Acoustic Environment at Traffic Signal Node: Environmental Assessment and Mitigation Strategies – A Case Study of Thiruvananthapuram

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Abstract:

Traffic-related noise pollution has emerged as a critical environmental concern in rapidly urbanising Indian cities, with traffic signal nodes acting as persistent acoustic hotspots. This study investigates the acoustic environment at selected signalised intersections in Thiruvananthapuram, Kerala, where increasing vehicular density and congestion have intensified environmental noise exposure. The aim is to assess traffic-induced noise characteristics and develop environmentally responsive mitigation strategies integrated with urban and architectural design.

The study adopts a field-based empirical methodology. Environmental noise measurements were conducted using calibrated sound-level meters in accordance with standard monitoring protocols. Measurements were carried out at multiple receptor points around each traffic signal node during morning, midday, and evening periods on working, festive, and holiday conditions. Key acoustic parameters analysed include equivalent continuous sound level (Leq), maximum noise level (Lmax), and minimum noise level (Lmin). Traffic volume, vehicle composition, and signal delay conditions were recorded concurrently to understand noise–traffic relationships. GPS-based spatial mapping was used to identify the node-wise distribution of noise and hotspot intensity.

The measured noise data were analysed and translated into noise mapping outputs by generating noise intensity maps, enabling comparative assessment of acoustic conditions across the selected traffic signal nodes. The results indicate that noise levels at all studied nodes consistently exceed prescribed urban standards, with peak values observed during signal delays due to idling, stop–start movement, and frequent honking. Junction geometry, surrounding land use, and built enclosure significantly influence noise amplification and propagation patterns.

Based on the acoustic assessment, the study proposes node-specific and neighbourhood-character-based environmental design strategies, including spatial buffering, landscape-based attenuation, façade-level acoustic treatments, and material interventions. The findings demonstrate that environmental design can effectively reduce noise exposure and improve urban soundscape quality without altering traffic volumes, offering a transferable framework for sustainable intersection design in Indian cities.

Keywords:

Traffic Signal Node, Noise Mapping, Leq, Traffic Noise, Acoustic Environment.