

# Auditory Exploration of Derinkuyu Underground City Cappadocia Turkey

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**ABSTRACT:** This study seeks to understand the soundscape of Derinkuyu Underground City in Cappadocia in Turkey and its sonic characteristics from an analytical and practical point in relation to its different urban spaces with the application of acoustic space and arena theory and soundwalk methodology to understand these sonic experiences. Firstly, characteristics of Derinkuyu Underground City is described. Then the methodology is analyzed and the experience of the soundwalk on site is described. Later, the sonic observations that are unique to the site are presented and discussed. Finally, a further discussion is set regarding the lo-fi/hi-fi soundscape theory to analyze the social and cultural impacts of the city's soundscape and how the inhabitants of the city might have perceived their sonic environment.

**KEYWORDS:** soundmark, soundwalk, hi-fi soundscape, derinkuyu underground city.

## 1. Introduction

Soundscape could be the acoustic manifestation of a place, where the sounds give the inhabitants a sense of place (Fisher 1998) and identity. Soundscape could also be considered as a collection of sonic events; which also includes the aural architecture of the environment or a city. It can be suggested that a social unity among its inhabitants could be created by the special attributes of an aural architecture. Aural architecture does not only deal with the sound propagation or physical properties of sound; however, it evokes the question of perception of sound and the experience of a space by listening to it.

In this paper, characteristic sonic events that create the soundscape of Derinkuyu Underground City in Turkey are detected, its aural architecture is examined and it is analysed whether the special sonic events could have contributed to a social cohesion and feeling of identity among its inhabitants. Firstly, this study investigates the soundscape of Derinkuyu Underground City and its sonic characteristics with the application of acoustic space and arena theory as discussed by Blesser and Slater (2007). The theory defines auditory spaces as acoustical arenas, which are spaces defined and reproduced by sonic events. Then the soundwalk methodology is described and analysed to understand these sonic experiences in relation to different areas of the city leading to the discussion of the unique sonic events of an underground city and the exploration for the soundmark of the city. Within this framework, authors' soundwalk of Derinkuyu Underground City experience was used for associating and perceiving these experiences during the field research. The perceptions of the authors in the acoustic environment of Derinkuyu Underground City are in the centre of this paper. Finally, a discussion is made to understand the social and cultural impacts of the characteristic sonic events on its inhabitants in relation to the hi-fi and lo-fi soundscape theory of Murray R. Schafer (1977). The study focused not only on the soundwalk and sensory perceptions but also concentrated on the cultural history of the city to identify daily life and communication in the city.

The main objective of this study is to explore and define the unique sonic events of Derinkuyu Underground City and to discover whether there was a soundmark of this city. It could be claimed that there is a direct relation between soundmark of a city and how its inhabitants form and perceive their environment. It is aimed to understand if these unique sonic events and a possible soundmark of the city have created a unique acoustic manifestation for the underground city and its inhabitants.

## 2. Theoretical framework

In this section, the theoretical framework which describes soundscapes as acoustic spaces and acoustic arenas as described by Blesser and Slater (2007) are discussed to understand

how sonic events may define an urban soundscape. An acoustic arena could emerge when a particular event is heard by a group of people and a boundary is defined around an acoustical arena. The particular sonic event cannot be heard beyond this boundary. The particular properties of an acoustical arena are determined by the power and the frequency spectrum of the sonic source, the aural architecture, and the material properties of the structural elements and the volume of the physical space. The acoustic arenas might be flexible volumes depending on the sonic source and their interaction with the other acoustic arenas. The acoustic arenas can be experienced in large scales in urban areas. The topography, urban architecture, the traffic speed; they can all effect the boundaries and qualities of the acoustic arena in an urban area.

Distinguishable sonic events; such as traffic noise, train or boat noise, entertainment noise, sound of a specific wind, sound of a park with birds, fountains may be a unique sonic event that is recognized in that particular acoustic arena. These unique and distinguishable sonic events might be the “soundmark” (as defined by Murray Schafer 1977) of that acoustic arena or it can even define the boundaries of the acoustic arena itself. Group of people who are subjected to this unique sonic event can associate this sound with certain feelings, values or events. This soundmark can create a social cohesion among the inhabitants of an acoustic arena. The inhabitants can share the meaning of the sound and relate it to their unique acoustic arena. People might experience the urban acoustic arena through its soundscape with its sound symbols.

### 3. Derinkuyu Soundwalk and Sonic Observations

The underground cities had great potential as a defense strategy in ancient times to protect its inhabitants from battles. One of the most interesting and largest ancient underground cities is the Derinkuyu Underground City in Cappadocia, Turkey. Derinkuyu is a multi-level underground city which extends between 60–85 m below the ground surface. It was not yet possible to discover the complete extent of the city; however, it is estimated that it might accommodate approximately 20000 people at the same time. The city is also believed to be interconnected with various other underground cities via tunnels.

Derinkuyu has many of the spaces that are generally to be found in an underground city, such as stables, pantries, refectories, churches, living quarters and spaces for wine production. There are seven or eight floors in the city; however, the floor concept here is different from how it is used today. The floors do not have definite boundaries and are not exactly placed under the upper floor and the vertical distances between the floors can change from place to place.

Derinkuyu Underground City had originally many entrances from the surface, mostly very well concealed; however, at the moment the entrance to the city is from one designated

entrance. The soundwalk starts with steps in a tunnel lead down to a room, probably 3–4 meters below the surface. Entering this narrow tunnel marks first impression about the soundscape of the city; all the natural sounds that could be expected from an open air city are blocked. The ambient soundscape feels much more intimate. Then there is a much larger space, which is interconnected with other rooms. The larger space is supposed to be a stable for the animals and the other relatively small rooms are wine pressing rooms. The soundscape of these area are dominated by the high reverberation time. When other visitors filled the space, the loudness of the conversations of the people is too high. This is due to the relatively large volume; however, mostly due to the reflective materials.

Then branching tunnels go in different directions either as descending steps or ramps. These could be regarded as the vertical streets of the city. This soundwalk is mostly a vertical soundwalk in the city. It is also important to mention that it is dark all the way along in this city. At the end of the vertical street (Figure 1) there are larger spaces which can be equivalent of public squares. The dominant soundscape is a reverberant soundscape and an instinct to speak softer. These spaces lead to the residential areas of the city by long, narrow, winding tunnels. These long passageways combined with relatively larger volumes produces a Helmholtz Resonator effect; an acoustic structure that amplifies narrowband frequencies.

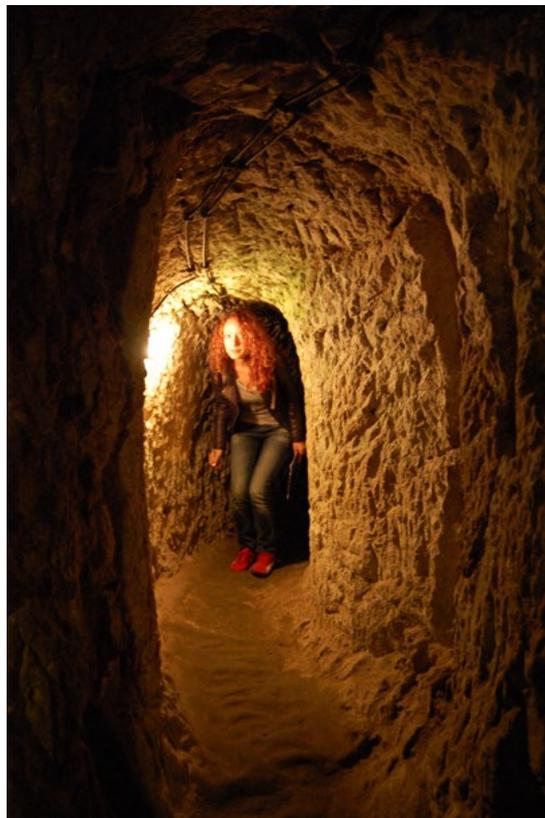


Figure 1. The end of a tunnel leading to a new level.

The individual living spaces are separated by arches, columns or walls; however, it is still impossible to have a private soundscape; since there is no private space with airtight boundaries. In between floors there are ventilation holes with diameters of approximately 5–10 centimetres, carved into the floor and ceiling of rooms to allow for ventilation and communication. The inhabitants of the underground city were able to communicate without having to walk through long and tiring tunnels and to act quickly and easily in emergency situations. This creates a unique soundscape for the living quarters of the city.

After levels of living quarters of the city, the deepest section is reached by the steep, long and narrow passages with sudden changes in direction. The lowest levels are reserved for church (Figure 2), cemetery and the end of the main ventilation shaft. The church is a relatively large area covered with a vault. The soundscape of the church is so loud that when more than one people talks, speech intelligibility blurs. In addition to that, if people want to talk each other they talk in a low voice due to the highly reflective materials around. The level of background noise determines the quality of an acoustic arena here. It can create a state of psychological tranquillity; a cooperative agreement to respect the public soundscape and be silent.



Figure 2. The church at the deepest level.

The main ventilation of the city was also located at the lowest floor. The importance of the ventilation shafts cannot be understood at first instance through the soundwalk. Most of the city was air conditioned throughout 4 main airshafts and at least 15,000 ventilations ducts (also communication holes) provide fresh air into each rooms of the underground city.

These ventilation shafts as communication holes contribute to the unique soundscape of the Derinkuyu Underground City. The city is organized around these ventilation shafts. It can be argued that the acoustic boundaries of the city is defined by the extent of the shafts and airducts. The isolated units of the city have the experience of social inclusion. It expands the acoustic arena and creates a vertical acoustic arena as well as a horizontal one.

It would be argued that ventilation holes create a shared experience of a soundmark and a sense of belonging and the feel of a particular city. In the exploration of a soundmark for Derinkuyu Underground City, the main ventilation shafts are regarded as the soundmarks.

## 4. Social and Cultural Dimension

Murray Schafer (1977) claims that ancient times have hi-fi and modern times have lo-fi soundscapes. He calls hi-fi soundscape that “allows the listener to hear further into the distance just as the countryside exercises long-range viewing”. He continues to say “sound overlaps less frequently” in ancient times:

there is a perspective – foreground and background sound relations. In modern cities there is no distance; there is only presence. (Schafer 1977)

Because there are lots of noise and they overlap that you cannot differentiate the sounds and their distances. Therefore, we believe that Derinkuyu has a hi-fi soundscape, people in Derinkuyu can easily hear each other and they might communicate very efficiently. These narrow corridors and rooms do not allow too much diffusion of sound waves and it was experienced by the authors that it is possible for people to find their ways following the sounds. The sound source distance and the direction can be understood very easily because of hi-fi soundscape. These thousands of small ventilation shafts which are connected to the 4 big main shafts can easily spread the sound. People in Derinkuyu could easily understand that where the sound coming from and which way to reach its source.

M. Schafer (1977) also asserts that people who live in small communities (he means villages rural areas also ancient times) have their ears always alert so that they know how to read changes in the sound environment. The soundscape of the Derinkuyu is so intense that it is almost impossible to hear clearly when 4–5 people talk at the same time in a room. In addition to that, if people want to talk to each other they should talk in a low voice. Of course when they use the air shafts for communication they should shout and wait for the response in the head of the shafts. This creates a vertical sonic perspective in ancient times. For instance, when one of the four main shafts is listened, there is a sonic perspective on the lowest level. This hi-fi sonic perspective creates a different listening experience on people in Derinkuyu. There are layers in sonic environment and if people want to stay alert during enemy interventions they should differentiate these layers and understand the distance and direction of the sound. Only hearing the voices should not be enough to stay alert. Therefore, it is believed by the authors of this paper, that the inhabitants use different listening modes in Derinkuyu. It should be understandable and useful that reading these modes through Barry Truax’s (2001) and Michel Chion’s (1990) different listening modes.

Truax's Listening-in-readiness is based on alert listening mode when there is an important sound and taking attention. It is

...an intermediate kind of listening, that in which the attention is in readiness to receive significant information, but where the focus of one's attention is probably directed elsewhere. (Truax, 2001)

#### Listening-in-readiness

depends on associations built up over time, so that the sounds are familiar and can be readily identified even by "background" processing in the brain. (Truax, 2001).

In Derinkuyu, people always should be alert against enemy actions. They always listen their environments especially ventilation shafts very carefully.

Even when a sound is unfamiliar or unexpected, this type of listening is ready to treat it as new information and evaluate its potential significance. (Truax, 2001).

They read every sound very carefully and analyze it according to its semantic meaning and source. Chion (1990) claims that semantic listening "refers to a code or a language to interpret message" (Chion, pg. 23). This semantic listening mode in Derinkuyu could help people to locate the treat and save their lives. Trying to understand the codes and the languages and paying the full attention to listening could create different and more layered mode than they have during their daily life in their village on the ground level. Also, this layers has not only horizontal perspective also vertical perspective that they should have to understand the directions.

Listening is a multidirectional time based event compared to seeing. Seeing is mostly directional and limited to angle of our eyes. However, listening wider; almost omni-directional event that our ears can hear sounds around us. Therefore, living experience in Derinkuyu with a limited view (narrow corridors, limited light sources, small places) is so difficult to compare to the rural life in the village on the ground level. In addition to that, listening becomes more important and peoples' ears stay in sonic alert mode more often. While the senses are posited as distinct fields, they operate and interact within a general structural frame of the body. This perspective posits an important break from treating the listening act as merely decoding or categorizing, but rather conceives of a whole body experience that creates a "resonant" subject (Nancy 2007). Although, it is very hard to see

enemy or other treats in this huge underground city, listening vertical sonic perspective in the ventilation system creates a safe place for their daily lives in Derinkuyu Underground city. We believe that, this multidirectional listening event also create a different time and space perception in the city.

## 5. Concluding Remarks

The main ventilation shafts and thousands of ducts connecting each otherwise isolated units of the city could be claimed to be the soundmark of the city. The inhabitants of the underground city were able to communicate without having to walk through long tunnels and to act quickly and be informed of what was happening. The boundaries of the city and acoustic arenas were defined by these ventilation ducts and main shafts. It could be claimed that the communication holes create a shared experience of a soundmark and a sense of belonging in Derinkuyu Underground City. It was also further examined how perspective of the sound helped people to find their ways and survive during the wars to emphasize the importance of hi-fi soundscape environment in Derinkuyu Underground City.

However, the effect of communication holes especially in different areas of the city and its cultural impacts needs to be further researched and supported via acoustic measurements such as reverberation time measurements and also background noise levels measurements.

It is also foreseen that research from Derinkuyu Underground City may contribute to the prediction of possible soundscapes for future underground cities; which is a great possibility to build more and more in the future.

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