PREFACE

The present research entails the 'study of traffic jam noise at different floor levels near intersections of Varanasi city'. The arterial and sub-arterial roads of this mid-sized city have narrow carriageways which are further subjected to encroachment by pedestrians, parking vehicles, temporary vending shops etc., thereby increasing the roadside friction and lowering the traffic speed. The available carriageway for traffic movement is therefore reduced, lowering the functional classification of the arterials and sub-arterials in accordance with IRC:106-1990. Based on the functionality, most of the arterials were downgraded to collector streets and sub-arterials; while the many sub-arterials were downgraded to collector streets. The traffic witness's severe congestion during peak traffic periods of the day in the morning and evening, which often manifests to complete breakdown of traffic movement, resulting in a traffic jam. The city of Varanasi has been witnessing traffic jam in the morning and evening at almost all major intersections for quite some time now, and this phenomenon has been stretching itself for longer durations. Out of the several pollutants generated due to traffic jam, the present study envisages addressing the issue of noise pollution.

Traffic jam on Varanasi roads is attributable to the heavy pressure of vehicles near intersections where lane discipline is often violated. 2-wheelers and 3-wheelers being predominant modes of mass transport are sandwiched under the overwhelming presence of four-wheelers on narrow carriageways. Presence of heavy vehicles are known for generating a high level of noise in the traffic stream were fewer in the city areas, however, finds a good presence on the old GT road and the intersections at Police Line and Pandeypur.

The literature has many references to studies conducted for interrupted traffic flow noise and their modeling, however, the aspect of traffic jam noise and its modeling was not addressed earlier. Many researchers in the past have voiced their concern for including strong traffic congestion in noise prediction models. Makarewicz and Gałuszka (2011) in their study on road traffic noise prediction based on speed-flow diagram have noted that none of the noise prediction models provides for congestion correction. Some others have stated that the statistical noise models developed for free flow conditions fail when vehicle speed distribution influence such as non-free flow traffic, traffic jams, etc. was to be considered. Literature seems to be unanimous on the need for developing a model which may be ideal for meeting a range of needs.

The assessment of traffic jam noise near intersections and developing a model for its prediction was found to be a research gap which is being addressed in the present work. This research also seeks to undertake assessment and modeling of traffic jam noise arriving at various floor levels of adjoining buildings due to mixed traffic composition which lacks lane discipline.

The methodology included obtaining traffic volume and noise level data for 10 minutes' duration during the course of a traffic jam which was measured at a distance of 25 m away from an intersection on deceleration lane of a leg. Data collection was made for a sustained duration of four-years for 65 legs of 19 intersections spread all across the city. Noise level data sets were analysed for percentile noise levels (L_{10}, L_{50}, and L_{90}); equivalent noise level (L_{eq}); noise climate ($L_{10} - L_{90}$); noise range ($L_{max} - L_{min}$); traffic noise index (TNI) and noise pollution level (NPL) at various floor levels of building façade at a distance (d) from the noise source.

Traffic jam noise in terms of L_{eq} exceeded the permissible limit of daytime noise for the commercial area at all 65 legs covered under the study irrespective of the observer distance ranging from 2.40 to 14.99 m from the noise source. The highest value of L_{eq} was recorded on the GF of Sundarpur leg of Bhikharipur intersection of 92.0 dBA, while the lowest value was recorded on the SF of Khajuri leg of Pandeypur intersection of 66.8 dBA.

Vehicles involved in a traffic jam (noise source) were counted for a trap length of 50m on the deceleration lane carriageway. Four types of regression models viz. floor-wise leg models, floor-wise intersection models, floor-wise city models, and consolidated city model at a confidence level of 95% were developed for prediction of L_{eq}. Noise climate (NC) or noise range (NR) being parameter for noise variability; 'PCU' or 'Q_w' being parameter for traffic volume having 'p_1' or 'p_2' as respective percentage of heavy vehicles; 'd' being observer distance, and '$\%AO$' being %Area-Occupancy were used as independent parameters for model development. The developed models were subjected to statistical analysis for the goodness of fit and statistical significance using chi-square and t-test. It was found that NR instead of NC, and 'Q_w' in place of 'PCU' were better parameters for prediction of traffic jam noise.

For the sake of easy reading, the thesis is organized into seven chapters. Chapter 1 provides for 'introduction' of the study. The second chapter presents the literature review and Chapter 3 deals with the study area. Methodology aspects are placed in Chapter 4, while field data and its analysis are presented in Chapter 5. Mathematical modeling is detailed in Chapter 6. The conclusions, recommendations, and scope for further work are annexed in Chapter 7. The references obtained for the study are finally placed.