

Contents

| | | |
|-------------------------|--|-----|
| Title Page | | i |
| Certificate of Approval | | ii |
| Certificate | | iii |
| Acknowledgement | | iv |
| Declaration | | vi |
| List of Symbols | | vii |
| Abstract | | ix |
| Contents | | x |
| Chapter 1 | Introduction | 1 |
| | 1.1 Scope of the present work | 1 |
| | 1.2 Documentation Outline | 4 |
| Chapter 2 | Review of Literature | 5 |
| | 2.1 Introduction | 5 |
| | 2.2 Wind flow around building structure | 5 |
| | 2.3 Some conclusions drawn from literature | 25 |
| | 2.4 Large Eddy Simulations | 26 |
| | Table 2.1 | 29 |
| Chapter 3 | Experimental Measurements | 41 |
| | 3.1 Introduction | 41 |
| | 3.2 The Industrial Wind Tunnel | 41 |
| | 3.3 Models | 42 |
| | 3.4 Simulation of Atmospheric Boundary Layer | 44 |
| | 3.5 Instruments used in Present Study | 44 |
| | 3.6 The evaluation of Pressure Co-efficient | 44 |
| | 3.7 List of Experiments | 45 |

| | | |
|------------------|--|-----------|
| Chapter 4 | Numerical Simulation Based on LES | 53 |
| | 4.1 Introduction | 53 |
| | 4.2 Governing flow equations in primitive variable form | 54 |
| | 4.3 Governing flow equations in stream function-vorticity form | 56 |
| | 4.4 Numerical Procedure | 58 |
| | 4.4.1 Finite difference formulation | 58 |
| | 4.4.2 Discretisation of sub grid scale model | 68 |
| | 4.4.3 Boundary conditions | 69 |
| | 4.4.4 Calculation of wall pressure | 70 |
| | 4.4.5 Solution algorithm | 70 |
| | 4.5 Algebraic Grid Generation Technique | 71 |
| | 4.6 Validation of the 2D LES code | 74 |
| | Test Cases: (a) Flow in a Driven Square Cavity | 74 |
| | (b) Flow past Rear-ward Facing Step | 76 |
| | (c) Flow over a single 2D building model | 78 |
| | 4.7 Conclusion | 78 |
| Chapter 5 | Results and Discussions | 93 |
| | 5.1 Introduction | 93 |
| | 5.2 Flow over a single prismatic building of height/width 1.0 | 94 |
| | 5.3 Flow over a single prismatic building of height/width 2.0 | 96 |
| | 5.4 Flow over two prismatic buildings of height ratio 1:2, shorter building upstream | 98 |
| | 5.5 Flow over two prismatic buildings of height ratio 1:2, tall | 102 |

| | |
|---|-----|
| building upstream | |
| 5.6 On discrepancies between experimental data and numerical prediction | 106 |
| 5.7 Numerical prediction of flow over two buildings of identical height | 109 |
| Case I Height to width ratio 1.0 | 109 |
| Case II Height to width ratio 2.0 | 112 |
| 5.8 Numerical prediction of force co-efficient | 115 |
| 5.9 Numerical prediction of flow over three buildings | 122 |
| Case I Height to width ratio 1 | 122 |
| Case II Short building (height/width 1) between two tall buildings (height/width 2) | 124 |
| Case III Short building (height/width 1) placed downstream of two tall buildings (height/width 2) | 127 |
| Case IV Short building (height/width 1) placed upstream of two tall buildings (height/width 2) | 129 |
| 5.10 Conclusion | 132 |
| Chapter 6 Conclusions | 203 |
| 6.1 Concluding remarks | 203 |
| 6.2 Scope of future work | 206 |
| References | 209 |