequency-band analysis presented in figure 5 redirects the discussion from overall exposure magnitude to the spectral characteristics of railway noise. Several measured indoor frequency bands remain above the World Health Organization's recommended daytime limits and, in certain instances, approach or even exceed the Indonesian residential noise standard. These

findings demonstrate that acoustic disturbance persists within particular frequency ranges, indicating that evaluations of domestic sonic comfort should not rely solely on aggregate sound pressure levels. Instead, they must also consider which frequency components continue to be perceptible within interior residential environments.

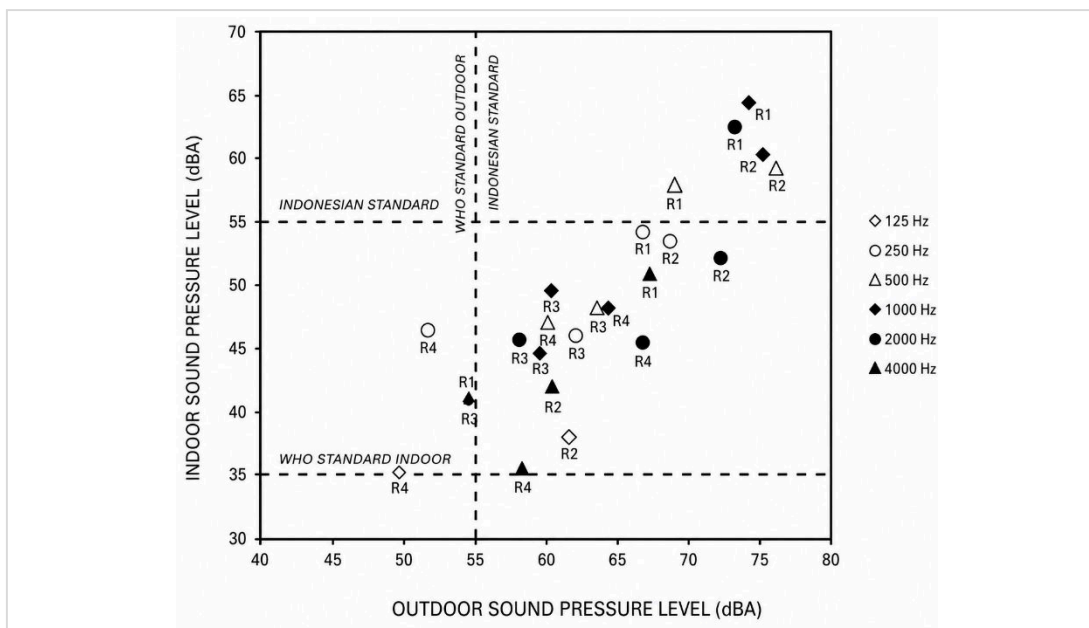


Figure 5. Graph of outdoor and indoor frequency distribution

The frequency-band analysis presented in Figure 5 redirects the discussion from overall exposure magnitude to the spectral characteristics of railway noise. Several measured indoor frequency bands remain above the World Health Organization's recommended daytime limits and, in certain instances, approach or even exceed the Indonesian residential noise standard. These findings demonstrate that acoustic disturbance persists within particular frequency ranges, indicating that evaluations of domestic sonic comfort should not rely solely on aggregate sound pressure levels. Instead, they must also consider which frequency components continue to be perceptible within interior residential environments.

Spatial distribution and residents' perception in each dwelling

The analysis integrates spatial exposure mapping with residents' narratives to explain how occupants negotiate railway noise through fixed, semi-fixed, and non-fixed elements in organizing domestic activities and privacy into distinct sonic

zones. In R-1, [figure 6](#) indicates sound levels ranging approximately from 60 to 68 decibels. The front portion of the dwelling facing the railway is represented by yellow-to-red zones, measuring approximately 66–68 decibels, whereas deeper interior spaces transition into green and blue zones with levels of approximately 60–64 decibels. This spatial gradient illustrates a progressive reduction in acoustic exposure from the front room toward the bedroom. Such a pattern corresponds to the sequence of the concrete railway fence, intermediary exterior space, alley, terrace, and interior rooms. Interview findings indicate that although the resident continues to hear passing trains, the bedroom is perceived as a safer and quieter environment. Consistent with the findings of [Mustafa and Muhealdeen \(2023\)](#), spaces located farther from the principal noise source, combined with barriers and layered spatial arrangements, contribute significantly to reducing acoustic exposure. Accordingly, sonic protection in R-1 is generated through the interaction of spatial layering, boundary elements, and interior depth.



Figure 6. Spatial gradient of R1 train-noise exposure and layered protection

Semi-fixed elements likewise contribute to the formation of domestic boundaries through their influence on openings, circulation patterns, and outdoor exposure. As illustrated in [figure 7](#), the front room in R-1 functions as a semi-public area, whereas the bedroom serves as a protected private zone. An unused refrigerator, table, speaker, children's toys, sofa, television, and corridor cabinet collectively establish additional material layers within the interior. Some pieces of furniture

also obstruct unused façade openings, thereby influencing the reflection, absorption, and retention of sound within the dwelling ([Cucharero, Hänninen, and Lokki 2019](#)). Residents' adaptive responses, including pausing conversations and closing doors or windows during train passages, further demonstrate that the sonic boundary in R-1 emerges through the combined effects of permanent walls, interior furnishings, and everyday behavioral adaptations.

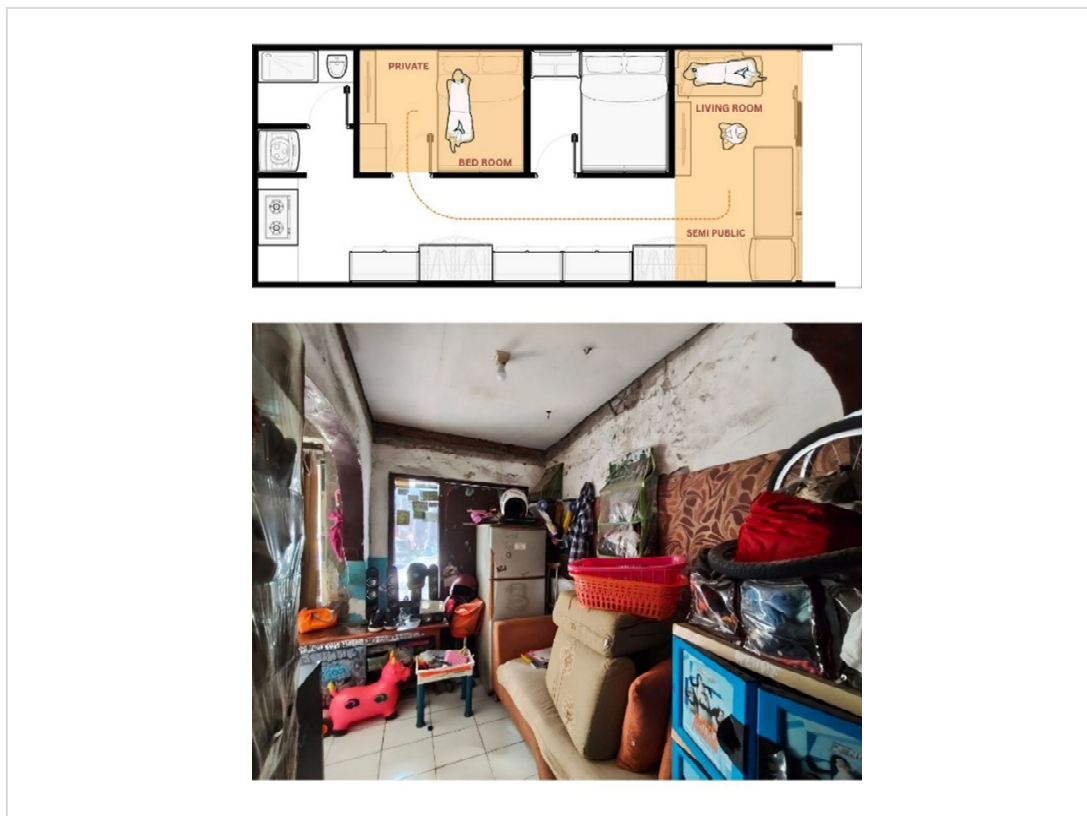


Figure 7. Spatial activity arrangement and interior condition of R1

The combination of immediate proximity to the railway corridor and the openness of the front boundary substantially intensifies acoustic exposure within the most actively occupied portion of the dwelling. As illustrated in [figure 8](#), the measured sound levels in R-2 range from approximately 68 to 76 decibels, with yellow, orange, and red zones dominating nearly the entire spatial configuration. The highest intensity, approaching 76 decibels, occurs in the area directly exposed to both the railway and the adjacent alley, whereas spaces located deeper within the house experience only a modest reduction, remaining within approximately 70–74 decibels and therefore still exhibiting

considerable acoustic exposure. Because the front portion of the dwelling simultaneously functions as a *warung*, the area subjected to the greatest noise intrusion also serves as the principal space for economic activities and social interaction. Interview findings reveal that the resident experienced considerable difficulty sleeping during the first two months of occupancy but gradually adapted to the recurring train noise over time. Consequently, the adaptive strategy observed in R-2 is characterized less by substantial physical modification than by habituation and behavioral adjustment to the persistent acoustic environment.



Figure 8. Spatial gradient of R2 train-noise exposure in mixed-use space

The domestic threshold in R-2 functions as an intermediary zone that negotiates private, commercial, and social activities simultaneously. As depicted in [figure 9](#), a corrugated metal canopy extends across the alley and the *warung* frontage, effectively expanding the perceived boundary of the dwelling into the surrounding public realm. While this canopy supports commercial operations, it also maintains an open spatial relationship among the house, the alley, and the railway corridor. Interview data further indicate

that food prepared for commercial purposes is cooked within the front *warung* area, whereas household cooking activities are relocated to the rear kitchen. Such an arrangement illustrates the expansive nature of the sonic boundary in R-2, where the front space continues to function productively despite continuous exposure to sounds generated by passing trains, customers, children, motorcycles, and neighborhood activities.



Figure 9. Spatial activity arrangement and front *warung* condition of R2

A greater physical distance from the railway does not necessarily correspond to a higher level of acoustic protection. In R-3, [figure 10](#) presents a markedly different sound gradient, ranging from approximately 40 to 70 decibels. The open *warung* and cooking area are represented by yellow-to-red zones with sound levels of approximately 60–70 decibels, whereas the deeper interior spaces transition into green and blue zones measuring approximately 40–50 decibels. This pronounced contrast demonstrates that the openness of the front boundary continues to facilitate substantial sound transmission despite

the dwelling being located farther from the railway than R-1 and R-2. Interview responses indicate that residents perceive the rear family room as the safest and quietest part of the house, while the open *warung* and upper floor are regarded as locations where train noise is most pronounced. These observations reinforce the findings of [Mustafa and Muhealdeem \(2023\)](#) who argue that room orientation, the placement of quiet spaces, and the presence of intermediary spatial layers play significant roles in enhancing acoustic comfort by functioning as residential buffer zones against external noise sources.



Figure 10. Spatial gradient of R3 train-noise exposure and rear protection

The maintenance of an open domestic configuration is closely associated with the social and economic functions of the space. As shown in [figure 11](#), the *warung* terrace in R-3 is entirely open, lacking a front fence and maintaining a direct connection with the neighborhood street. Interview findings indicate that food preparation for commercial purposes and household consumption occurs within the same terrace area, allowing the resident to cook while

simultaneously interacting with neighbors. Although this openness increases vulnerability to sounds generated by passing trains, customers, neighboring residents, children, and motorcycles, the adaptive response is not to enclose the space physically. Instead, residents rely primarily on behavioral strategies, including temporarily stopping conversations and increasing the television volume whenever trains pass through the area.



Figure 11. Spatial activity arrangement and open *warung* terrace condition of R3

In R-4, sonic protection is influenced not only by horizontal distance from the railway but also by vertical spatial organization, floor level, building openings, and the direction of sound propagation. As illustrated in [figure 12](#), measured sound levels range from approximately 48 to 56 decibels, with red and orange zones occurring in more exposed locations and blue zones representing more protected areas. Spaces adjacent to openings and the balcony record sound levels of approximately 54–56 decibels, whereas areas shielded by the internal spatial arrangement and the surrounding building mass measure approximately 48–50 decibels. Although these values are lower than those observed in R-2 and R-3, the spatial distribution nevertheless demonstrates that openings and upper-floor spaces remain comparatively susceptible to

railway noise intrusion. Interview evidence indicates that train sounds are clearly audible within the upper-floor bedroom whenever the balcony is open, while the ground-floor living room is perceived as considerably quieter and safer. This finding corresponds with [Samra et al. \(2024\)](#), who argue that acoustic privacy is shaped through the interaction of physical barriers, openings, partitions, and residents' behavioral practices in maintaining distinctions among public, semi-public, and private spaces. Consequently, the sonic boundary in R-4 is established through the combined effects of surrounding building mass, controlled openings, and the strategic use of the ground-floor living room as a more acoustically manageable environment.



Figure 12. Spatial gradient of R4 train-noise exposure and opening control

The enhanced acoustic protection provided by the ground-floor living room affords residents greater control over both sound exposure and interaction with the surrounding neighborhood. As illustrated in [figure 13](#), this space accommodates guest reception and everyday relaxation because occupants perceive it as offering superior acoustic comfort. Such protection results from the dwelling's location within a narrow alley, the shielding effect of adjacent building masses, enclosing walls and doors, and an internal spatial organization that is

not directly oriented toward the railway corridor. Nevertheless, interview findings indicate that sounds originating from neighboring houses and activities within the alley remain clearly audible because of the close physical proximity among dwellings. Accordingly, the sonic boundary in R-4 responds not only to railway noise but also to the broader soundscape of the *kampung*, with residents adopting adaptive behaviors such as closing doors and temporarily pausing activities during periods of increased acoustic disturbance.

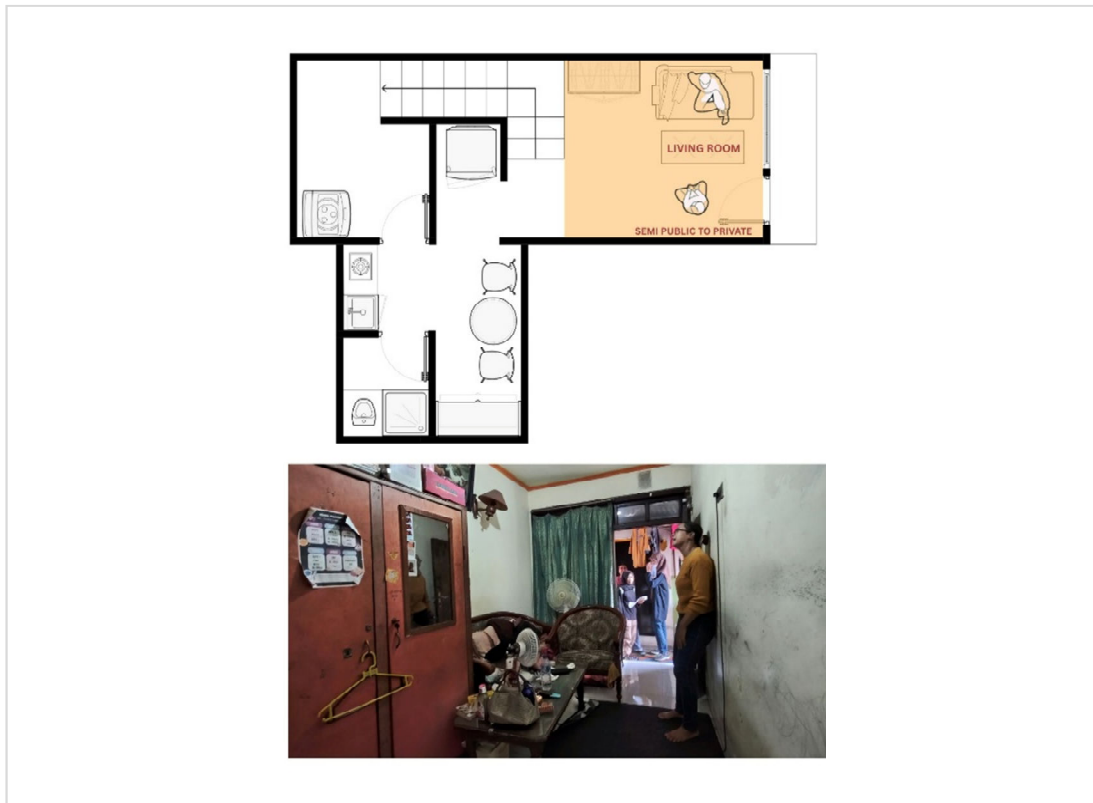


Figure 13. Spatial activity arrangement and ground-floor living room condition of R4

Conclusions

The establishment of domestic sonic boundaries within urban *kampung* housing emerges through a continuous negotiation among environmental sound exposure, spatial organization, residential functions, and occupants' everyday behavioral practices. The propagation of railway noise is determined not merely by the physical distance between a dwelling and the railway corridor but also by architectural characteristics such as spatial depth, the degree of openness at the front boundary, floor level, the configuration of openings, and the shielding effect of surrounding building masses. Consequently, acoustic conditions inside the dwelling are produced through the interaction between environmental factors and spatial design rather than by proximity to the railway alone. The four investigated housing samples demonstrate distinct strategies of sonic mediation. In R-1, acoustic protection is achieved through the sequential arrangement of

intermediary spaces and increased room depth leading to the bedroom, creating a layered buffer against external noise. By contrast, R-2 exhibits a more permeable sonic boundary because its front room functions as a *warung* while being situated immediately adjacent to the railway, thereby maintaining a high level of exposure. In R-3, the front portion of the dwelling continues to accommodate commercial activities and neighborhood interaction, whereas the rear family room serves as a comparatively protected acoustic refuge. Meanwhile, R-4 illustrates that sonic protection is influenced not only by horizontal distance but also by vertical spatial organization and opening control, as the ground-floor living room provides greater acoustic comfort than the upper-floor bedroom. Collectively, these observations demonstrate that domestic sonic boundaries are established through the interaction of fixed elements, semi-fixed elements, and residents' adaptive behaviors, as summarized in [table 3](#).

Table 3. Domestic sonic boundary elements

Housing sample	Fixed elements	Semi-Fixed elements	Non-Fixed elements
R-1	- Permanent wall - Layered spatial sequence (concrete railway fence, terrace, corridor, bedroom depth)	- Front-room furniture (unused refrigerator, table, sofa, TV) - Corridor storage (cabinets, stored objects)	- Closing doors/ windows - Pausing activity - Using bedroom as protected space
R-2	- Permanent wall - Direct front boundary (iron railway fence, narrow alley)	<i>Warung</i> threshold (corrugated canopy) - Open middle-room arrangement	- Habituation - Pausing conversation - Separating business and private activity
R-3	- Permanent wall - Open front boundary (terrace, no front fence) - Deeper domestic layer (rear family room)	<i>Warung</i> terrace setting - Inner storage layer (storage area, cabinets)	- Maintaining front openness - Pausing conversation - Increasing TV volume - Using rear family room as quieter retreat
R-4	- Permanent wall - Spatial shielding (small alley position, surrounding building mass)	Interior thickening near openings (wardrobe, movable domestic objects)	- Closing doors/ windows - Using ground-floor living room as safer zone



Figure 14. Adaptive zoning of domestic sonic boundaries

The synthesis presented in table 3 is conceptually illustrated in figure 14 as a model of adaptive domestic sonic zoning. The findings indicate that the front portion of the dwelling does not necessarily function as an acoustically protected area because both R-2 and R-3 intentionally preserve this space as a *warung*, cooking area, and setting for social interaction despite its exposure to railway noise. Instead of eliminating sound at the exterior boundary, acoustic protection is progressively transferred toward deeper interior layers through corridors, intermediary rooms, furniture arrangements, canopies, doors, and the shielding effects of

surrounding building masses, all of which act as filters before sound reaches more protected spaces. Furthermore, the location of the acoustically safest space varies among the investigated dwellings and is not invariably the bedroom. In R-1, the deepest bedroom provides the highest level of protection; in R-3, the rear family room functions as the principal quiet zone; and in R-4, the ground-floor living room offers greater acoustic security than the upper-floor bedroom. These findings demonstrate that domestic sonic boundaries operate as adaptive spatial zoning mechanisms that mediate railway noise through the combined influence of

architectural elements and residents' everyday practices, thereby enabling domestic life to coexist with persistent environmental sound within dense urban settlements.

Acknowledgments

The authors sincerely express their gratitude to the local administration of Kelurahan Gubeng for granting permission and facilitating the implementation of the fieldwork. The authors also extend their appreciation to the university and all colleagues whose valuable assistance, collaboration, and continuous support contributed significantly to the successful completion of this research.

References

- Almusawi, Tahrir Taki Ali, Ashwaq Fadhel Muhkaber Alomare, Lina Kifah Kadhum, and Zainab Qahtan Abd Alkhayat. 2025. "The Impact of Building Façade Designs on Noise Reduction: A Case Study from Iraq." *Journal of Engineering and Sustainable Development* 29 (5): 589–97. <https://doi.org/10.31272/jeasd.2605>.
- Altman, Irwin, and Carol M. Werner. 2013. *Home Environments*. Edited by Irwin Altman and Carol M. Werner. 8th ed. Boston, MA: Springer US. <https://doi.org/10.1007/978-1-4899-2266-3>.
- Altman, Irwin, and Joachim F. Wohlwill. 2012. *Human Behavior and Environment ADVANCES IN THEORY AND RESEARCH: Environment and Culture*. 4th ed. New York: Springer New York.
- Badai Samodra, FX Teddy, Irvansyah, and Collinthia Erwindi. 2018. "Empowering Traditional House for Future Noise Control Based on Sound Frequency Propagation." *IOP Conference Series: Earth and Environmental Science* 213 (December):012020. <https://doi.org/10.1088/1755-1315/213/1/012020>.
- Blesser, Barry, and Linda-Ruth Salter. 2007. *Spaces Speak, Are You Listening?: Experiencing Aural Architecture*. MIT Press.
- Chernysheva, Liubov. 2024. "The Vagaries of Sonic Neighborly Life: Privacy at Home and Sound Politics in Post-Socialist Mass Housing." *Space and Culture* 27 (3): 288–301. <https://doi.org/10.1177/12063312231210103>.
- Creswell, John W. 2009. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 3rd ed. SAGE Publications.
- Cucharero, Jose, Tuomas Hänninen, and Tapio Lokki. 2019. "Influence of Sound-Absorbing Material Placement on Room Acoustical Parameters." *Acoustics* 1 (3): 644–60. <https://doi.org/10.3390/acoustics1030038>.
- Fleming, Genie M., Moataz M. ElQadi, Ruzka R. Taruc, Autiko Tela, Grant A. Duffy, Emma E. Ramsay, Peter A. Faber, and Steven L. Chown. 2023. "Classification and Ecological Relevance of Soundscapes in Urban Informal Settlements." *People and Nature* 5 (2): 742–57. <https://doi.org/10.1002/pan3.10454>.
- Groat, Linda N., and David Wang. 2013. *Architectural Research Methods*. John Wiley & Sons, Inc.
- Husin, Denny. 2026. "The Heterotopia of Urban Kampung in Jakarta: Revealing the Other Pattern through Mapping". *ARTEKS: Jurnal Teknik Arsitektur* 11 (1): 31–40. <https://doi.org/https://doi.org/10.30822/arteks.v11i1.3925>.
- Kang, Jian. 2023. "Soundscape in City and Built Environment: Current Developments and Design Potentials." *City and Built Environment* 1 (1): 1. <https://doi.org/10.1007/s44213-022-00005-6>.
- Kang, Jian, and Brigitte Schulte-Fortkamp. 2018. *Soundscape and the Built Environment*. Edited by Jian Kang and Brigitte Schulte-Fortkamp. CRC Press. <https://doi.org/10.1201/b19145>.
- Kerr, Sophie-May, Natascha Klocker, and Chris Gibson. 2021. "From Backyards to Balconies: Cultural Norms and Parents' Experiences of Home in Higher-Density Housing." *Housing Studies* 36 (3): 421–43. <https://doi.org/10.1080/02673037.2019.1709625>.
- LaBelle, Brandon. 2020. *Acoustic Justice: Listening, Performativity, and the Work of Reorientation*. Bloomsbury Publishing. <https://books.google.co.id/books?id=3IMKEAAAQBAJ>.
- Lang, Jon T. 1987. *Creating Architectural Theory: The Role of the Behavioral Sciences in Environmental Design*. Van Nostrand Reinhold Company.
- Lang, Jon T., and Walter Moleski. 2010. *Functionalism Revisited: Architectural*

- Theory and Practice and the Behavioral Sciences*. Ashgate Publishing, Ltd.
- Murphy, Enda, and Eoin A. King. 2022. "Principles of Environmental Noise." In *Environmental Noise Pollution*, 9–51. Elsevier. <https://doi.org/10.1016/B978-0-12-820100-8.00002-6>.
- Mustafa, Shilan Ameen, and Banaz Nasraldeen Muhealdeem. 2023. "Acoustic Comfort Evaluation in Traditional Houses and Its Impact on Inhabitant Satisfaction in the City of Sulaimani." *UHD Journal of Science and Technology* 7 (2): 50–68. <https://doi.org/10.21928/uhdjst.v7n2y2023.p50-68>.
- Niezabitowska, Elżbieta Danuta. 2018. *Research Methods and Techniques in Architecture*. Routledge. <https://doi.org/10.4324/9781315165592>.
- Ramadhani, A, E Fatimah, and A S Wartaman. 2021. "Place Attachment of Railroad Settlement Residents, Case Study: Kampung Tenggumung, Surabaya City." *IOP Conference Series: Earth and Environmental Science* 737 (1): 012065. <https://doi.org/10.1088/1755-1315/737/1/012065>.
- Rapoport, Amos. 2005. *Culture, Architecture, and Design*. Locke Science Publishing Company.
- Samra, Bobby, Dwira Nirfalini Aulia, Dwi Lindarto, and Hilma Tamiami Fachrudin. 2024. "Privacy Principles in Malay House Design: Integrating Visual and Acoustic Privacy in Selatpanjang Residences." Edited by M. Aziz, M.R.P. Sakti, I. Purnama, and T. Derin. *E3S Web of Conferences* 593 (November):02003. <https://doi.org/10.1051/e3sconf/202459302003>.
- Sompie, Ivana Agnes, Coriesta Dian Sulistiani, and Tampanatu P. F. Sompie. 2022. "The Adaptation to Sonic Territoriality: A Domestic Space Case Study." *Civil Engineering and Architecture* 10 (5): 1967–82. <https://doi.org/10.13189/cea.2022.100519>.
- Suhartini, Ninik, and Paul Jones. 2023. *Beyond the Informal*. The Urban Book Series. Cham: Springer International Publishing. <https://doi.org/10.1007/978-3-031-22239-9>.
- Sunjoto, Margareth. 2023. 'Rethinking Indonesia's Lighting Standard for Urban Kampung Roads'. *ARTEKS: Jurnal Teknik Arsitektur* 8 (3): 357–66. <https://doi.org/https://doi.org/10.30822/arteks.v8i3.2203>.
- Tan, Diwen, and Minh Quang Nguyen. 2024. "Beyond the Palimpsest: Traditions and Modernity in Urban Villages of Shenzhen, China." *Cities* 151 (August):105093. <https://doi.org/10.1016/j.cities.2024.105093>.

Author(s) contribution

Nurma Fathia Alisyah contributed to the research concepts preparation, methodologies, investigations, data analysis, visualization, articles drafting and revisions.

Dewi Septanti contribute to the research concepts preparation and literature reviews, data analysis, of article drafts preparation and validation.

FX Teddy Badai Samodra contribute to methodology, supervision, and validation.