

CONTENTS

Preface	v
Acknowledgement	vii
Chapter 1 Introduction	1
References	2
Chapter 2 Environmental Aspects	5
2.1 General	5
2.2 Rain	6
2.3 Wind	6
2.4 Sunlight	10
2.5 Pollution	12
2.5.1 Non Biological Staining Agents	13
2.5.2 Biological Staining Agents	15
References	19
Chapter 3 Material Aspects	23
3.1 General	23
3.1.1. Permeability	23
3.1.2. Water Absorption	23
3.1.3. Surface Texture	24
3.1.4. Colour	24
3.1.5. Resistance to Chemical Attacks	25
3.1.6. Resistance to Biological Growth	26

3.2 Exposed Brick	26
3.3 Concrete	32
3.4 Natural Stones	36
3.5 Tiles	43
3.6 Metal	47
3.7 Glazing	55
3.8 Plaster and Paint Surface Coatings	61
3.9 Material Interfaces	69
3.9.1. Bricks — Concrete/Plaster	69
3.9.2. Bricks/Concrete/Plaster — Natural Stone	69
3.9.3. Bricks/Concrete/Plaster — Glass	69
3.9.4. Bricks/Concrete/Plaster — Metals	71
3.9.5. Bricks/Concrete/Plaster — Paint	71
3.9.6. Natural Stone — Glass	71
3.9.7. Natural Stone — Metals	72
3.9.8. Natural Stone — Paint	72
3.9.9. Glass — Metals	72
3.9.10. Glass — Paint	72
References	73
 Chapter 4 Design Aspects	 75
4.1 General	75
4.2 Ledges	78
4.2.1. Factors Causing Staining around Ledges	78
4.2.2. Staining Mechanisms around Ledges	81
4.2.3. Design Considerations	83
4.3 Joints Misalignment	89
4.3.1. Factors Causing Staining at Misaligned Joints	90
4.3.2. Mechanisms of Staining at Misaligned Joints	91
4.3.3. Design Considerations	92
4.4 Protruding fixtures	97
4.4.1. Factors Causing Staining at Protruding Fixtures	98
4.4.2. Mechanism of Staining at Protruding Fixtures	99
4.4.3. Design Considerations	102

4.5 Louver Units	104
4.5.1. Factors Causing Staining around Louver Units	104
4.5.2. Mechanism of Staining at Louver Units	107
4.5.3. Design Recommendations	108
4.6 Experimental Methodology	110
4.6.1. Methodology	111
References	114
Chapter 5 Maintenance Aspects	117
5.1 General	117
5.2 Cleaning Stains	117
5.2.1. Exposed Brick and Concrete Walls	119
5.2.2. Natural Stone	120
5.2.3. Tiles	123
5.2.4. Metal	125
5.2.5. Glass	129
5.2.6. Plaster-and-Paint Surfaces	130
5.3 Facade Access Systems	131
5.4 Codes and Standards	132
International Codes and Standards:	132
Singapore Codes and Standards:	134
5.5 Means of Access	134
5.5.1. Permanent Systems	134
5.5.1.1. Trolley Unit	135
5.5.1.2. Monorail Track	137
5.5.1.3. Traversing Trolley	138
5.5.1.4. Personal Unit	140
5.5.1.5. Fixed Davit	140
5.5.1.6. Powered Travelling Davit	140
5.5.1.7. Travelling Ladders and Platforms	141
5.5.2. Temporary Access	141
5.5.2.1. Temporary Installed Gondolas	141
5.5.2.2. Counterweighted Suspension Beam	143
5.5.2.3. Suspended Platform	144

5.5.2.4. Parapet Clamp	144
5.5.2.5. Scaffolding	145
5.5.2.6. Boomlifts	147
5.5.2.7. Facade-cleaning Robots	148
5.6 Building Forms	149
References	152
Index	155