AN ACOUSTICAL PALETTE FOR URBAN DESIGN

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Abstract
An acoustical palette for urban design interventions was developed as part of a soundscape study for the redevelopment of a transition district in a medium-sized city. Design strategies included reducing, buffering and mitigating undesirable existing sounds; preserving and enhancing desirable existing sounds; and introducing design elements that bring with them new sounds and activities that are desired to enhance the acoustical, architectural and social life of the district. A series of acoustical measurements, modeling, auralizations and corresponding architectural design studies were executed to explore the possibilities for the acoustical interventions as urban design strategies. The result of the study consists of a series of aural and architectural images of proposed design elements for inclusion in the new district plan.

INTRODUCTION

The project site was a transition neighborhood between a large university campus and suburban residential neighborhoods to the west of a medium-sized city in the southeastern United States. A number of student housing complexes are grouped along a major automobile transportation artery with some bus service connecting the student apartments with the university campus. The roads are heavily congested during busy times of day. There is little pedestrian activity in the area. There are also few retail, dining and commercial establishments at the present time. An architectural and urban design team was asked to investigate future opportunities for comprehensive ecological, transportation, housing and mixed–use urban sustainable development for the area. A soundscape study was conducted as part of the initial site analysis. Acoustical interventions were proposed for the new development in the area to complement the architectural and urban design proposals.

METHOD

The soundscape study consisted of 7 elements.

1. Qualitative observations of the type, level, time duration and sources of sounds were recorded during a series of sound walks. The sound walks were taken at representative times of day: early morning, the middle of the day, afternoon, evening and night to gain an understanding of how the type and character of activities and sounds varied over the course of typical days. Primary and secondary acoustical zones were identified in the project site.
2. Long term average acoustical measurements of typical ambient sound levels were made at multiple locations within the district to document the acoustical conditions in each of the major acoustical zones identified within the project area. Overall A-weighted sound levels and a variety of statistical measures were recorded at each location for several days. A Rion NL 32 sound level meter in an environmental case was used for these measurements. Average day night sound levels and other long term acoustical metrics were calculated from these data.
3. Short term measurements of specific acoustical events that occurred in each of the acoustical zones and which contributed to the ambient sound levels were recorded as both overall A-weighted sound levels and octave band sound pressure levels. The short term measurements of specific acoustic events were recorded to isolate to the extent possible each of the sounds that comprised the ambient at each location as well as specific combinations of sounds that occurred simultaneously. An Ivie PC 40 real time analyzer and a Cesva SC 310 type 1 sound level meter were used for these studies. These measurements were made during each of the sound walks at representative times of day so an acoustical profile of the specific acoustical events that comprised the ambient sounds at different times of day could be developed.
4. Calibrated recordings were also made of the specific acoustic events in each zone to document the aural complexity of the soundscapes as well as the source sounds that contributed to the overall sound levels at each location.
5. Acoustical mapping of the soundscapes graphically depicted the findings over the project area.
6. Focus group discussions with the design team were conducted to identify the categories of sounds found in the soundscape studies and to develop potential acoustical intervention strategies that could be considered in the project.
7. Acoustical modeling of various types was conducted to evaluate the various elements included in the acoustical palette to understand how and where each element could be used.

OBSERVATIONS

The sound walks identified 5 primary acoustical zones within the project area and several transition zones located between the primary zones where the characteristics of each were found.

A primary acoustical zone ran along SW 20th Avenue, the main transportation artery running east and west. This zone was dominated by traffic noise on the street with an LDN of 65 dBA. Typical sound levels of automobiles moving on the street were 58-64 dBA during the day time hours. These levels decreased to 48-56 dBA as the number

of cars decreased during the night time hours. The loud sounds as the city busses started and stopped numerous times directly on the roadway were a characteristic sound heard at regular intervals. Sounds from I-75 in the distance and some of the natural sounds could be heard between cars on the road especially during the night.

A second acoustical zone was identified within the residential housing complexes behind the first row of buildings facing the main street. This zone was dominated by the sounds of medium density residential living. This included people driving to the parking lots, residential air-conditioning units operating, people talking and other sounds typical of suburban apartment living. The LDN was 55 dBA with typical sounds of cars on the roads of 48-53 dBA during the day time hours. Ambient levels of 40-45 dBA including distant traffic on SW 20th Avenue and I-75 as well as air-conditioning units and natural sounds such as wind and insects were recorded at night.

A third acoustical zone was identified 4 blocks away from the main street where the apartment complexes adjoined a large natural area. This zone was dominated by the sounds of the natural environment with the traffic sounds heard only in the remote distance. The LDN was 49 dBA with sound levels varying from 38-47 dBA as the wind blew through the trees, birds flew into the area and left and insect activity increased and decreased. Sounds of traffic on SW 20th Avenue and I-75 were heard in the distance.

A fourth acoustical zone was identified along SW 34th Street. This is a 4 lane heavily trafficked road running north and south along the eastern edge of the project site. There are a number of large commercial establishments located along this road. The soundscape is dominated by traffic noise and the sounds of the commercial enterprises located along the street. This zone had an LDN of 75 dBA at a location near SW 34th Street. Sound levels of 69-73 dBA from traffic were recorded during day time hours. Sound levels decreased to 57-64 dBA during night time hours as traffic decreased. Traffic sounds came in very discreet “pulses” Sounds from commercial air-conditioning units, loading and unloading of deliveries at stores, waste removal and compaction, cars entering and leaving parking lots, opening and closing of car doors, people speaking as they walked to and from their cars and other sounds typical of suburban shopping areas were identified.

A fifth acoustical zone was identified running parallel to I-75, a major interstate highway that runs north and south along the western edge of the project site. High sound levels from large numbers of automobiles and heavy trucks traveling at very high speeds dominated the soundscape of this zone. An LDN of 67 dBA was recorded approximately 60 meters from the roadway. Sound levels of 58-63 dBA were recorded consistently during day time and night time hours as the number and types of vehicles varied on the road. More trucks were generally present during night time hours.

Transition zones that incorporated characteristics of each of the primary zones were found in the areas between the zones. This occurred as sounds from each zone decreased in level as the distance from the sources increased. The transition zones had the characteristics of both zones at reduced levels.

RESULTS

The concept of a soundscape or acoustical landscape allows one to identify the types of sounds that are not desirable in the existing and future contexts and to propose methods to reduce, buffer and mitigate these sounds. The language of a soundscape includes

keynote sounds, sound signals, the acoustic horizon, soundmarks and acoustic events. The acoustic metrics associated with documenting specific acoustic events such as time and frequency specific metric as well as recorded sounds transform technical language or environmental acoustics into an aesthetic language that can be used by architects and urban designers. These terms facilitate discussion among design team members and community residents who are making aesthetic rather than technical decisions about the built environment.

Discussions with design team members indicated that increased social activities, outdoor gathering spaces, possible outdoor dining, walk-up retail, dining and shopping areas, recreation of various types, walking and bicycle travel were among the activities included in the master plan for the area. Many of these activities did not occur in the existing neighborhoods. Physical interventions were being designed to create environments where these activities could occur. Focus group discussions with the design team identified acoustical strategies that could be developed to support the architectural and urban design strategies. A series of acoustical interventions were developed for each of the strategies.

The sounds of high density traffic flows on SW 34th Street, SW 20th Avenue and I-75 mask or cover up many of the natural sounds in the area. They also interfere with communication among people at normal conversational levels. The design team sought methods to reduce traffic flows and the associated noise and to develop alternate, sustainable modes of transportation.

There are 3 primary acoustical strategies that were addressed in the initial design for the area to reduce, buffer or mitigate existing sounds that were identified as undesirable in the redevelopment plan.

1. **Reducing and/or masking of the noise sources.** This may include the use of electric buses, reducing the number of car trips on the road, increasing the number of bicycle and pedestrian trips, etc. This may also include the addition of masking sounds such as background amplified music in gathering spaces such as indoor/outdoor cafes; the use of flowing water, fountains or water falls in transitional areas between noise sources and gathering spaces; and locating active play areas between noise sources and areas where quieter activities may occur. Separating through transportation routes from local traffic to reduce flows and associated noise levels as well as developing infrastructure for alternate transportation modalities such as bicycles are also included in this strategy.
2. **Buffering areas where people may gather and/or walk from primary sources of noise.** This may include separating sidewalks and gathering spaces from major through traffic by distance and/or topography; providing integrated acoustical and landscape buffers and filters between traffic thoroughfares and places of repose, congregation and pedestrian transportation; and providing landscape and constructed elements to define space and reduce noise entering the space.
3. **Mitigating primary sources of noise in areas where strategies 1 and 2 can not be implemented for a variety of practical reasons.** This may include the use of noise enclosures of various types around either the sources or receiver locations of various types.

Sounds that are worthwhile to preserve, include and even possibly enhance in the proposed neighborhoods/urban community can also be identified both from the existing context as well as from similar communities in other locations. Preserving and enhancing sounds in the existing soundscape and adding new sounds to provide added acoustical meaning to the community require a different set of strategies. These include the items listed below.

1. Provide distance and/or barriers between soundscapes identified as being worthwhile to preserve and/or enhance and both new and existing sources of noise.
2. Zone activities on the site to locate those program elements that can use and/or enhance the soundscapes near them. For example, the bicycle and pedestrian paths as well as the dog park and soccer fields can be located to adjoin the natural areas rather than locating transportation arteries in these areas.
3. Arrange the program activities in such as way that they can either buffer or mitigate intruding noise. For example, buildings and walls can be organized to shield outdoor gathering areas from primary noise sources.
4. Provide acoustical or soundscape design concepts for each program activity and each "zone" of the site.

Adding new acoustical elements to the soundscape that are not present in the existing community that may encourage the architectural and urban design goals for the project included the items listed below.

1. Importing neutral and/or natural sounds into the area as a masking noise or soundscape element including fountains, flowing water, textured surfaces for walking and driving, sculpture that can catch the breezes and produce soothing sounds, wind chimes and others.
2. Allowing the sounds of gathering activities to flow from the space of origin through a series of designed spaces to provide acoustical foreshadowing of the event to encourage participation.
3. Designed areas of quiet and repose where people can retreat from urban life when desired.
4. Importing specific sounds with qualities to support or stimulate program activities including background and foreground music, clock towers, carillons or other sounds of social significance.

CONCLUSIONS

The soundscape studies defined a method to assess acoustical conditions in a complex urban environment. A series of acoustical interventions associated with reducing, buffering and mitigating undesirable sound sources; preserving and enhancing desirable sound sources; and creating new and desirable attributes to an urban soundscape have been identified.

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