

Brief Table of Contents

1	Introduction to Infrastructure and Careers in Civil and Environmental Engineering	1
2	The Natural Environment	20
3	Structural Infrastructure	40
4	Transportation Infrastructure	57
5	Environmental and Energy Infrastructure	79
6	Construction Sites	104
7	Infrastructure Systems	120
8	History, Heritage, and Future	137
9	Analysis Fundamentals	156
10	Design Fundamentals	181
11	Planning Considerations	212
12	Energy Considerations	237
13	Sustainability Considerations	254
14	Economic Considerations	277
15	Environmental Considerations	293
16	Social Considerations	310
17	Ethical Considerations	324
18	Security Considerations	340
19	Other (No Less Important) Considerations	356
20	Analysis II	381
21	Design II	397

Aviation (ASCE 2009 Grade: D)	70
Waterways (ASCE 2009 Grade: D-)	71
Ports	72
Locks	72
Tunnels	73
Rail (ASCE 2009 Grade: C-)	75

5 Environmental and Energy Infrastructure 79

Introduction	79
Energy (ASCE 2009 Grade: D+) 80	
Energy Sources	80
Energy Transport	80
Energy Generation	80
Distribution	82
Drinking Water (ASCE 2009 Grade: D-) 82	
Sources and Demand	83
Storage	83
Conveyance	84
Treatment	84
Distribution	85
Wastewater (ASCE 2009 Grade: D-) 86	
Sources	87
Conveyance	87
Treatment	89
Discharge	90
Stormwater 90	
Collection and Conveyance	90
Culverts	91
Storage	92
Treatment	93

Parks and Recreation (ASCE 2009 Grade: C-)	95
--	----

Solid Waste (ASCE 2009 Grade: C+) 97	
--------------------------------------	--

Collection	97
Transfer	97
Recycling and Reuse	98
Composting	99
Landfills	99
Incinerators	100

Hazardous Waste (ASCE 2009 Grade: D) 101	
--	--

Superfund	101
Brownfields	101

6 Construction Sites 104

Introduction	104
Security	105
Staging Areas	105
Equipment 105	
Trailers and Storage Containers	105
Cranes	106
Excavators	106
Bulldozers	107
Loaders	107
Skidsteers	108
Dump Trucks	109
Earthmovers	109
Lifts	110
Blasting Equipment	110
Piledrivers	111
Dewatering	111
Ready-Mix Concrete Trucks	112

Concrete Pumping	112
Concrete Forms	112
Falsework	113
Utilities	114
Erosion Control	115
7 Infrastructure Systems	120
Introduction	120
Systems Overview	123
Infrastructure Components as Systems	126
Intra-Sector Systems	126
Inter-Sector Systems	128
The "Big Picture" System	131
8 History, Heritage, and Future	137
Introduction	137
Themes	140
Transportation	141
Roads	141
Canals	143
Bridges	145
Water Distribution and Treatment	147
Water Distribution	147
Water Treatment	149
Wastewater Conveyance and Treatment	150
Wastewater Conveyance	150
Wastewater Treatment	151
And Then There Was More...	151
The Future	151
9 Analysis Fundamentals	156
Introduction	156

The Nature of Analysis	158
The Analysis Process	159
Case Study: Creation of the Rational Method	165
Analysis Applications	167
Construction Engineering Analysis Application—Gantt Charts	167
Environmental/Water Resources Engineering Analysis Application—Open Channels	168
Geotechnical Engineering Analysis Application—Soil Size Analysis	170
Municipal Engineering Analysis Application—Stormwater Runoff	173
Structural Engineering Analysis Application—Tension and Compression in Beams	174
Transportation Engineering Analysis Application—Pavement Analysis	176
10 Design Fundamentals	181
Introduction	181
The Design Process	182
Problem (Need) Identification	183
Collection of Background Information	184
Development of Alternative Designs	185
Evaluation of Designs	186
Selection of Best Design	187
Documenting the Design	189
Implementation of Solution	189
Design Factors	190
Design Constraints	190
Regulations	190

Standards	191	Sources of Energy	243
Safety Factors	191	Environmental Impacts	244
Acceptable Risk	192	Energy as an Infrastructure Consideration	248
Design Life	192	Transportation Sector Energy Use	248
Case Study: Chicago River Reversal	193	Buildings	249
Design Applications	195	Wastewater Treatment	250
Construction Engineering Design		Landfills	251
Application—Cut and Fill	195	13 Sustainability Considerations	254
Environmental Engineering Design		Introduction	254
Application—Septic Systems	197	The Needs of the World	257
Geotechnical Engineering Design		Resource Demand	262
Application—Footings	201	Measures of Sustainability	266
Municipal Engineering Design		The Role of Civil and Environmental Engineers	in Promoting Sustainability 267
Application—Land Development	204	Sustainable Design	268
Structural Engineering Design		Green Buildings	269
Application—Bridges	206	Sustainable Land Development	272
Transportation Engineering Design		Water Reuse	272
Application—Inlet Spacing	206	14 Economic Considerations	277
11 Planning Considerations	212	Introduction	277
Introduction	212	The Relationship Between Infrastructure and	the Economy 279
The Need for Planning	214	Sources of Funds	280
Infrastructure Planning	218	Funding Local Projects	280
Transportation Planning	221	Funding State and Federal Projects	281
Land Use Planning	224	Consideration of Project Economics	286
Regional Planning	227	15 Environmental Considerations	293
Emergency Planning	229	Introduction	293
Population Projections	231	Environmental Protection	294
12 Energy Considerations	237	Environmental Impacts	299
Introduction	237		
Background	238		
Energy Trends and Predicting Demand	239		

Land Development	299
Building Demolition	300
Wastewater Treatment	300
Highways	301
Dams	301
The Good (Bad?) Ole Days	302
Environmental Regulations	303
Environmental Complexity	305
16 Social Considerations	310
Introduction	310
Welcoming the Challenge	313
Social Impact Assessment	313
Displacement	314
Neighborhood Cohesion	315
Health	318
Environmental Justice	319
17 Ethical Considerations	324
Introduction	324
Ethics and Engineering	325
Codes of Ethics	327
Ethical Decision-Making Framework	330
Case Study	331
Corruption	333
18 Security Considerations	340
Introduction	340
Economic Impacts and Infrastructure Security	343
Critical Infrastructure	344
Designing for Failure	346

Water Security	346
Energy Security	349
Transportation Security	350
Risk Considerations	352

19 Other (No Less Important) Considerations 356

Introduction	357
Safety Considerations	357
Protecting the Public	357
Protecting Operations and Maintenance Workers	358
Protecting Construction Workers	359
Maintenance Considerations	363
Constructability Considerations	364
Aesthetic Considerations	368
Political Considerations	369
Legal Considerations	373
Torts	374
Contracts	375
Property Law	376

20 Analysis II 381

Introduction	381
Construction Engineering: Critical Path Method	382
Environmental Engineering: Air Pollution	383
Geotechnical Engineering: Katrina Floodwalls	386
Structural Engineering: Deflection of Beams	388
Transportation Engineering: Transportation Impact Study	392

21 Design II 397

Introduction 397

Construction Engineering: Concrete Mix and
Formwork 398

Environmental Engineering: Primary Treatment
of Wastewater 404

Geotechnical Engineering: Floodwalls 407

Structural Engineering: Design of Structural
Members 410

Transportation Engineering: Horizontal
Curves 413

Index 421