

Appreciation of Soundscape Design of Traffic Streams at Road Junctions – A Case Study of Ring Road Junction, Vijayawada, Andhra Pradesh, India

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ABSTRACT: Urbanization is a worldwide phenomenon. Globally, there is a constant increase in urbanization across various cities. Cities' urban spaces, in terms of open, built-up, and green space, are changing as a result of this rapid development. Creating or redefining an urban environment necessitates careful planning and guidelines, as well as a user-friendly approach to design. The visual aesthetics of a space are prioritized over all other dynamics and considerations required to complete a proper urban setting. Roads and built-up spaces are key components of an urban setting. The sound propagation in between these spaces decides the livability of people. In most of the urban cities across the world, the increasing noise level in the communities put forth a major issue for its people and their livability. Redesigning the spaces with alternate strategy to create a better acoustical urban environment is important. One such strategy is soundscape and it uses environmental sound to redefine an urban space. A soundscape approach to the design will bring out a positive and stress free surrounding. This paper aims to study and understand urban sound and the implementations of soundscape design in urban environment through case studies. Also intends to examine the existing case of the Ring Road Junction in Vijayawada and propose a soundscape strategy that can be implemented to create a less noisy junction. The paper concludes by proposing a strategy for designing an urban soundscape.

Keywords: - Urbanization, Traffic streams, Soundscape, Urban Acoustics, Urban Environment

1. INTRODUCTION

Auditory (listen / hearing of sound) is one of the five sense of human body. Sound is an important element that plays a major role in the mental and physical health of human being. As the livelihood of people depend upon sound they perceive, it's quality determines whether the place is a suitable environment for a happy living. The transmission of sound in open and built-up spaces is significantly different but the way of perceiving is the same. Considering these conditions, the research on sound in urban designing and planning is growing. One such research is soundscape in urban planning. The term "soundscape" refers to the "perception of the acoustic environment as perceived by people in that place, in context." (Weber, 2012). Soundscape by itself is a vast region of study and has different outcomes to the designs considering the physical factors such as location; demographic factors such as population, vehicular movements and footfall and infrastructure factors like open and built-up areas. This paper particularly deals on role of sound scape in urban design in case of plazas and junctions at traffic signals.

The paper focuses on understanding the term soundscape and the major elements in soundscape. Case studies of traffic

junctions and plazas in urban areas are selected to understand the problems faced by the people and how soundscape offers a suitable solution. With this understanding, a set of considerations is formulated for planners and designers to be considered while designing an urban environment.

2. RESEARCH AND LITERATURE

2.1 Sound and Noise

Sound and noise are two different things. Noise is unwanted sound that usually create nuisance to the environment. Music and sound are pleasant to hear and generate a soothing effect. Poor urban planning may lead to noise pollution. Noise pollution is the leading cause of outdoor noise worldwide, and it is primarily caused by machines, transportation systems, motor vehicles, air crafts, and trains. A good urban plan should be able to control and reduce noise pollution through it's strategic planning of land use, open and green spaces, pattern and nodes of the city.

2.2 Urban sound and it's classification

Urban sound is the sound produced by cities and their inhabitants. Urban sound can be classified according to characteristic sound and acoustic environment of the cities. This method is intended for use in urban analysis and thus in

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the preparation of supporting documents for the planning process and its effective tool in planning and urban design. Urban sound can be classified into two categories, the natural acoustics and the human made acoustics.

Natural acoustics refers to the sound produced by natural resources in their natural soundscape, like the sound of any living organism (Jesper et al, 2010). The study of these natural acoustics helps in understanding the different dimensions of the city and how these dimensions help in creating an identity to it. The natural acoustics can be further classified into two board categories of Geophony : the sound generated by the environment and Bio-phony : the sound generated by the organisms other than humans.

Geophony is the sound generated from water, wind, rain and other natural process (Bryan et al, 2011). For example: sound of water from a fountain in a junction/roundabout – it creates an soothing environment and diminishes and masking the traffic noise thus creating an environment less stressful for the pedestrians and street hawkers on the road.

Bio-phony is sound generated by living organism other than humans such as birds, movement of leaves in trees (Bryan et al, 2011). For example: Central park in New York has created a habitat for the birds to be indulged in today’s scenario creating a blissful environment to live in and to escape from the monotonous lifestyle. “Many cities, including New York, have set a goal of ensuring that every resident has access to a park or green space within a 5–10-minute walk. Such goals could be expanded to include not only a park, but also a quiet space.” (Beatley, 2021).

Human made acoustics are the sounds generated from human activities. These have a significant impact on the environment as these activities mainly shape the space we are living in. For examples: sound generated because of road traffic, sound generated because of construction works etc.

2.3 Urban Sound and it’s limitations

In outdoor environment, sound has been a major problem for modern cities due to increase in road networks, vehicles and traffic jams. The growth of the latter can be predicted up to an extent and the former can be modulated by the human interventions which can be solution to change in lifestyle and perception of a space. There is an immediate need for the change in the living quality and perception of people because with the increase in noise pollution, the level of stress and mental health conditions of the generation is declining. So to bring a positive impact in these situations, the quality of urban sound should improve.

2.4 Urban Soundscape

“The subject of acoustic ecology is soundscape, which refers to both the natural acoustic environment, which includes animal and tree sounds, water and weather sounds, and

environmental sounds created by humans through musical composition, sound design, and other human activities, as well as mechanical sounds produced by industrial technology” (Elmqvist, 2016). “A soundscape is the collection of sound phenomena that leads to a perceptual, esthetic, and representational understanding of the sonic world” (Hedfors, 2003). “As a result, soundscape is an expression that focuses on the listener's experience of space” (Hedfors, 2003). “The soundscape approach includes managing the acoustic environment elements that are of high quality and value to people, either through acoustic design or through outdoor space management, in the same way that landscape design is used to improve visual perception of the environment.” (Brown, 2010).

2.5 Urban Soundscape and it’s importance

“In recent years, there has been a growing recognition that sound is an essential component of the urban environment and that it should be given the same weight as visual aesthetics in city planning and the urban design process.” (Olafsen, 2009). It refers to the acoustic environment of a location, such as a residential neighbourhood or a city park, as perceived and understood by people in context. It is the acoustic equivalent of the term "landscape," and it includes all sound sources, both desired and unwanted. The study of sound within a landscape and its effect on organisms is known as soundscape ecology. A natural soundscape is an important factor in livability and quality of life.

The aim of urban acoustics is to integrate the social and aesthetics aspects of the urban acoustics to provide a healthy, comfortable, peaceful, stress less, natural and safe way of living in an environment. To create a sense of space and unique identity for a city or a place. To enhance the visual aspects of the city with a mixture sound and landscaping is termed as soundscape. To increase tourism that can change the economic conditions of people living there. To reduce the noise pollution and increase the quality of air and natural resource.

3. METHODS USED FOR SOUNDSCAPE

Designing or redesigning using soundscape can be better solutions for creating quiet areas and happening beautiful junctions. They not only reduce the noise level but are also the sustainable innovations that can be applied in urban design as it keeps future in mind. They also create a sense of space and change the people’s perspective of living or coming to that place.

Different strategies / techniques used to mask and reduce the noise levels are :

Plantations: Usage of green plantations, green ground coverage. Increasing the area of green space in the city has the potential to contribute to the quietening of spaces, attracting birds into the centre of the city. Climbers on walls

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can provide a habitat for birds, birds enhance the tranquillity of an area by masking the unwanted noise and with this there is potential to enhance the natural soundscape. Green walls can reduce the reflection of sound thus allowing the sound to diminish before it travels long distance (Rehan, 2014).

Materials: Creating acoustically softer surfaces will increase an area's tranquillity, which will have an effect on noise reduction. Where hard surfaces can be practically replaced with permeable/semi-permeable surfaces or planting, surface water run-off can be reduced.

Water structure: The water structure muffles the background noise of the city. The sound of a waterfall is a good example of this. “The waterfall is such an appealing natural feature as well as a sound mark that many architects and urban designers want to incorporate it into their designs.” (Rehan, 2014) Water fountain sounds are also an important component of sonic outdoor spaces. This could be because water sounds may overlap with other natural sounds in some cases (Aletta, Kang & Axelsson, 2016).

Noise barriers: To reduce the perceived impact of traffic noise, barriers can be used. In urban open spaces, well-designed noise barriers can be used creatively. Concrete, glass, metals, and recycled material mixtures are just a few of the materials that can be used. There is potential for using barriers to improve the aesthetic qualities of the area. Barriers like walls and buildings, these are as opposed to respectful distances. Walls and buildings are viewed as hard sound barriers that cause echoes and long reverberation times, whereas respectful distances are viewed as soft acoustic transitions between different types of urban activities (Rehan, 2014).

4. LESSONS FROM VARIOUS CASE AREAS

To understand and derive a set of strategies/guidelines that

needs to be considered while designing an urban environment. A study on existing soundscape examples is necessary to understand the thought-process of the design, further the results acquired after soundscape techniques have been incorporated.

4.1 A Case area of PALEY PARK, New York city-

It is a little park located between the high rise, high density, high traffic area of Midtown Manhattan. Stuck between two buildings there is no way to drown out the noises from the road and the city. So to reduce the noise level and mask the sound from the city, water has been used. A wall has been placed at the end of the park with water running over it, it creates an image of water running down from the wall to the ground to the trees. But it's just a mechanically handled system.

“The key to its success is a 6.1 m high waterfall that runs along the length of the park's backside. To mask the sound of the city, the waterfall creates a backdrop of gray noise. The park is surrounded by walls on three sides and is open to the street on the fourth (via an ornamental gate). The walls are ivy-covered, and the overhead canopy of locust trees adds to the park's serenity” (Elmqvist, 2016). Because of this the water masks the entire sound from the city and the urban planners and designers have used plants that can absorb sound. This creates the park to be a space of privacy, quiet and escape route from reality of fast life.

The park features a one-of-a-kind blend of synthetic materials, textures, colors, and sounds. The wire mesh chairs and marble tables are light and do not detract from the setting. The park's ground surface is rough-hewn granite pavers that extend across the sidewalk to the street curb, rather than terrazzo or concrete. The green of the ivy-covered side contrasts with colorful flowers, and the white waterfall muffles street noise.



Fig -1: Images of Paley park in between two high rise building in New York city (Source : Rehan, 2014)

4.2 A case area of Ring Road Junction, Vijayawada, Andhra Pradesh:

The purpose of this study of Ring Road Junction is to document and appraise the existing soundscape features present in the junction. Also to record the results and its effect on people; whether the existing design is beneficial or not and if not, provide an alternate solution in redesigning the existing landscape for a better soundscape conditions.

The Ring Road Junction at Ramavarapadu, Vijayawada is a connecting highway junction between Karl Marx road (commonly known as Eluru road) and AH45 (Benz circle road). It acts as a point of intersection for three different roads; Eluru road, Benz circle road and the Ring road. It is a junction of high vehicular traffic throughout the day because of its proximity to the national highway. Since it acts as an exit to the city of Vijayawada, it is bound to create an

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everlasting expression of the city for passerby, travellers and the citizens. The junction is surrounded by residential areas on the right side and commercial and recreational spots on the left side. Apart from the huge vehicular traffic, there is a significant amount of pedestrian traffic as the junction has two bus-stands flanking it. As the road parts away in two different directions, the change in route and paths happen mostly in this junction. Therefore, there are all kinds of pedestrian movement and vehicular movement such as auto-

rickshaws, buses, cars, heavy vehicles such as trucks, lorry etc. amounts to 2750 ECU’s at peak hours.

On the basis of the broad outline analysed in the Literature (Rehan, 2014) has been strengthened and modified to the context of Vijayawada and formulated an Urban Soundscape Strategy covering from Institutional Mechanism to policy document as well as projects, schemes and programs to implement appropriate soundscape strategies as shown in the Figure-2

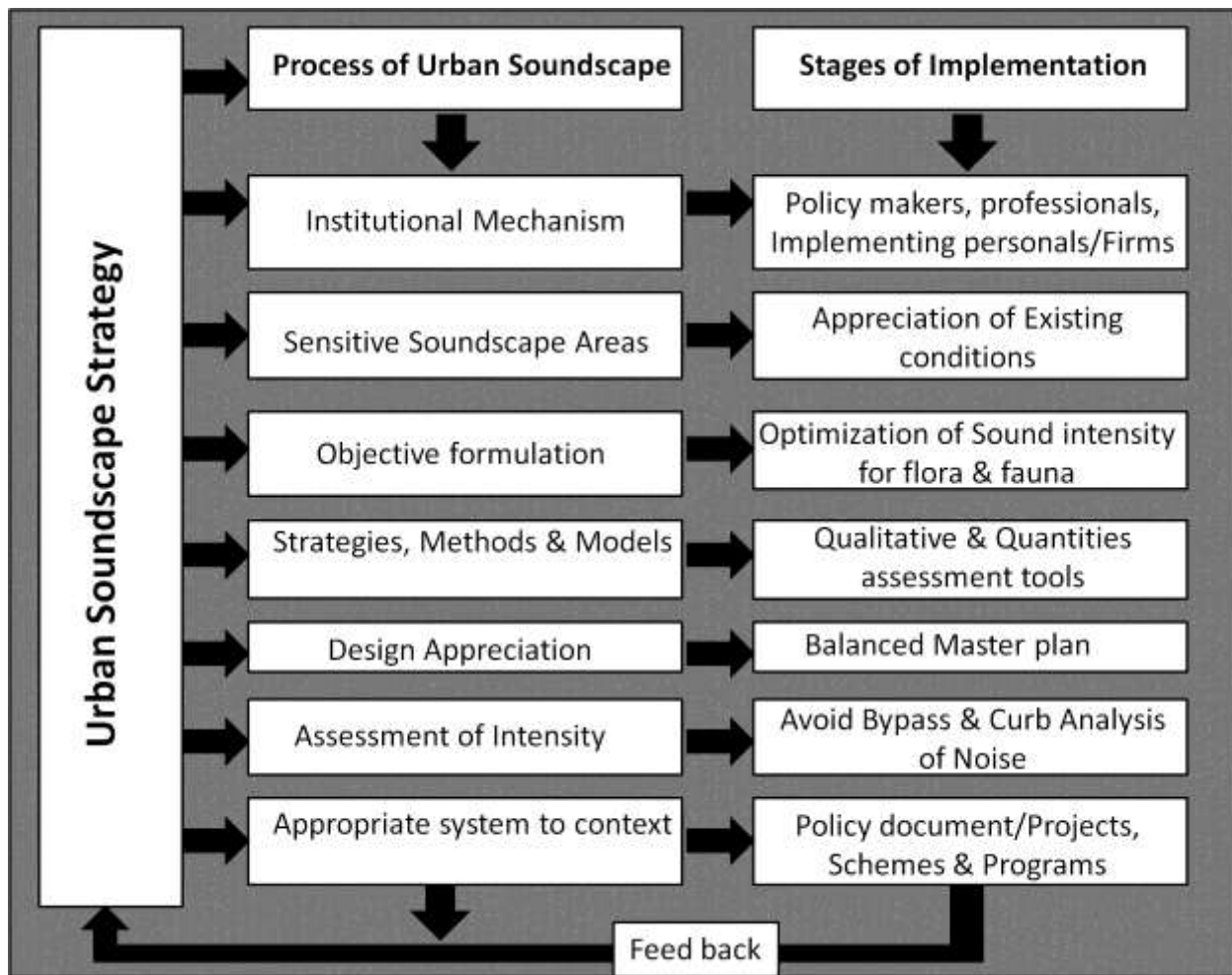


Fig -2: Urban Soundscape Strategy

Existing features of Soundscape

As shown in the figure 3, the existing features of Soundscape in the site has been surveyed and found that there was sparse vegetation along with a water fountain on the side of the outer ring road bridge, i.e., connecting the Ramavarapadu Ring Road Junction and the Central Junction which has a group of statues. The space has been developed to have certain vegetation such as ficus panda, ficus benjamina as a hedge to the edge of the traffic island besides, a group of four trees of azadirachta indica and termania mantaly. The Municipal authorities proposed a jet fountain with focus lights of different shades to establish active night environment around this area as shown in the Figure-4. The Main idea is that this junction has got special character during the night i.e., Visakhapatnam bound buses has an halt at this area to pick up

the passengers till up to the late night. So to provide an active environment and micro climatic differences the local body has proposed certain vegetation as mentioned above. The same can be seen in Figure-7 & 9. However the paper aims to understand the Soundscape systems with reference to the Soundscape mentioned above, accordingly a questionnaire survey has been conducted and analysed for discussion. It is observed that a hotel Innotel as shown in the figure-XY stands as an island where U-diversion of the road towards left hand side of the hotel creates traffic congestion and at times even traffic jam. The entire streams to the traffic speed come down to almost Zero due to blind U-turning and every vehicle operates the horn. So the sound environment leads to a miserable condition. In addition to this is the main spine to lead to International airport of Vijayawada. It is essential and

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critical to address this junction particularly in the direction of Soundscape. After the lockdown period of pandemic i.e., Covid-19 a structured survey (Interview) is conducted for pedestrians, commuters of this area who crosses the road, who were waiting for the city buses, sub-urban buses, long station buses and pedestrians of the residential colony on 20th January, 2021 during morning 8:00AM to 10:00AM,

12:00PM to 02:00 PM, 06:00 PM to 08:00PM and 10:00PM to 12:00PM. All these four distinct durations have got significance related to Office commuters, School children, passengers and normal public. For each duration 75-100 pedestrians have been interviewed where as only 60-70 responded to the questions. The results of the questionnaire survey shown in chart 1 to 4.



Fig - 3: Existing plan of the ring road junction. (Source : Author)



Fig - 4: Fountains at the side line of the bridge and Junction. (Source: Author)



Fig - 5: Traffic during peak hours of evening and night. (Source: Author)

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Fig - 6: Traffic during afternoons. (Source: Author)



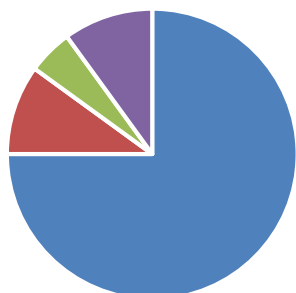
Fig - 7: Side line of the road main junction circle. (Source: Author)



Fig - 8: Cross-sections on the road (Source: Author)

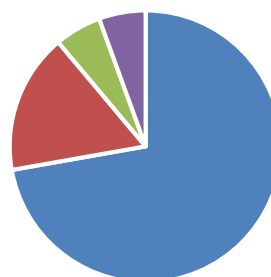


Fig - 9: Landscaping beyond the junction (Source: Author)



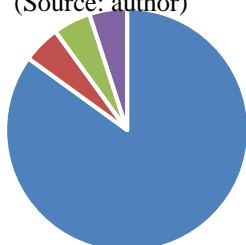
■ TRAFFIC ■ WATER FOUNTAIN
■ PEOPLE ■ OTHERS

Chart - 1: 08:00AM-10:00AM SOUND INTENSITY (Source: author)



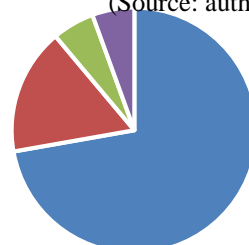
■ TRAFFIC ■ WATER FOUNTAIN
■ PEOPLE ■ OTHERS

Chart - 2: 12:00PM-02:00PM SOUND INTENSITY (Source: author)



■ TRAFFIC ■ WATER FOUNTAIN
■ PEOPLE ■ OTHERS

Chart - 3: 06:00PM-08:00PM SOUND INTENSITY (Source: author)



■ TRAFFIC ■ WATER FOUNTAIN
■ PEOPLE ■ OTHERS

Chart - 4: 10:00PM-12:00AM SOUND INTENSITY (Source: author)

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On the basis of the survey it is found that noise levels are very high during peak hours i.e., 08:00AM-10:00AM and 06:00PM to 08:00PM to the amount of 75% and 80% respectively and categorically mentioned that the level of noise is intolerable and the same is measured by Testo 816 - 1 dB meters and found 60-80 decibels of rolling sound. The Testo 816-1 dB meter of the professional model has been used for measuring sound levels in the in public places with Precise sound level measurements according to IEC 61672-1 Class 2 and ANSI S1.4 Type 2.

The sound generated from the water could able to recognize by the pedestrians who were waiting at close proximity to water fountain expressed that the level of sound is 15-25%

during afternoons and nights and expressed that the sound is enjoyable. However, they also expressed the sound level of traffic is more than the fountain. The general speaking and sounds from the other sources is 5-10% for all durations and it has been expressed by the pedestrians in negligible as compared to the traffic. The same can be seen in the Chart No-1 to 4.

In addition to the above another survey was conducted to the occupant of the immediate street side buildings such as shopkeepers, street side eateries and dwellings and sample size is 15 shopkeepers, 25 residences and 3 street side eateries and the results related to the responses of the perception of environment to the stretch of 100 meters from the junction is mapped in the Chart No: 5

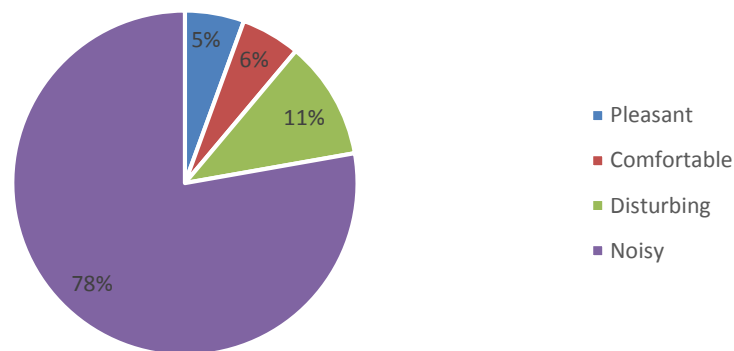


Chart -5: People’s perspective of environment (Source: author)

With the data from the survey of people’s perspective and behaviour in the junction, the existing feature tries to control and mask the noise of the vehicles but it doesn’t function to its full potential. The location the fountain in the corner and the existing green barrier only produce minor changes to the surrounding. Again, aesthetics overrides acoustics/ healthy environment resulting in the failure of the design.

But by redesigning the junction with minimal changes, the soundscape features will mask the noise level to a higher potential. The output of the results facilitate to redesigning and adding to the existing features (Refer figure 10.) with specific reference to achieve appropriate Soundscape. More specifically it is to emphasis from the analysis of the existing features, it was found that water played as a key element in masking the noise generating from the traffic and the next key element was the Plantations. So the proposal is as follows:

Water Fountains: Continuing the existing fountain on the side with an addition of central water fountains in the junction in front of and behind the statue will not just act as acoustical barrier masking the sound of the vehicles but also as an aesthetic element from the city beautification concept. Thus, providing a visual and acoustical barrier which is at the same

time is pleasing to the eyes and ears.

Addition of Plantations: Though the plantation density is just enough for the junction, there is still a scope for planting more trees. These trees can be planted overlooking the residential areas thereby masking the noise and minimizing the reach to the quarters.

Materials: The pedestrian path is built using hard materials that reflect the noise, therefore replacing them with soft materials or introducing a green patch in between will reduce the reflectivity of sound and decrease the noise level.

Post design Analysis

With the redesigning of the junction, the traffic noise heard by the users is likely to reduce to up to fifty percent due to the masking by four different water fountains (as water masks the sound level up to 40 percent) and the added vegetation masks the noise of the traffic up to 10 percent. The change of material from hard to soft materials reduces the reflectivity of the noise and helps in controlling the noise from reaching the user. The user can feel the difference in the noise level. However, the above produced results are hypothetical and are subjected to differ with increase in traffic or user group.



Fig - 10: Conceptual plan for redesigning Ring road junction, Vijayawada (Source: Author)

5. CONCLUSION

Soundscape Designing in urban planning and designing helps to improving the essence of a place but it often ignored and is always overridden by aesthetic elements of design and planning. A planner or a Designer should clearly understand their role in causing discomfort in people when they prioritize aesthetic factors over acoustical planning strategies. The mental and physical well-being of the people are put to risk when noise factor is ignored.

The paper analyses the Ring Road Junction in Vijayawada in terms of how the soundscape elements are ignored and wrongly planned mostly to focus on the aesthetic factors of the junction. It can be clearly seen that the elements used in the junction does not produce any effect on the noise generated. Therefore, through a conceptual design solution the previously mentioned issues were addressed and minimized. However, the results are hypothetical and are subjected to change after implementation of the design. It has further scope to get it integrated to have desirable outdoor thermal comfort for users or pedestrians.

From the above analysis we can understand that it is important for every urban planner and designer to follow few strategies while designing an urban soundscape, such as:

1. Sound and Beautification of the city should have equal importance while designing an urban space
2. Government should make strict regulations for soundscape designing and should promote it by conducting training classes.
3. Planners and designers should make sure that the sound is unique to the place and its pleasing to the users.
4. Use of different materials, different types of trees which

reduces the noises in the space and helps to create a good environment.

5. They should also focus on masking the noise levels as it helps in controlling the sound in the environment.
6. Addition of vegetation and plantation should be used as it enhances the natural feeling.
7. Usage of acoustically softer materials as it reduces the reflectivity of the noise.
8. Addition of embankments and barriers like earth berms, green barriers, water elements to cut off the noise from traveling to long distances.
9. Finally, the approach to the design should be sustainable considering the present and future of the environment.

Thus, for a better environment and living, soundscape design is a good option for the designers and planners to consider and design.

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