DOI : dx.doi.org/10.22441/vitruvian.2021.v10i3.001

p-ISSN : 2088-8201 e-ISSN : 2598-2982

STUDY OF SOUND BEHAVIOR FROM AUDIAL EXPERIENCE IN TAMAN SARI YOGYAKARTA

Patricia Pahlevi Noviandri [1], Christian Nindyaputra Octarino [2]

Department of Architecture, Faculty of Architecture and Design, Universitas Kristen Duta Wacana, Yogyakarta, Indonesia

Surel: [1] patriciapahlevi@staff.ukdw.ac.id; [2] christian.octarino@staff.ukdw.ac.id

Vitruvian vol 10 no 3 Juni 2021
Diterima: 09 12 2020 | Direvisi: 23 06 2021 | Disetujui: 25 06 2021 | Diterbitkan: 30 06 2021

ABSTRAK

Taman Sari merupakan tempat peristirahatan Raja sekaligus tempat pertahanan yang dibangun pada masa Sri Sultan Hamengkubuwono I bertakhta. Kompleks yang terdiri dari beberapa bangunan heritage ini telah menjadi salah satu situs penting di Yogyakarta dalam hal menunjang pariwisata. Atmosfer dan suasana heritage yang ada di area Taman Sari menjadi daya tarik tersendiri yang dapat mendatangkan minat dari para wisatawan. Taman Sari memiliki identitas suara (soundmark) yang berimplikasi pada pengalaman pendengaran wisatawan, sekaligus mendukung suasana heritage yang ada. Saat ini, identitas suara yang ada di Taman Sari dinilai sudah lemah sehingga mengurangi suasana yang dirasakan oleh pengunjung. Penelitian ini membahas tentang identifikasi perilaku bunyi pada situs Taman Sari yang bertujuan untuk mengetahui letak sumber bunyi yang dapat mempengaruhi suasana pariwisata dalam aspek audial. Metode yang digunakan adalah simulasi gerakan suara dengan menggunakan perangkat lunak Ecotect. Dimensi dan material pelingkup ruang disesuaikan dengan kondisi di lokasi dengan pemetaan jenis material dan lokasi dari identitas suara yang ada. Hasil simulasi perangkat lunak akan dianalisis dalam kaitannya dengan teori persebaran suara. Berdasarkan analisis, diketahui bahwa elemen lunak dan elemen keras mempengaruhi karakter perilaku suara di Taman Sari. Perilaku suara yang ditemukan di lokasi adalah pantulan suara yang sebagian menghasilkan gaung dan suara langsung yang dapat didengar oleh wisatawan di berbagai segmen. Hasil dari penelitian ini diharapkan dapat menunjang pengalaman wisatawan di situs cagar budaya melalui peningkatan kualitas aspek audial kawasan.

Kata Kunci: Akustik lingkungan, perilaku suara, identitas suara, simulasi, Taman Sari

ABSTRACT

Taman Sari is the resting place of the King as well as a place of defense that was built during the reign of Sri Sultan Hamengkubuwono I in the Sultanate of Yogyakarta. The area, which consists of several heritage buildings, has become one of the important sites in Yogyakarta in terms of supporting city tourism. The heritage atmosphere in the Taman Sari area is a special attraction that can attract tourists' interest. Taman Sari has a soundmark that has implications for the hearing experience of tourists, as well as supports the heritage atmosphere. Currently, the soundmark in Taman Sari is considered weak, thereby reducing the atmosphere felt by visitors. This study discusses the identification of sound behavior on the Taman Sari site, which aims to determine the location of the sound source that can affect the tourism atmosphere in the audial aspect. The methodology was based on the simulation of sound movement using Ecotect software. The dimensions and materials of the space enclosure are adjusted to the conditions at the location by mapping the type of material and the location of the existing voice identity. The simulation results will be analyzed in relation to the theory of sound distribution. Based on the analysis, it is known that softscape and hardscape elements affect the character of voice behavior in Taman Sari. The sound behavior found at the location is the sound reflection which partially produces echoes and direct sounds that can be heard by tourists in various segments. The results of this study are expected to enhance the tourist experience at cultural heritage sites through improving the quality of the area's audial aspects.

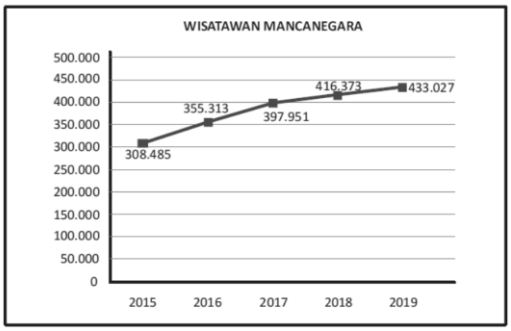
Keywords: *Acoustic Environment, Sound Behavior, Soundmark, Simulation, Taman Sari*

DOI : dx.doi.org/10.22441/vitruvian.2021.v10i3.001

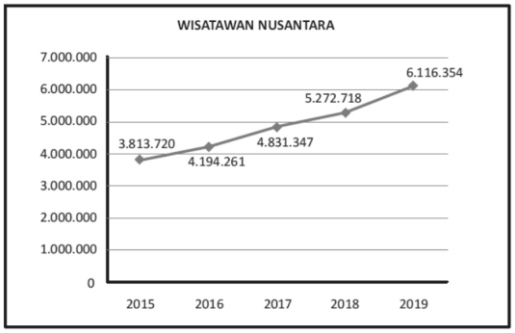
Vitruvian *Jurnal Arsitektur, Bangunan, & Lingkungan* | Vol.10 No.3 Juni 2021 : 177-186

INTRODUCTION

The condition of Yogyakarta tourism has increased every year. The data (figure 1) from the Government Tourism Province of D.I. Yogyakarta explains there are 6,5 million tourists who came to this province in 2019. As a city of culture as well as a city of education, Yogyakarta always has many visitors every year. Therefore, Yogyakarta has satisfactory services and improving its services frequently in the field of tourism.



(a)



(b)

Figure 1 Growth of Tourist on Yogyakarta Province (a) foreign tourist (b) domestic tourist
Source : (Dinas Pariwisata Daerah Istimewa Yogyakarta, 2019)

Yogyakarta has some type of tourist destination such as History and Culture, Museum, Tourism Village, Natural Tourism, and Recreation Parks. Taman Sari is one of the history and culture tourism destinations. In 2019, Taman Sari visitors reached 478.202 people. This is made Taman Sari in be the fourth position with the most visitors in History and Culture tourism destination category (figure 2).

Taman Sari is a series of historical and cultural attractions after the Yogyakarta Palace and the Palace Performance. In understanding the history of the city of Yogyakarta, tourists generally take a series of trips to these three attractions.

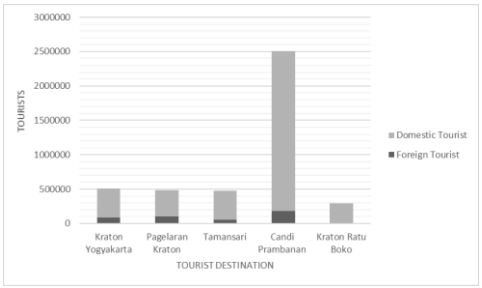


Figure 2 Number of visitors based on tourist destination in history and culture category
Source : (Dinas Pariwisata Daerah Istimewa Yogyakarta, 2019)

Taman Sari as heritage tourism has two important roles, i.e. as a cultural heritage site that must be preserved and tourism site. *Taman Sari* as a cultural heritage site that must be preserved means that *Taman Sari* provides a gateway to the past for visitors in the present. While. *Taman Sari* as a tourism site means that the development of Taman Sari from a cultural heritage site to a tourist site that prioritizes tourism components in its design. Components of tourism products (Khotimah and Wilopo, 2017) include attraction, accessibility, amenity, and ancillary.

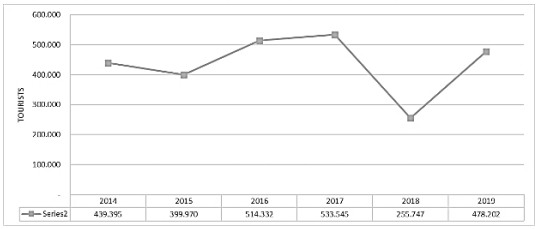


Figure 3 Visitors growth in Taman Sari
Source : (Dinas Pariwisata Daerah Istimewa Yogyakarta, 2019)

In 2018, Taman Sari had a decline in visitors but climb up in 2019 (figure 3). Heretofore, Taman Sari still much in demand. Taman Sari is a tourism site so that they must improve frequently the components of tourism in Indonesia. Currently, Taman Sari's main role is as a site to accommodate tourism activities (Patricia P Noviandri and Sabono, 2018). Consider about four components of tourism, Taman Sari's attraction is less

DOI : dx.doi.org/10.22441/vitruvian.2021.v10i3.001

p-ISSN : 2088-8201 e-ISSN : 2598-2982

attractive. Activities offered to visitors are listening to historical stories, observe heritage sites, and do site documentation. Tourists who want to hear the history of Taman Sari usually come to this site only once. Visitors are more interested in documentation (photo sessions) for their social media.

The Essence of Tourism is diversity, uniqueness, and locality (Ardika, 2019). Every tourism destination has uniqueness then it can be sustainable tourism. That is means, the destination will always have visitors and they will visit many times. The uniqueness can be achieved by providing attractive attractions for visitors. Its mean visitor can interact with the site, for example, special interest tours, cultural-based tours and environment-based tourism (ecotourism) supported by a variety of cultural event and souvenir (Khotimah and Wilopo, 2017).

As explained before, Taman Sari is a heritage site that cannot be changed related to building visuals. Every place especially heritage sites has a sense of place. Sense of place is an experience created by a combination of physical and social features(Cross, 2001)(Hashemnezhad H., 2013). Sense of place is a people's subjective perception about their environment and feeling about places (Hashemnezhad H., 2013). Visitors can perceive a sense of place not directly through architectural artistic value and place identity. However, architecture and streetscape enhance more to creating the perceptual qualities of a place (Hu and Chen, 2018).

Visual is not enough to perceive a sense of place received by visitors. Because of that, auditory able to improve someone's experience about space. Auditory experience is done by mapping the existing sound and designing sound through activities that support the location. The soundscape is all the auditory experience that people received. That's means, the soundscape is all sounds that can be heard in a specific location (Miller, 2013). The soundscape is formed depending on space/function, sound source, and human (Noviandri, 2017).

There are three categories to identify soundscape namely keynote sound, signals, and soundmark (Schafer, 1994). Sound mapping is used to determine the soundmark that appears at a location. Soundmark is related to human understanding and identity of a city's history through the memory sound that is presented in space (Zhou, 2014a). Soundmark refers to uniqueness sound of community, noticed by people in that community, and deserves to be protected (Schafer, 1994). This will affect the human sense. Soundmark will be used as an enhancement of the sense of place of an area, especially heritage areas.

Table 1. Acoustic condition of Taman Sari

Location	Dominant Sound	Faint Sound	Sound Intensity
Gapura Panggung	human voice, footsteps	sound of vehicles machine, the sound of wind in trees	66 dB
Gedong Sekawan	human voice, footsteps,	sound of water, wind sound, sound of water machine, bird chirping	62 dB
Umbul Binangun	human voice, footsteps, sound from mosque	water machine, bird sounds, footsteps, camera sounds, sound of water	59.5 dB
Gapura Agung	sound of broom sweeping, sound of motorcycle, human voice	sound of water, bird chirping, camera sounds, sound of broom sweeping	60 dB

Source : (Patricia Pahlevi Noviandri and Sabono, 2018)

Taman Sari Soundscape is different from then and now so that the soundmark of the past is not heard anymore (Patricia P Noviandri and Sabono, 2018). According to Noviandri (2018), Taman Sari's Soundmark regarding both past days and now days are water sound and bird sound. The soundmark in Taman Sari requires strengthening sound

DOI : dx.doi.org/10.22441/vitruvian.2021.v10i3.001

Vitruvian *Jurnal Arsitektur, Bangunan, & Lingkungan* | Vol.10 No.3 Juni 2021 : 177-186

that establishes the meaning of Javanese culture such as gamelan music or performance in this place (Patricia Pahlevi Noviandri and Sabono, 2018).

Taman Sari's soundmark is currently not heard sounds that enhance the atmosphere of Javanese culture but rather towards the sounds of activities from tourism such as the shutter camera, and human voices. A sound intensity that has a moderate to loud level is obtained from human voices. Taman Sari's soundmark in the present time is a human voice (table 1).

Nature sound like wind, trees, water, and birds sound, audible but not too clear to hear. Soundscape changes build upon a space design (Zhou, 2014a). This makes soundmark changes related to people's understanding, memories, and sense of the space. The idea of designing a soundmark which have a Javanese atmosphere through a low until the medium frequency of the sound source.

Javanese music instruments such as Gong and Saron Demung Laras Pelog have frequencies from 280 to 520 Hz (Mitrayana and Cytasari, 2014)(Trisnowati, 2017). Music with Javanese atmosphere has a low frequency, besides the sound of water as the main element in the creation of a sense of place in Taman Sari.

Improving the soundmark begins with understanding the acoustic conditions of the location, which is then used to put an activity with the sound produced so that it adds space characteristics. Understanding acoustic conditions are done by analyzing the sound behavior that occurs due to the sound given.

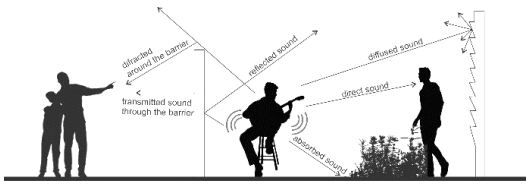


Figure 4. Schematic sound behavior (source: author, 2020)

Movement of sound waves depending on building materials, finishes, and components (Akinayo, Ayandokun and Okah-Avae, 2007). Sounds outdoor have sound behavior similar to sounds indoor, the difference is in the context of location.

1. Direct sound to a receiver
2. Transmission of sound through a barrier
3. Reflection sound
4. Diffraction of around the barrier
5. Absorption sound through ground and plants
6. Diffuse sound - reflected in rough material

This study takes analysis for sound behavior with considering the material and shape of a building for finding a location for soundmark placing in Taman Sari. After knowing the sound behavior, at the Taman Sari location will be simulated sound propagation that occurs, so that it knows the range of sound at each sound point. By observing the distribution of the sound, it can be seen where the sound source will be placed which can affect the atmosphere of Taman Sari so that it is more meaningful and feels Javanese culture.

RESEARCH METHOD

Data Compilation and Analysis Method

This research use experiment simulation using Ecotect software. Researchers find the location of the speaker (as the location of the soundmark: water sound, bird sound, or gamelan sound) from sound mapping in previous studies(Patricia P Noviandri and Sabono, 2018)(Patricia Pahlevi Noviandri and Sabono, 2018). The dimensions and materials are adjusted to the conditions at the location with material measurement, material mapping, and soundmark location applied in Ecotect software.

Every part of Taman Sari has one simulation so that the movement of sound in this area can be examined. However, the parking area located in Gerbang Kenari Area was not included in this simulation and analysis because in that area too much traffic sound (Patricia Pahlevi Noviandri and Sabono, 2018). That sound makes a unique sound that can be heard.

The type of material applied in Ecotect software is selected from their template that is as similar as possible to its original condition (figure 5). This material is chosen by a characteristic of material in terms of acoustics. It is mean the type of material based on how material influencing sounds, such as soundproofing, reflector, or diffuser.

DOI : dx.doi.org/10.22441/vitruvian.2021.v10i3.001

p-ISSN : 2088-8201 e-ISSN : 2598-2982

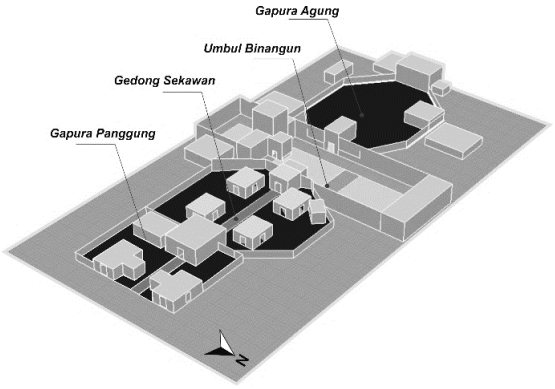


Figure 5 Taman Sari block site for ecotect simulation
(source: author, 2020)

This research depended on software, therefore, there is research limitation, such as:

1. Weather (temperature and wind) cannot be included in the calculation of sound propagation.
2. Speaker limitations in running simulations (1 speaker).
3. Sound propagation has limited space, this condition can be assumed that sound over the wall disappears because of wind. In this study, the sound source included in Ecotect is sound with low frequency as if it came from a Javanese music instrument or the water sound of a fountain.
4. 3D buildings are made simpler by only showing the original form.

Table 2. Material in Ecotect

Element	Material
Floor	ConcSlab_OnGround
Floor	PoolWater
Floor	ConcSlab_Tiles_OnGround
Floor	Exposed Ground
Wall	DoubleBrickSolidPlaster
Ceiling	SuspendedConcrete
Void	Void

Source: Ecotect, 2020

Research Contribution

This research is useful to give Taman Sari tourism ideas without changing physical buildings. The tourist sights are built through the viewpoint of sound that forms a thick atmosphere of Javanese culture and the history of Taman Sari.

RESULT AND DISCUSSION

Physical Aspect of Taman Sari

Taman Sari is a heritage site that has been influencing the history of the development of Yogyakarta. Currently, Taman Sari is a heritage tourism site that sits next to Kampung Taman Sari. Taman Sari complex is divided into 4 parts. The first part is the artificial lake located on the western side of *Taman Sari*, the second part is the *Umbul Binangun* bathing complex located in the south of the artificial lake, the third part is *Pasarean Ledok Sari* and *Garijitawati* pool which is located in the south of the bathing complex, and the fourth part is the eastern part of the first and second parts. It extends from east to southeast of *Kompleks Magangan*. In this study, which will be discussed is the second part of Taman Sari, i.e. *Umbul Binangun* Bathing Complex.

The remaining Taman Sari sites consist of *Gapura Agung, Umbul Binangun, Gedong Sekawan, Gapura Panggung*, and *Gapura Kenari* (figure 5). In the past, Taman Sari, the main entrance to Taman Sari area was located at Gapura Agung but currently the main entrance is located at Gapura Kenari.

Taman Sari Water Castle is divided into five sections. The first part is the *Gapura Panggung* which is the main gate for visitors. The second part is *Gedong Sekawan*, in this location, four buildings have the same shape. In the next section, entering the main attraction of Taman Sari, the *Umbul Binangun* area in the form of the King's bathing pool. The last part in the Water Castle area is the Great Gate.

Generally, Taman Sari does not have a variety of materials on its buildings and landscape (figure 7). Most of all buildings are made of stone with a thickness of 30 to 70 cm. For the landscape, the groundcover is a combination of softscape (sand and grass) and hardscape (plaster pebbles, stone and brick for pathways.).

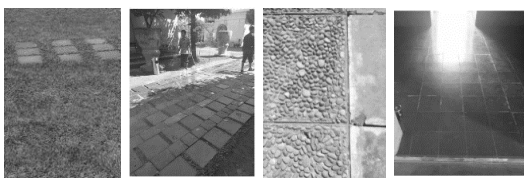


Figure 6 Landscape material
Source: author, 2018

DOI : dx.doi.org/10.22441/vitruvian.2021.v10i3.001

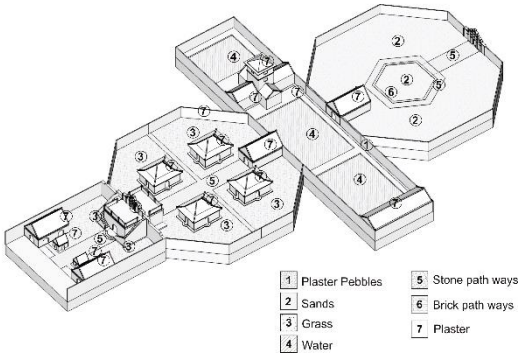


Figure 7 Material Identification of Taman Sari
Source: author, 2021

All the material in Taman Sari has a role in sound propagation. As can be seen in table 3, the surface material becomes an acoustic material as a diffuser, reflector, or absorber based on their characteristics. Taman Sari area is dominated by reflector material. That means Taman Sari has high sound propagation.

Table 3. Material's Role in the Sound Propagation

Material	Characteristic	Acoustic Role
plaster pebbles	ragged, hard	diffuser
sands	ragged, soft	diffuser and absorber
grass	ragged, soft	diffuser and absorber
water	smooth, soft	absorber
stone	Flat, hard	reflector
brick	Ragged, hard	diffuser
plaster	Flat, hard	reflector

Source: Author, 2021

Gapura Panggung

In the Gapura Panggung area, the sound source is placed inside the building at the front of the ticketing area (figure 9). The sound source is simulated into 6 sections on milli-second (ms). At the Gapura Panggung the distribution of sound is quite good (figure 8). Echo appears at 80 ms and gradually disappears inside the building, this is caused by building material that works as a reflector material.

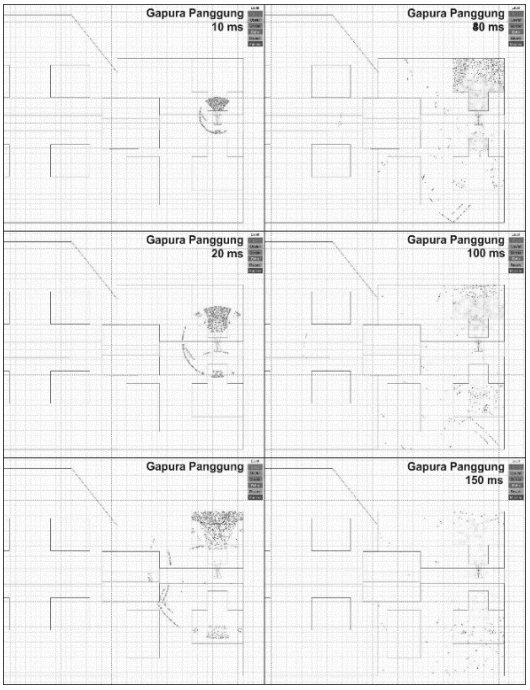


Figure 8 Sound Propagation of Gapura Panggung
Source: author, 2020

The sound that comes out towards the park spreads right across the sound source but is less able to spread towards the west. The sound that exists in the Gapura Panggung area is also spread inside the tunnel-shape building. This means in that section; someone can listen to the sound from the front side even it's not too loud.

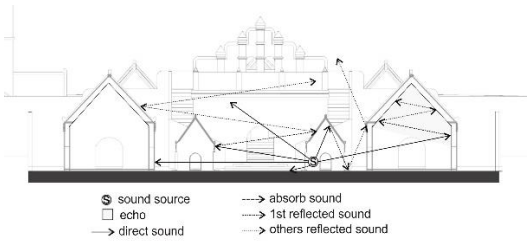


Figure 9 Schematic Section Sound Behavior of Gapura Panggung
Source: author, 2021

The echo appears at the building's ceiling. At this point, a sound source that is classified as a light sound (bird sound, or chicken sound) can be placed. This kind of sound source is suitable to strengthen the natural atmosphere that is emphasized in Taman Sari's sense of place but it does not make an echo.

DOI : dx.doi.org/10.22441/vitruvian.2021.v10i3.001

p-ISSN : 2088-8201 e-ISSN : 2598-2982

Gedong Sekawan

Gedong Sekawan has an interesting building configuration. Four buildings are symmetrically arranged in the middle of the area. Until now, the four buildings are unfunctional and only became an attraction for the visitors related to their layout and order.

Sound sources that can be placed inside one of these buildings are sound sources in the form of signals. In this type of sound, sound energy quickly disappears because in the building there is a possibility of a faster echo compared to other buildings (figure 10).

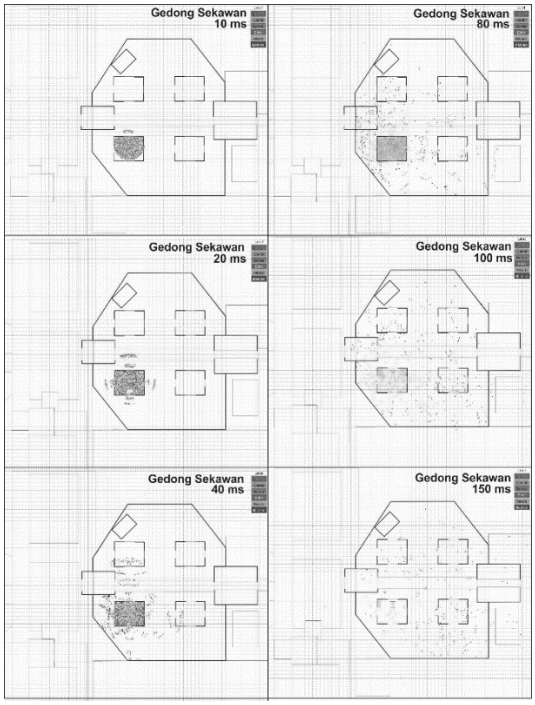


Figure 10 Sound Propagation of Gedong Sekawan
Source: author, 2020

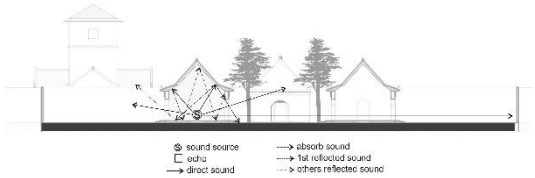


Figure 11 Schematic Section Sound Behavior of Gedong Sekawan
Source: author, 2021

The sound distribution is more dominant towards the southeast of the building, this is caused by many areas of reflection adjacent to the sound source. However, noise can spread to the middle of the area where visitors can walk to the next section. The placement of the sound in the form of a signal will affect the soundscape of Taman Sari area and become a sign for the visitor to enter the main area.

Umbul Binangun

In the pool area, two interesting points can be given a sound source. The need for these two locations is a result of the division of the pond area. One sound source will not be enough because of the separation of the pool area. Sounds that are placed can be the sound of fountains and animal sounds. This will improve the atmosphere of the park which is expected to be felt in the area.

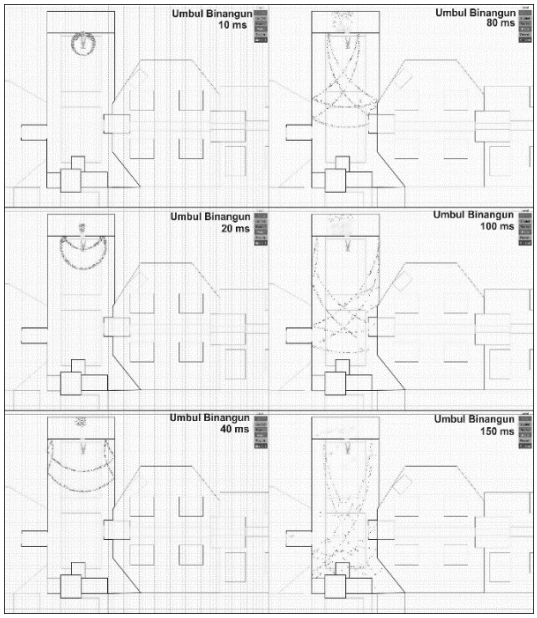


Figure 12 Sound Propagation of Umbul Binangun
Source: author, 2020

Sound distribution at both locations, north and south side, shows a fairly even sound (figure 12 and 13). However, the two sound sources in the pool do not have a high intensity to avoid double the dominant sound. Both locations are given a sound source that is useful to spread the sound.

The sound source in the northern pool has more reverberation than the southern. This is caused by the difference in the spatial dimension, that the northern has longer space. Whereas in the southern pool, the distribution of sound can last longer, echo

DOI : dx.doi.org/10.22441/vitruvian.2021.v10i3.001

Vitruvian *Jurnal Arsitektur, Bangunan, & Lingkungan* | Vol.10 No.3 Juni 2021 : 177-186

sounds are existing in the area due to the smaller spatial dimensions and also the reflector material around the sound source.

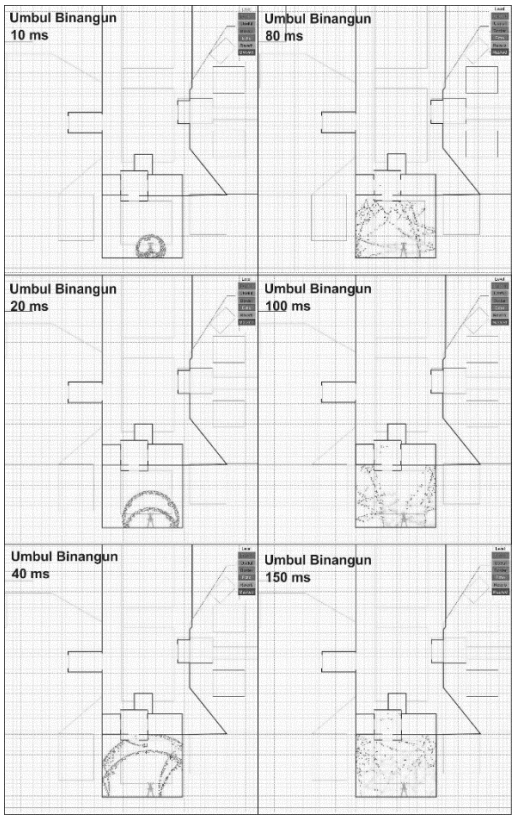


Figure 13 Sound Propagation of Umbul Binangun (south area)
Source: author, 2020

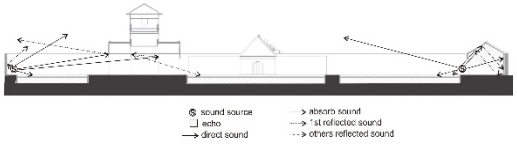


Figure 14 Schematic Section Sound Behavior of Umbul Binangun
Source: author, 2021

At this time, the pool at Umbul Binangun has a fountain that makes a sound. The existing sound source is able to provide the identity of the Taman Sari area. However, currently, the sound of water is not very audible to other parts of the Taman Sari area.

Gapura Agung

The final part of Taman Sari Water Castle is Gapura Agung. Gapura Agung is the end of this complex, then visitors will be directed to the Gumuling Well in another section of Taman Sari. Gapura Agung is often used by visitors to stop or rest before continuing their trip to other areas. At this location, several shops sell souvenirs, local products, and snacks.

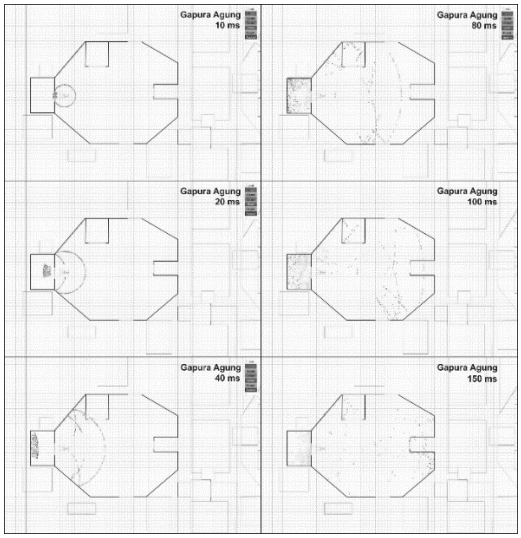


Figure 15 Sound Propagation of Gapura Agung
Source: author, 2020

In the simulation of the Gapura Agung section, a sound source located near the Gapura Agung facing east. Sound distribution in this section is quite good (figure 15), the sound can be heard evenly and reached the pool. This can be used as a trigger for people's curiosity to see what is on the other side. The middle part of the Gapura Agung can be used as the stage of events related to Taman Sari.

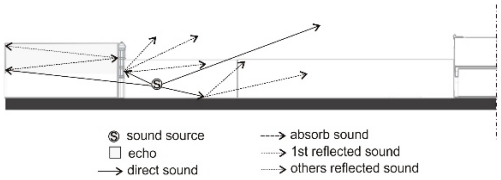


Figure 16 Schematic Section Sound Behavior of Gapura Agung
Source: author, 2021

The Gapura Agung area is an outdoor area surrounded by wall plaster with a landscape in the form of sand, stone, and brick so the sound will naturally be diffused and absorbed (figure 16). The balance of reflection and absorption material makes this

DOI : dx.doi.org/10.22441/vitruvian.2021.v10i3.001

area has a good acoustics performance for music (rhythmic sound) or another stage performance.

This simulation results of sound behavior principles related to reflection and absorption explain that there is a correlation between building geometry and sound material (such as stone, brick, water, plaster, and vegetation). Building with small dimensions and dominated by reflector material will have a very high possibility of echoes. The echo is not something that should always be avoided in terms of outdoor sound analysis. However, it can be used to give a different impression of space than other buildings.

Table 4. Sound behavior and the idea of Sound Source

Location	Sound Propagation	Sound Source
Gapura Panggung	Good spread but too much echo	Natural Sound from animals and plants
Gedong Sekawan	Too much echo at building	Signal
Umbul Binangun	Difficult to achieve even distribution of sound	Natural Sound from water and animals
Gapura Agung	sound spread equally	Music Performance

Source: author, 2020

The sound distribution that occurs in Taman Sari allows the placement of new sound sources to strengthen the sense of place that already exists. The sound given is not a new sound from outside but actual sounds that already exist at the location (table 4). Sound propagation in one location can determine a suitable sound source. From table 4, explain the recommendation of the sound source based on analysis of sound propagation.

Gapura Panggung has a good sound spread but has too much echo so that natural sound, as well as birds sound or chicken sound, can make different ambiance for entering Taman Sari sites. *Gedong Sekawan* has an echo if a sound source is put in the building. Therefore, the signal sound (such as sound from Gong) which just has one frequency can be suitable in this place. *Umbul Binangun* has long area. Consequently is the sound can not hear from side to side. Therefore, sound sources are put in two areas of *Umbul Binangun* and have some different sound sources. Gapura Agung is an open space with a solid barrier, so that sound is spread equally. This condition opens the opportunity to provide a rhythmic sound source. The sound intensity is increased so that the spatial experience of the visitors can be felt both visually and audibly.

Enjoying architectural space requires understanding and design of space that can display multisensory in public spaces so that it can provide sensitivity to the phenomenological character themselves (Borucka, 2015). Combine the specific condition of the environment and then explore the symbolic soundscape in the local place (Zhou, 2014b) make uniqueness for that space. This is an effort made in creating an interesting soundscape in Taman Sari to strengthen the social and cultural values that exist.

CONCLUSION

Strategic and creative approaches are important to conserve the value of heritage culture that can exist until today. One strategy to improve the performance of heritage buildings without many interventions on physical aspects is the improvement of audial experience. With this, the sense of place of a heritage tourism location can also be improved.

The placement and sound type selection depends on the specific physical conditions and geometry in the location. Through the Taman Sari case study, the elements of hardscape and softscape have a big role in influencing the behavior of sound characters in Taman Sari. Sound behavior found at Gapura Panggung and Gedong Sekawan is reflected sound which is produced echoes. Sometimes reflected sound changing to diffused sound because of ragged material such as brick and grass. Direct sounds can be heard clearly by tourists in different segments.

Regarding the analysis of sound behavior, some idea of sound source has

DOI : dx.doi.org/10.22441/vitruvian.2021.v10i3.001

appeared. Light sound can be placed some natural sound from animals, plants, or water at Gapura Panggung and Umbul Binangun. A loud sound can be placed at Gapura Agung and Gedong Sekawan. These places will have a different atmosphere to make sense of place in Taman Sari.

REFERENCES

Akinayo, O., Ayandokun, A. and Okah-Avae, O. U. (2007) *A Write-up on the Propagation of Sound, its Travel Path, Travel Medium, and Behavior in the Mediums*. Akure, Ondo State.

Ardika, I. G. (2019) *Sustainable Tourism: Clear The Path Through Communities*. Edited by N. Kuaranita and M. I. R. Asityasari. Jakarta: Kompas.

Borucka, J. (2015) 'Sound art and Architecture: New Horizons for Architecture and Urbanism', *Procedia - Social and Behavioral Sciences*, 174, pp. 3903–3908. doi: 10.1016/j.sbspro.2015.01.1131.

Cross, J. E. (2001) 'What is Sense of Place ?', in *Headwaters Conference*, pp. 1–14.

Dinas Pariwisata Daerah Istimewa Yogyakarta (2019) *Statistik Kepariwisataan 2019*. Yogyakarta: Dinas Pariwisata Daerah Istimewa Yogyakarta.

Hashemnezhad H., H. A. K. & H. P. M. (2013) 'Sense of Place" and "Place Attachment" (A comparative study)', *International Journal of Architecture and Urban Development*, 3(1), pp. 5–12.

Hu, M. and Chen, R. (2018) 'A Framework for Understanding Sense of Place in an Urban Design Context', *Urban Science*, 2(2), p. 34. doi: 10.3390/urbansci2020034.

Khotimah, K. and Wilopo, W. (2017) 'Strategi Pengembangan Destinasi Pariwisata Budaya (Studi Kasus pada Kawasan Situs Trowulan sebagai Pariwisata Budaya Unggulan di Kabupaten Mojokerto)', *Jurnal Administrasi Bisnis S1 Universitas Brawijaya*, 42(1), pp. 56–65.

Miller, N. (2013) 'Understanding Soundscapes', *Buildings*, 3, pp. 728–738. doi: 10.3390/buildings3040728.

Mitrayana and Cytasari, V. . (2014) 'Pengukuran Frekuensi Bunyi Saron Demung Laras Pelog Gamelan Jawa Menggunakan Perangkat Lunak Visual Analyser', *Fisika Indonesia No 54*, XVIII.

Noviandri, P. P. (2017) 'Soundscape mapping in heritage area (Case Study: "Legi" Market, Kotagede, Yogyakarta, Indonesia)', in *Proceeding Wuicace The 1 st Warmadewa University International Conference on Architecture and Civil Engineering*, pp. 275–282.

Noviandri, Patricia P and Sabono, F. (2018) 'Adaptasi Bangunan Cagar Budaya Tamansari Yogyakarta Terhadap Perkembangan Jaman Melalui Soundscape', in *Seminar Ikatan Peneliti Lingkungan Binaan Indonesia (IPLBI)*. Makassar: Ikatan Peneliti Lingkungan Binaan Indonesia (IPLBI), pp. 78–86.

Noviandri, Patricia Pahlevi and Sabono, F. (2018) 'Kajian Perubahan Ruang dan Soundmark Kawasan Wisata Pusaka Tamansari Yogyakarta', *Atrium*, 4(1), pp. 11–22. Available at: http://library.ukdw.ac.id/atrium/index.php/atrium/article/view/96/40.

Schafer, R. M. (1994) *The Soundscape : Our Sonic Environment and the Turning of the World*. Rochester, Vermont: Destiny Books.

Trisnowati, E. (2017) 'Analisis Frekuensi pada Gong Laras Slendro', *Indonesian Journal of Science and Education*, 1(1), pp. 30–35.

Zhou, M. (2014a) 'Research on Soundmark of City Soundscape', in *The 21st International Congress on Sound and Vibration*, pp. 2013–2015.

Zhou, M. (2014b) 'Research on Soundmarks of Soundscape at Historical District', *Applied Mechanics and Materials*, 584–586, pp. 521–524. doi: 10.4028/www.scientific.net/amm.584-586.521.