Contents

Preface About the Author		xiii xvii	
The	e first	page	1
		SECTION 1	
		The human body	
1	Bod	y sizes	5
	1.1	Our Earth's populations	5
	1.2	Measurements	5
	1.3	No "average person"	11
	1.4	Designing to fit the body	27
		nmary	29
		ng steps	30
		her reading	30
	Note	es	31
2	Mol	bility	33
	2.1	Work in motion	33
	2.2	Body joints	35

xiii

	2.2.1 The hand	35
	2.2.2 The spine	39
	2.3 Designing for mobility	43
	2.4 Workspaces	44
	Summary	51
	Fitting steps	51
	Notes	51
3	Muscular work	53
	3.1 Physiological basics	53
	3.2 Dynamic and static efforts, strength tests	58
	3.3 Fatigue and recovery	62
	3.4 Use of muscle strength data in design	63
	Summary	67
	Fitting steps	67
	Notes	67
4	Body strength	69
	4.1 Static and dynamic strength exertions	70
	4.2 Maximal or minimal strength exertion	72
	4.3 Hand strength	73
	4.4 Foot strength	76
	4.5 Whole body strength	78
	4.6 Design for use preferences	79
	Summary	83
	Fitting steps	83
	Further reading	84
	Notes	84
	section	
	The human mind	
5	How we see	87
	5.1 Our eyes	88
	5.2 Seeing the environment	90
	5.3 Dim and bright viewing conditions	97
	Summary	102
	Sammar J	102

CONTENTS	vii	

	ing steps	102
Fur	ther reading	102
Not	es	103
6 Ho	w we hear	105
6.1	Our ears	105
6.2	Hearing sounds	107
6.3	-	113
Sur	nmary	123
	ing steps	123
No	es	124
7 Ho	w we sense objects and energy	125
7.1	Sensing body movement	12:
7.2	The feel of objects, energy, and pain	12
7.3	Designing for tactile perception	130
Sur	nmary	134
Fit	ing steps	134
No	tes	13:
	w we experience indoor and outside climates	
	w we experience indoor and outside climates	13
8 Ho	w we experience indoor and outside climates Human thermoregulation	13: 13: 14:
8 Ho	w we experience indoor and outside climates Human thermoregulation Climate factors: Temperatures, humidity, drafts	13: 13: 14:
8 Ho 8.1 8.2	w we experience indoor and outside climates Human thermoregulation Climate factors: Temperatures, humidity, drafts Our personal climate	13: 13: 14: 14:
8 Ho 8.1 8.2 8.3	w we experience indoor and outside climates Human thermoregulation Climate factors: Temperatures, humidity, drafts Our personal climate Working in hot environments Working in cold environments	13: 14: 14: 14: 14: 15:
8.1 8.2 8.3 8.4	w we experience indoor and outside climates Human thermoregulation Climate factors: Temperatures, humidity, drafts Our personal climate Working in hot environments Working in cold environments	13: 14: 14: 14: 15: 15:
8 Ho 8.1 8.2 8.3 8.4 8.5	W we experience indoor and outside climates Human thermoregulation Climate factors: Temperatures, humidity, drafts Our personal climate Working in hot environments Working in cold environments Climate effects on mental tasks	133 14 14 14 15 15
8.1 8.2 8.3 8.4 8.5 8.6 8.7 Su	W we experience indoor and outside climates Human thermoregulation Climate factors: Temperatures, humidity, drafts Our personal climate Working in hot environments Working in cold environments Climate effects on mental tasks Designing comfortable climates mmary	133 14 14 14 15 15 15
8.1 8.2 8.3 8.4 8.5 8.6 8.7 Su	w we experience indoor and outside climates Human thermoregulation Climate factors: Temperatures, humidity, drafts Our personal climate Working in hot environments Working in cold environments Climate effects on mental tasks Designing comfortable climates	133 144 144 15 15 15 15
8 Ho 8.1 8.2 8.3 8.4 8.5 8.6 8.7 Su Fit	W we experience indoor and outside climates Human thermoregulation Climate factors: Temperatures, humidity, drafts Our personal climate Working in hot environments Working in cold environments Climate effects on mental tasks Designing comfortable climates mmary	13: 13: 14: 14: 15: 15: 15: 15:
8.1 8.2 8.3 8.4 8.5 8.6 8.7 Su Fit	W we experience indoor and outside climates Human thermoregulation Climate factors: Temperatures, humidity, drafts Our personal climate Working in hot environments Working in cold environments Climate effects on mental tasks Designing comfortable climates mmary ting steps	133 144 144 15 15 15 15 15
8.1 8.2 8.3 8.4 8.5 8.6 8.7 Su Fit	Human thermoregulation Climate factors: Temperatures, humidity, drafts Our personal climate Working in hot environments Working in cold environments Climate effects on mental tasks Designing comfortable climates mmary ting steps tes Pental activities The brain—nerve network	13: 13: 14: 14: 15: 15: 15: 15: 15: 15: 15: 15
8 Ho 8.1 8.2 8.3 8.4 8.5 8.6 8.7 Su Fit No	Human thermoregulation Climate factors: Temperatures, humidity, drafts Our personal climate Working in hot environments Working in cold environments Climate effects on mental tasks Designing comfortable climates mmary ting steps tes The brain—nerve network Taking up and processing information	13° 14.1 14.1 150 15.1 15.1 15.1 15.1 15.1 15.1
8 Ho 8.1 8.2 8.3 8.4 8.5 8.6 8.7 Su Fit	Human thermoregulation Climate factors: Temperatures, humidity, drafts Our personal climate Working in hot environments Working in cold environments Climate effects on mental tasks Designing comfortable climates mmary ting steps tes The brain–nerve network Taking up and processing information Making decisions	13: 13: 14: 14: 15: 15: 15: 15: 15: 15: 15: 15

viii	CONTENTS
	CONTENTS

	Summary Fitting steps Notes	
	SECTION Body and mind working together	
10	Hard physical work	183
	 10.1 Physiological principles 10.2 Energy consumption 10.3 Heart rate as a measure of work demands 10.4 Limits of human labor capacity 10.5 Designing heavy human work Summary Fitting steps Notes 	183 184 189 191 195 196 196
11	Light and moderate work	199
	 11.1 Physiological and psychological principles 11.2 Tiredness, boredom, and alertness at work 11.3 Suitable postures at work 11.4 Accurate, fast, skillful activities Summary Fitting steps Notes 	200 203 206 209 215 216 216
12	Task load and stress	219
	12.1 Task load 12.2 Mental workload 12.3 Distress 12.4 Underload and overload 12.5 Psychophysical assessments of task loads Summary Fitting steps Notes	219 222 223 225 226 230 230 230

SECTION **IV**Organizing and managing work

13	Working with others	235
	13.1 Getting along with others	236
	13.2 Motivation and behavior	238
	13.3 Task demands, job rewards	242
	Summary	244
	Fitting steps	245
	Notes	245
14	The organization and you	247
	14.1 The human is in the center	248
	14.2 Organizational strategy	249
	14.3 Organizational structure	250
	14.4 Organizational conduits	252
	14.5 Organizational guidelines and rules	252
	14.6 Organizational culture	253
	14.7 Individual thoughts, feelings, and behavior	254
	14.8 A good place to work	256
	Summary	257
	Fitting steps	258
	Notes	259
15	Working hours and sleep	261
	15.1 Circadian body rhythms	261
	15.2 Sleep	264
	15.3 Rest pauses and time off work	269
	15.4 Daily and weekly working time	271
	Summary	276
	Fitting steps	277
	Further reading	277
	Notes	277

16	Nigh	nt and shift work	279
		Organizing shift work	281
		Three basic solutions for shift work	282
		Shift patterns	284
	16.4	Selecting suitable shift systems	285
		mary	286
		ng steps	287
	Note	'S	287
		SECTION $oldsymbol{V}$	
		Human engineering	
17	Desi	gning the home	291
	17.1	Designing for mother and child	292
		Designing for impaired and elderly persons	293
		Access, walkways, steps, and stairs	293
		Kitchen	294
	17.5	Bedroom, bath, and toilet	295
	17.6	Lighting, heating, and cooling	297
		Home office	297
	Sum	mary	301
	Note	s and more information	301
18	Offic	ce design	303
	18.1	Office spaces	304
	18.2	The physical environment	307
		18.2.1 Office lighting	307
		18.2.2 Office climate	312
		Office furniture	317
		Ergonomic design of the office workstation	321
	Sumi		330
	Note	s and more information	333
19	Com	puter design and use	335
	19.1	Sholes' "typewriting machine" with its	
		QWERTY keyboard	336
	19.2	From typewriter to computer keyboard	337

	19.3	Human factor considerations for keyboarding	339
	19.4	Input-related anthromechanical issues	343
	19.5	Possible design solutions	344
	19.6	Design alternatives for keyboards	347
	19.7	Designing for new syntax and diction	348
	19.8	Designing smart software	349
	19.9	Designs that combine solutions	349
	Sumr	nary	350
	Notes	s and more information	351
20	Worl	kplace design	353
	20.1	Sizing the workplace to fit the body	353
	20.2	On the feet or sitting down?	356
	20.3	Manipulating, reaching, grasping	359
	20.4	Displays and controls	362
	Sumi	nary	367
	Notes	S	368
21	Load	handling	369
	21.1	Material handling strains the body	369
	21.2	Body capabilities related to load handling	370
	21.3	Assessing load handling capabilities	373
	21.4	NIOSH's lifting and lowering guidelines	376
	21.5	Liberty Mutual's material handling guidelines	377
	21.6	Designing for easy load handling	379
	Sumi	nary	384
	Notes	S	385
22	Heal	thcare for patients and providers	389
	22.1	Patient care and safety	390
		Care staff performance and safety	390
	22.3	Emergency medical services (EMS),	
		paramedics, first aid physicians, ambulances	391
	22.4	Design of wheelchairs and hospital beds	392
	22.5	Moving patients	393
		Medication alerts	395
		Electronic personal and health records	396
		Medical devices	397
		Stress in the workplace	397
	22.10	Safety guidelines, standards, and laws	398

	Sum: Note	mary 's	398 399
23	Autonomous automobiles: Emerging ergonomic issues		
	23.1	Road travel by automobile	404
	23.2	Reasons for reengineering road traffic	404
		Better ergonomics	405
		New technologies—New ergonomic challenges	408
	Sumi	•	410
	Note	s	412
24	Maki	ing work efficient and pleasant	413
	24.1	Using our skills and interests; getting along	
	24.2	with others at work Setting up our own work, workplace,	413
	~	and work environment	417
	Sumi	•	423
	Notes	s and more information	423
Th-	last		
	last p		425
	erence	28	427
Inde	ex		445