

WIND TUNNEL SIMULATION STUDY OF THE LINE SOURCE
DISPERSION IN THE NEAR-FIELD OF ROADWAYS UNDER
HETEROGENEOUS TRAFFIC CONDITIONS

by

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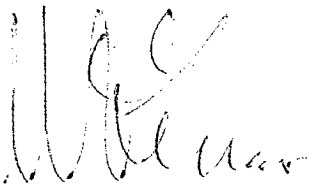
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CERTIFICATE

This is to certify that the thesis entitled *Wind Tunnel Simulation Study of the Line Source Dispersion in the Near-field of Roadways under Heterogeneous Traffic Conditions* being submitted by **Mr. Mahalinge Gowda, R.M.**, has been prepared under our supervision in conformity with the rules and regulations of the **Indian Institute of Technology, Delhi**. We further certify that the thesis has attained a standard required for the award of a degree of *Doctor of Philosophy* of the institute. The research reported and results presented in the thesis have not been submitted, in part or full, to any other university or institute for the award of any degree or diploma.



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***D*edicated
to
my parents
and
parents-in-law**

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ABSTRACT

Simulation experiments were carried out in the Environmental Wind Tunnel (EWT) to understand the effect of potential traffic parameters (traffic volume, traffic speed and traffic composition), on vertical spread of pollutants (σ_z) in the near-field region of roadway for different terrain roughnesses; under two typical near-field building configurations and approaching wind directions. This EWT facility was developed and fabricated at IIT, Delhi which is the first of its kind in India. A new model traffic movement system was also designed and successfully made operational in the EWT. This system allowed to vary traffic composition, speed, volume and wind-road inclination. In addition, it maintained 'no slip' boundary conditions, which was violated in the moving floor system developed by Ide et al. (1987) and Kitabayashi et al. (1977).

Sixty-six hydrocarbon tracer experiments were performed to evaluate σ_z in each of the two building configurations, considered in the near-field of roadway for three terrain roughnesses and two approaching wind directions of 90° and 60° . It was found that heterogeneous traffic composition significantly increased the σ_z , relatively over a longer downwind distances in comparison to homogeneous traffic composition. Spectral observations made for typical heterogeneous traffic conditions, showed an increase in spectral energy, due to vehicle induced effects relatively over a wider range of frequencies. Comparison of experimentally observed longitudinal mean velocity with predictions of modified multi-vehicle wake model of Eskridge and Hunt (1979), showed a close agreement.

The comparison of vertical spread parameter, σ_z obtained from the simulation experiments carried out in the EWT, with corresponding field studies of Chock (1978) and Rao and Keenan (1980) showed that experimental values were within $\pm 15\%$ of field values. It concluded that present simulation criteria, considered in the EWT, seemed to be realistic to the field conditions for understanding the behaviour of σ_z for various traffic and terrain conditions.

Artificial Neural Network (ANN) technique has been used as a simulator for experimental data. It was found that ANN technique satisfactorily predicted σ_z for other ranges of traffic parameters which could not be simulated in the EWT.



TABLE OF CONTENTS

| | |
|---|----------------|
| Certificate | (i) |
| Acknowledgments | (ii) |
| Abstract | (v) |
| Table of Contents | (vii) |
| List of Figures | (xiv) |
| List of Plates | (xxii) |
| List of Tables | (xxiii) |
| List of Abbreviations | (xxv) |
| | |
| 1. INTRODUCTION | 1-12 |
| 1.1 General | 1 |
| 1.2 Statement of the Problem | 2 |
| 1.3 Motivation for the Present Study | 4 |
| 1.4 Scope of the Present Study | 6 |
| 1.4.1 Suitability of Wind Tunnel Simulation Study | 7 |
| 1.4.2 Simulation of Traffic in Wind Tunnel | 7 |
| 1.4.3 Artificial Neural Network Application | 8 |
| 1.5 Objectives of the Present Study | 9 |
| 1.6 Organization of Thesis | 10 |
| | |
| 2. REVIEW OF RELEVANT LITERATURE | 13-63 |
| 2.1 General | 13 |
| 2.2 Studies on Traffic Induced Dispersion Near Roadways | 13 |
| 2.2.1 Field Experiments | 14 |
| 2.2.2 Theoretical Studies | 15 |

| | | |
|-----------|--|--------------|
| 2.2.3 | Experimental Studies in Wind Tunnels | 18 |
| 2.3 | Studies on Traffic Induced Effects | 19 |
| 2.4 | Advecting Wind Correction | 19 |
| 2.5 | Modified Dispersion Parameters | 21 |
| 2.6 | The Atmospheric Boundary Layer | 24 |
| 2.6.1 | Characteristics of the Atmospheric Boundary Layer | 25 |
| 2.6.2 | Characteristics of the Adiabatic Atmospheric Boundary Layer | 31 |
| 2.7 | Similarity Considerations for Wind Tunnel Experiments | 42 |
| 2.8 | Modelling of Atmospheric Boundary Layers in Wind Tunnel | 45 |
| 2.9 | Atmospheric Boundary Layer Simulation Techniques in Wind Tunnel | 48 |
| 2.10 | Atmospheric Boundary Layers Generating Devices | 53 |
| 2.10.1 | Active Devices | 53 |
| 2.10.2 | Passive Devices | 54 |
| 2.11 | Hot-wire Anemometry | 59 |
| 2.11.1 | Convective Principles Governing the Operation of Hot-wire | 61 |
| | | |
| 3. | ARTIFICIAL NEURAL NETWORK TECHNIQUE | 64-91 |
| 3.1 | General | 64 |
| 3.2 | Overview | 64 |
| 3.3 | The Biological analogue | 67 |
| 3.4 | Artificial Neuron | 68 |
| 3.5 | Structure of Neural Network | 69 |
| 3.5.1 | Feed-Forward and Recurrent Network Structure | 70 |
| 3.5.2 | Modular Network Structure | 71 |
| 3.6 | Learning Mechanism | 72 |
| 3.7 | Training the Network | 73 |
| 3.8 | Training Algorithm | 74 |

| | | |
|-----------|---|----------------|
| 3.9 | Generalization | 76 |
| 3.10 | Validation of Network | 77 |
| 3.11 | Comparison of Neural Network to Empirical Modeling | 79 |
| 3.12 | Limitations of Neural Networks | 80 |
| 3.13 | Potential Applications of Neural Networks | 81 |
| 3.14 | Neural Network Based Modeling Steps | 82 |
| 3.15 | Backpropagation Neural Network Algorithm | 84 |
| 3.16 | Cascade Correlation Neural Network Algorithm | 88 |
| 4. | DESIGN DETAILS OF ENVIRONMENTAL WIND TUNNEL | 92-113 |
| 4.1 | General | 92 |
| 4.2 | Brief Description of the EWT Facility at IIT, Delhi | 93 |
| 4.2.1 | Design Considerations | 93 |
| 4.2.2 | Test Section Dimensions | 94 |
| 4.2.3 | Gross features of EWT at IIT, Delhi | 96 |
| 4.2.4 | Constructional Details of Different Components of EWT | 98 |
| 4.3 | EWT Laboratory Instrumentation | 102 |
| 4.3.1 | Flow Measurement Apparatus | 103 |
| 4.3.2 | Data Recorder | 103 |
| 4.3.3 | Data Acquisition Instruments | 104 |
| 4.3.4 | Tracer Gas Concentration Measurement Apparatus | 106 |
| 4.4 | Performance Characteristics of EWT | 106 |
| 4.4.1 | Flow Measurements | 107 |
| 4.4.2 | Model Stack Tracer Dispersion Study | 108 |
| 5. | EXPERIMENTAL SET-UP AND DATA ANALYSIS | 114-149 |
| 5.1 | General | 114 |
| 5.2 | Experimental set-up for Simulation of ABLs in the EWT | 114 |

| | | |
|---------|---|-----|
| 5.3 | Design of Model Vehicles Moving System along with a line source | 116 |
| 5.3.1 | Design of Line source | 116 |
| 5.3.2 | Design of moving traffic in the EWT | 118 |
| 5.4 | Near-field Terrain Building Blocks Arrangement | 120 |
| 5.5 | Tracer Dispersion Experiments | 123 |
| 5.5.1 | Details of the Tracer Gas Dispersion Experiments | 123 |
| 5.5.2 | Schematic of the Tracer Gas Dispersion Experiments | 124 |
| 5.5.3 | Tracer Gas Sampling and Analysis | 126 |
| 5.6 | Experiments for Vehicle Induced Velocity Flow Field | 127 |
| 5.6.1 | Details of Experiments for Vehicle Induced Velocity Measurement | 127 |
| 5.6.2 | Experimental Scheme for Recording Model Vehicles Induced Velocities | 128 |
| 5.6.3 | Calibration of the Hot-wire Probe | 130 |
| 5.7 | Experimental Data analysis of the Present Study | 132 |
| 5.7.1 | Estimation of Roughness Parameters in Simulated ABLs | 132 |
| 5.7.1.1 | Linear Least Squares Analysis Method | 133 |
| 5.7.1.2 | Exact Solution | 136 |
| 5.7.2 | Vertical Spread Parameter from Experimental Data | 138 |
| 5.7.3 | Stochastic Description of Dynamic Data | 139 |
| 5.7.4 | Digital Processing of Random Data | 139 |
| 5.7.5 | Spectral Analysis of Turbulence | 140 |
| 5.7.5.1 | Fourier Transform Technique | 140 |
| 5.7.5.2 | Fast Fourier Transform Algorithm | 141 |
| 5.7.6 | Fitting Spectral Density Function | 145 |
| 5.7.7 | Application of Artificial Neural Network | 146 |
| 5.7.8 | Performance Evaluation Statistics Adopted in ANN application | 148 |

| | | |
|-----------|---|----------------|
| 6. | SIMULATED ATMOSPHERIC BOUNDARY LAYERS IN THE EWT | 153-172 |
| 6.1 | General | 153 |
| 6.2 | Generation of Neutrally Stabilized ABLs in the EWT | 153 |
| 6.3 | Characteristics of Simulated ABLs in the EWT | 154 |
| 6.3.1 | Mean Velocity Profile | 154 |
| 6.3.2 | Log-law Profile | 158 |
| 6.3.3 | Turbulence Profile | 166 |
| 6.3.4 | Fitting of Spectral Density Function in the Wind Tunnel Data | 169 |
| | | |
| 7. | EXPERIMENTAL RESULTS AND DISCUSSIONS | 173-272 |
| 7.1 | General | 173 |
| 7.1.1 | Traffic conditions | 173 |
| 7.1.2 | Terrain features | 174 |
| 7.2 | Experimental results for near-field arrangement of simple staggered cubical blocks | 174 |
| 7.2.1 | Experimental results in ABL-I | 175 |
| 7.2.1.1 | Homogeneous traffic conditions | 175 |
| 7.2.1.2 | Heterogeneous traffic conditions | 179 |
| 7.2.1.3 | Comparison of σ_z variation for homogeneous and heterogeneous traffic conditions | 188 |
| 7.2.2 | Experimental results in ABL-II | 192 |
| 7.2.2.1 | Homogeneous traffic conditions | 192 |
| 7.2.2.2 | Heterogeneous traffic conditions | 198 |
| 7.2.2.3 | Comparison of σ_z variation for homogeneous and heterogeneous traffic conditions | 203 |
| 7.2.3 | Experimental results in ABL-III | 207 |
| 7.2.3.1 | Homogeneous traffic conditions | 207 |
| 7.2.3.2 | Heterogeneous traffic conditions | 214 |

| | | |
|---------|---|-----|
| 7.2.3.3 | Comparison of σ_z variation for homogeneous and heterogeneous traffic conditions | 219 |
| 7.2.4 | Comparison of σ_z variation in three simulated ABLs | 224 |
| 7.2.4.1 | Homogeneous traffic conditions | 224 |
| 7.2.4.2 | Heterogeneous traffic conditions | 228 |
| 7.2.5 | Comparison of experimental values with the available field data | 228 |
| 7.2.5.1 | Field conditions for GM experiments | 228 |
| 7.2.5.2 | Field conditions for NYS/GM experiments | 231 |
| 7.2.5.3 | Stability conditions | 231 |
| 7.2.5.4 | Discussions | 231 |
| 7.3 | Experimental results for near-field arrangement of irregular staggered blocks | 232 |
| 7.3.1 | Comparison in σ_z variation for homogeneous and heterogeneous traffic conditions in ABL-I | 234 |
| 7.3.2 | Comparison in σ_z variation for homogeneous and heterogeneous traffic conditions in ABL-II | 238 |
| 7.3.3 | Comparison in σ_z variation for homogeneous and heterogeneous traffic conditions in ABL-III | 238 |
| 7.3.4 | Comparison in σ_z variation in three simulated ABLs | 243 |
| 7.3.4.1 | Homogeneous traffic conditions | 243 |
| 7.3.4.2 | Heterogeneous traffic conditions | 243 |
| 7.4 | Spectral observations | 246 |
| 7.5 | Comparison of experimental data with predictions of modified multi-vehicle wake model of Eskridge and Hunt (1979) | 261 |
| 7.5.1 | Comparison of longitudinal mean velocity | 262 |
| 7.5.2 | Comparison of longitudinal component of fluctuating velocity | 265 |

| | | |
|-----------|---|----------------|
| 8. | ARTIFICIAL NEURAL NETWORK PREDICTIONS | 273-323 |
| 8.1 | General | 273 |
| 8.2 | Training and testing data set | 273 |
| 8.3 | Input and output parameters | 274 |
| 8.4 | Training and testing of Backpropagation neural network | 275 |
| 8.5 | Training and testing of Cascade neural network | 276 |
| 8.6 | ANN prediction input parameters | 277 |
| 8.7 | Prediction results for near-field arrangement of simple staggered cubical blocks | 277 |
| 8.7.1 | Homogeneous traffic conditions | 280 |
| 8.7.2 | Heterogeneous traffic conditions | 290 |
| 8.7.3 | Comparison in σ_z variation in three roughness conditions | 298 |
| 8.8 | Prediction results for near-field arrangement of irregular staggered blocks | 298 |
| 8.8.1 | Homogeneous traffic conditions | 301 |
| 8.8.2 | Heterogeneous traffic conditions | 310 |
| 8.8.3 | Comparison in σ_z variation in three roughness conditions | 318 |
| 9. | CONCLUSIONS | 324-330 |
| 9.1 | Contributions of the present study | 328 |
| 9.2 | Suggestions for future work | 329 |
| | References | 331-347 |
| | Appendices | 348-383 |
| | Brief Bio-data of the Author | 384 |

