

Contents

1	Introduction to a Building Automation System	1
1.1	What is building automation?	1
1.2	Why building automation is needed	6
1.3	Direct Digital Control (DDC)	6
1.4	Predecessors to DDC control	8
1.5	System topology	10
1.6	Key building blocks	11
1.7	Industrial networks	12
2	Controllers	15
2.1	Introduction	15
2.2	Programmable Logic Controllers (PLCs)	16
2.3	Network controllers	18
2.4	Terminal unit controllers	19
2.5	Connectivity with networks	20
2.6	Configuration and programming	22
2.7	Troubleshooting	24
2.8	Web enabled controllers (Aspect FT)	25
3	Industrial Networks	29
3.1	Different Systems	29
3.2	Proprietary versus Non Proprietary systems	30
3.3	BACnet	30
3.4	LonTalk (Lon Works)	37
3.5	Konnex (KNX)	46
3.6	Wireless Zigbee	48
3.7	The TCP/IP reference model	49
3.8	Industrial Ethernet	50
3.9	RS 485 standard	57
3.10	Remote control	61
3.11	Configuration and troubleshooting	64
4	Occupancy	67
4.1	Occupies/unoccupied/morning warm-up and night-time setback	67
4.2	Monitoring for fresh air and presence of pollutants in occupied areas	68
4.3	Requirements of building automation systems	69
5	Lighting	71
5.1	Automated systems	71
5.2	Demand Response	77
6	Air Handlers	79
6.1	Air Handling Units	79
6.2	Types of Air Handling Units	81
6.3	Typical control setup for Air Handling Units	84

7	Central Plant	85
7.1	Introduction	85
7.2	Chillers	86
7.3	Boilers	90
7.4	Cooling Towers	91
7.5	Pumps	95
8	Water Systems	97
8.1	Chilled water system	97
8.2	Condenser water system	99
8.3	Hot water system	99
9	HVAC Controls and Instrumentation	101
9.1	Introduction	101
9.2	Sensors and elements	101
9.3	Elements of control	110
9.4	Methods of control	113
9.5	Typical control systems	119
10	Alarms and Security	123
10.1	Introduction	123
10.2	Temperature sensors	123
10.3	Differential pressure transmitters	127
10.4	Status alarms	127
10.5	Valve actuators	128
10.6	Carbon-monoxide and carbon-dioxide sensors	129
10.7	Refrigerant sensors	131
10.8	Current sensors	131
10.9	Fire suppression and alarm sensors	132
11	Room Automation	135
11.1	Corporate Boardrooms/Presentation Suites	135
11.2	Video Conferencing/Video Projectors	137
11.3	Lighting control system	138
11.4	Public address systems	139
12	Energy Efficiency	141
12.1	Introduction	141
12.2	Cost of fuels	142
12.3	Energy performance	143
12.4	Energy audit	144
12.5	Case Study Example: Replacing a steam boiler at a high-tech facility	170

13	SCADA for Building Automation Systems	171
13.1	Introduction	171
13.2	Basic implementation	174
12.3	Troubleshooting	175
13.4	Application of ASHRAE	178
13.5	Features	179
13.6	Remote control and monitoring	181
13.7	Basic SCADA and SCADA for medium and large facilities	185
Appendix A – Practical Exercises		189

