

Index

A

- Absorption coefficient, 129, 144
- Active defense, 219
- Actual fires, 67
 - Andraus building, 68
 - Military Personnel Record Center, 68
 - McCormick Place, 69
 - One New York Plaza, 70
- Air
 - Ducts (see Service penetrations)
 - Entrainment by plume, 108, 122, 126, 135
 - Flow factor, 209
 - Infiltration, 205, 266
 - Inflow (see Ventilation of fire)
 - Movement of, in buildings, 205
 - Flow pattern of, 203, 208
- Arapahoe smoke chamber, 94, 95
- ASTM (see also Fire tests), 2
- Automatic fire detectors (see Detectors, smoke; Detectors, thermal)
- Automatic sprinkler system (see Sprinkler system)

B

- Balconies, role of in fire, 264
- Beams
 - Concrete (see Concrete constructions)

- Continuous, 55, 233
- Failure of, in fire, 44, 231
- Steel (see Steel constructions)
- Restrained, 56, 233
- Bed covers, fires of, 114, 119, 120
- Bedroom fire tests, 117, 120
- Box-protection (see Steel constructions)
- Box spring cavities (see Cavities)
- Building codes, 3, 59, 265, 269
- Building Firesafety Model, 7
- Buildup of fire
 - Contributing factors, 107
 - Ignition source, 107
 - Local environment, 107
 - Room confinement, 107
- Burning (see Rate of burning, Rate of heat release, Pyrolysis)
- Buoyancy-driven flow, 108, 111, 208

C

- California Bureau of Home Furnishings, 77
- Calculation of fire resistance
 - Analytical techniques, 44, 48, 226
 - Concrete construction, 49-60
 - Numerical techniques
 - Finite difference, 226, 229, 258
 - Finite element, 227
 - Quasianalytical technique, 227
 - Steel construction, 60-65
 - Structural analysis, 44

Carpets (see Floor coverings, Spread of fire)

Causes of fire (see Statistics)

Cavities, fire in

Box springs, 114

Structural elements, 264

Roofs, 264

Cavity barriers, 264

Ceiling dampers (see Dampers)

Chairs, burning of, 119, 178

Characterization of fires, 215, 217

Columns

Concrete (see Concrete constructions)

Steel (see Steel constructions)

Combustion number, 134

Combustibility, 77

Compartment boundaries

Convective heating of, 107

Individual penetration fluxes for, 213

Radiant heating of, 107

Radiation from, 107, 114

Compartmentization, 139, 219

Compartment without window, 259

Computer simulation models

Harvard, 125

IITRI, 124

UDRI, 125

Concrete constructions, fire resistance of, 49-59

Beams, reinforced or prestressed, 231, 240, 242, 243

Columns

Reinforced, 240, 241

Concrete-protected steel, 234, 247

Double-layer configurations, 237

Hollow construction, 238

In combination with other materials, 239

Masonry, 59, 238

Slabs (floor or roof), 49-59

Monolithic, 233, 237, 239, 241

Composite, 238, 239

Contour protection (see Steel constructions)

Control volume, 120, 121, 123

Convective cooling, 123, 127

Corridor flashover (see Flashover)

Creep, 21-26, 228

Critical radiant flux (see Radiation)

Critical temperature, 220, 227, 231

Curtain wall, 152

D

Dampers

Ceiling, 161

Fire, 161

Decision Tree, 4, 66

Decay period (see Periods of fire)

Detection-extinguishment, 182, 190

Detection of fires

Automatic, 182

Individual, 181

Detectors, smoke

Characteristics of, 183, 186, 187

Effect of air velocity on operation, 181, 184

Evaluation of, 185

Factors affecting operation of, 183, 186

Gas sensor, 183

Ionization chamber, 183

Photoelectric, 183

Placement of, 182, 183

Response of, to

Flaming fire, 185

Smoldering fire, 185

Selection of, 186

Standard for, 183

Utilization of, 187

Detectors, thermal, 183

Factors affecting operation, 186

Fix temperature, 186

Rate of rise, 186

Design for

- Fire safety, 259
- Fire tolerance, 222, 249, 255, 256, 258, 259

Dividing elements, 221, 258

Doors

- Fire resistant, 262
- Role of, in fire safety, 204, 262, 263
- Self closing, 263

Doorway jet

- Convective heat transfer by, 159
- Radiant heat flux from, 159
- Temperature of, 159

Duration of fire, 210-212

DWV pipes (see Service penetrations)

E

Early stages of fire, 8, 107

Electrical cable (see Service penetration)

Emissivity of fire gases (see Fire gases)

Ensemble effect, 118

Equal maximum temperatures, 251, 252

Equal time-temperature areas, 250

Equivalent orifice area, 205

Escape

- Potential, 9
- Routes, 9, 11

Expansion ratio, 134

Extension formulas, for fire resistance of

- Beams (see Steel constructions)
- Columns (see Steel constructions)
- Slab-like constructions, 233

Exterior cladding, in fire, 152

Exterior wall elements, in fire, 153, 258

F

Fire brands, 142

Fire dampers (see Dampers)

Fire drainage system, 267, 268

Fire endurance (see also Fire resistance), 49

Fire extinguishers, 190

Fire gases (see also Toxic gases)

- Accumulation of, 107
- Emissivity of, 129, 144
- Outflow of, 135, 210
- Radiation from, 107
- Temperature of, 112, 213
- Toxicity of, 132, 265

Fire incidents (see Statistics)

Fire load (see Specific fire load)

Fire Modeling

- Application, 10
- Ad Hoc Committee on, 109
- Building Firesafety Model, 7
- Goals of, 109
- Modular model, 120
- Preflashover models, 122
- Probabilistic model, 120
- Validation of models, 12, 133

Fire performance, 44

Fire plume

- Air entrainment into, 126
- From windows, 150-152
- Pumping action of, 122
- Temperature of, 119
- Trajectory of, 150

Fire response, 76

Fire resistance

- Allotment, 221
- Calculation of (see Calculation of fire resistance)
- Classification of, 61
- Definition of, 219, 221
- Design Manual, 46
- Fire tolerance, correlation with, 162, 249, 253, 261

- Prediction of (see also Prediction formulas), 44
- Rating, rules of, 224
- Sources of information on, 224
- Fire resistance of (see Calculation of fire resistance, Concrete constructions, Extension formulas, Prediction formulas, Steel constructions, Timber constructions)
- Fire resistance testing, 46
 - Application of results of, 48
 - Philosophy of, 220
- Fire-retarded materials, 117
- Fire services, 6
- Fire severity, 10, 215
 - Calculation of, 211, 213
 - Effect of ventilation on, 214, 215
- Fire spread (see Spread of fire)
- Fire statistics (see Statistics)
- Fire stopping, 142, 264
- Fire storm, 142
- Fire temperature (see Fire gases, Fire severity)
- Fire tests, combustibility (see also Smoke tests)
 - Laboratory scale, 76, 156, 179
 - Full scale, 116-118, 142, 156
 - ASTM, 87-89, 94, 95, 97, 99
- Fire tolerance
 - Definition of, 223
 - Design for, 223, 255, 256, 259
 - Fire resistance, correlated with, 162, 249, 252, 261
 - Requirements, 253, 259
- Flame
 - Advance over projections, 150, 152, 264
 - Height from windows, 150, 152
 - Height (length) in compartment fires, 134, 210
 - Shape, 129
 - Spread, 87
- Flame deflectors, 151, 264, 265
- Flames outside windows, 146, 147, 150, 152, 258, 264
- Flaming
 - Combustion, 125
 - Ignition, 120
 - State, 132
- Flash-fire propensity, 82-87
- Flashover
 - Criteria of, 108, 114
 - Definition of, 108, 175
 - In corridors, 155
 - Mechanism of, 108, 111, 175
 - Time of, 112, 156, 175
- Floors (see Slab-like constructions, Concrete)
- Floor coverings (see also Carpets)
 - Piloted ignition of, 111
 - Role of, in fire spread, 156
- Flooring radiant panel test, 179
- Foam, cellular plastic, 78, 79, 81, 84-87, 93, 97, 98, 101
- Fuel-surface-controlled fires, 209, 259
- Fully developed fires (see also Realms, Period of fire), 111, 178, 202
 - Energy evolved in, 202, 203
 - Experiments on, 203
 - Parameters of (see Fire severity)
 - Theory of, 208
- Furnace pressure, effect on test results, 160, 161, 262
- Furniture (see also Safe distances)
 - Burning of, 119
 - Layout
 - Effect of, on fire, 111, 113, 114
 - Importance of, 178

G

- Grashof number, 118
- Growth of fire (see also Realms, Periods of fire), 142

H

- Heat exchange in compartments, 127
- Heat flux distribution in corridors, 158
- Heat flux-time criterion, 115
- Heat release (see also Rate of heat release), 90
- High rise building, 141, 207
- Housing and Urban Development (HUD), 6

I

- Ignitability, 80-82
- Ignition influence factor, 153, 155
- Ignition of
 - Items, 107
 - Interior finishes, 176
- Incipient fires, characteristics of, 175
- Indicator specimens (strips), 115, 178
- Inflow of air (see Ventilation of fire)
- Interior finishes (see Interior linings)
- Interior linings
 - Combustible, 111, 147, 149, 153, 176
 - Effect of, on fire severity, 215

K

- Key elements, 221, 257

L

- Large fires, 140
- Latex foam padding, 114
- Law method, 252
- Layering, of fire gases, 115
- Life Safety Code, NFPA, 190
- Light obscuration (see Smoke)
- Lining materials (see Interior linings)

- Lethal conditions, development time, 126

M

- Mattress fires, 114, 119
- Maximum temperatures, 256
- Model studies (see also Fire modeling, Preflashover studies), 115
 - Boeing experiments, 133
 - Home fire project, 133
- Modulus of elasticity, 17-21
- Moisture content
 - Effect of, on fire resistance, 235
 - Volumetric, 236
- Moisture moment, rule of, 236
- Moment
 - Capacity, 54, 232
 - Diagram, 55, 232
- Monolithic slabs (see Concrete)

N

- National Fire Protection Association (NFPA), 4, 6, 190
- NBS
 - Flash-Fire Test, 83
 - Flooring radiant panel test, 88
 - Smoke chamber, 94, 96, 97, 133
 - Smolder Test, 77
- Nonburning surfaces, 123

O

- Occupancies involved in fire (see Statistics)
- Ohio State University
 - Fire model by, 122
 - Release Rate Test, 90, 92, 100, 126, 132, 133
- Open corridors, role of, in fire, 264
- Optical density (see Smoke)
- Origin of fire (see Statistics)

Outflow of hot gases (see Fire gases)
 Outside shell of buildings, 149
 Overall penetration flux (see Penetration heat flux)

P

Passive defense, 219, 265
 Penetration heat flux
 Individual, 213
 Overall, 210, 213
 Pertaining to standard test, 221, 251
 Periods of fire (see also Realms)
 Decay, 202, 217
 Fully developed (see also Fully developed fire), 7, 202
 Growth or preflashover, 7, 202
 Piloted ignition (see Floor coverings)
 Plastics (see Polymers)
 Plumbing (see Service penetrations)
 Plume (see Fire plume)
 Poissons ratio, 20
 Poke-through (see Service penetrations)
 Polymeric materials, combustibility
 of, 78, 81, 84–86, 89, 92, 95, 96, 100
 Post-flashover fire (see Periods of fire)
 Potential hazard, 109
 Prediction formulas, for the fire resistance of
 Concrete constructions (see Concrete constructions)
 Effect of moisture, 235
 Steel constructions (see Steel constructions)
 Timber constructions (see Timber constructions)
 Preflashover fire (see Periods of fire)
 Preflashover studies (see also Early studies, Model studies), 113, 115, 116, 133

Pressure distribution in buildings, 204, 206
 Pressure in test furnace (see Furnace pressure)
 Pressure modeling, 118
 Pressurization of buildings
 Air supply requirement, 266
 By air injection, 267
 Prestressed concrete (see Concrete constructions)
 Projections (see Flame)
 Protected steel beams and columns (see Steel constructions)
 Pyrolysis, 84
 Products of, 122, 210
 Rate of, 124, 209

R

Radiant heating of
 Compartment boundaries, 123
 Floor coverings, 156
 Furniture, 123
 Radiation
 Critical Flux level, 156, 180
 Heat exchange by, 127
 Importance of, 180, 207
 Role of, in fire spread, 176
 Threshold level of, for ignition, 147
 Radiation from
 Burning objects, 178
 Fire gases, 107, 108, 123
 Fires, 147
 Windows, 147
 Rate of burning, 116, 209
 Rate of heat release, 7, 90, 92, 124–126, 210
 Rate of weight loss, in burning
 Cribs, 115, 125, 178
 Furniture, 125, 175, 209
 Mattresses, 125
 Realms, 7
 Refuge areas, 266

Reinforced concrete (see Concrete constructions)
 Restraint, 56, 224, 233
 Rule(s) of
 Moisture moment, 236
 Ten, of fire resistance rating, 224

S

Safe distances, between (see also Furniture)
 Buildings, 147
 Combustible objects, 178
 Windows, 149, 151
 Scaling, 115
 Scenario, fire, 11
 Selection of materials, 175, 265
 Self-closing doors (see Doors)
 Separation distances (see Safe distances)
 Service penetrations
 Effect on fire endurance, 160
 Spread on fire through, 146, 160
 Severity of fire (see Fire severity)
 Slab-like constructions (see Concrete constructions, Extension formulas)
 Smoke
 Characteristics of, 182
 Concentration of, 131, 132
 Data, 91–101
 Detectors (see Detectors)
 Dilution of, 266
 Dispersion (spread) of, 182, 204, 206, 265
 Obscuration of light by, 132, 185, 265
 Particle size, 182, 183
 Release rate, 100, 132
 Tests, 94
 Arapahoe, 94
 ASTM D 2843, 95
 ASTM E 84, 97
 ASTM E 162, 94
 NBS, 94

OSU, 98
 Smolder susceptibility, 77–80
 Smoldering, 77, 132
 Polyurethane foam, 120
 Textiles, 120
 Upholstered furniture, 120
 Specific fire load, 211
 Design values, 218
 In corridors, 261
 Specific heat, 29–34
 Specific surface of fuel, 209
 Spread of fire, 128, 139
 Along building facade, 146, 264
 By radiation, 146, 176, 207
 Factors influencing, 142, 175
 In cavities (see Cavities)
 In mobile homes, 176
 Modes of, 146
 Probability of, 140
 Stochastic model of, 140
 Thermal conductivity, 29–34
 Thermal diffusivity, 29–34
 Thermal expansion, 15–16
 Through cavities (see Cavities)
 Through corridors, 153, 156
 Through doors, 153, 156
 Through service penetrations (see Service penetrations)
 Through windows, 146, 264
 Under doors, 156
 Volumetric, 143
 Spread of smoke (see Smoke)
 Spreading fires, 222
 Fire resistance requirement for, 257
 Calculation of, 257
 Sprinkler systems, 12, 190
 Advantages, disadvantages of, 269
 Reduction of loss with, 191
 Residential application, 190
 Trade-offs with the use of, 190
 Water supply for, 190, 191
 Stack effect, 160, 205
 Statistics, on
 Causes of fire, 170

- Chimney fires, 173
- Effectiveness of sprinklers, 191
- Fires reported, 170, 174
- Materials first ignited, 173
- Occupancies involved, 170
- Origin of fire, 171
- Steel constructions, fire resistance of, 60
 - Beams, protected, 61-65
 - Columns
 - Protected, 61-65, 234, 247, 248
 - Unprotected, 60, 247
- Strength, 26-34
- Stress-deformation history, 20, 226
- Stress-modified critical temperatures, 228
- Stress-strain, 20
- Suppression of fires
 - Automatic (see Sprinkler systems)
 - Manual, 189

T

- Tabulation of fire resistance (see Concrete constructions)
- Telephone cables (see Service penetrations)
- Temperature distributions in
 - Corridors, 158
 - Structural elements, 34-44
- Temperature history
 - Calculation of, 34, 226, 229, 244, 245, 258
 - Of concrete
 - Beams, 35, 240, 245
 - Slabs, 35, 240, 244
- Temperature of fire gases (see Fire gases, Fire severity)
- Temperature-time curve(s)
 - Families of, 216
 - Fire characterization by, 215
 - Standard, 49, 110, 219
- Tests (see Fire tests)
- Thermal feedback, 107, 120, 123

- Thermal detectors (see Detectors, thermal)
- Timber constructions, fire resistance of
 - Beams, 249
 - Columns, 249
- Time of
 - Flashover (see Flashover)
 - Full fire involvement (see Full fire involvement)
- Time-temperature curves (see Temperature-time curves)
- Toxic gases, concentration of, (see also Fire gases), 131, 132
- Trade-offs (see also Sprinkler systems), 190
- Two-layer model, 116, 123
- Two-sided exposure, 220, 222, 223, 257, 258, 262

U

- Unprotected steel (see also Steel constructions), 70, 247, 259
- University of San Francisco (USF), 77
- Upholstered furniture (see also Cavities, Chairs), 113
 - Burning of, 113, 114, 116, 178
- Fire
 - In cavities of, 113, 175
 - On surface of, 113
- Upper layer temperature (see also Layering), 123, 127

V

- Ventilation-controlled fires, 112, 209
- Ventilation of fire
 - Critical value of, 209
 - Effect of wind on, 209
 - Under classical conditions, 107, 122, 126, 127, 134, 208
 - Under real-world conditions, 208

Volatile decomposition products (see
Pyrolysis)

W

Walls (see Slab-like constructions,
Concrete)

Weight loss (see Rate of weight loss)

Wind effect, 150, 209

Windows

Fire resistant, 150, 262

Role of, in fire safety, 262

Wood, 81, 82, 86, 88, 89, 92, 95,
96, 100

Wood crib fires (see Rate of weight
loss)