

Subject Index

A

Adhesive failure, 333
 ADINA program (*see* Finite element analysis)
 Aerospace structures
 crack analysis, 19
 Aircraft repairs
 application of hybrid finite element method, 154
 Airplane fuselages, 347
 Alternating technique, 347
 Aluminum alloy, 2024–T351
 crack growth analysis, 246, 252
 Aluminum-lithium alloys, 135
 Analytical methods
 elliptical crack, 347
 frozen stress method, 5
 high-density moiré method, 5
 measurement of fracture parameters, 5
 nonplanar and multiple cracks, 314
 summary, 439
 ASTM Standards
 E 399–83, 58, 62–63
 E 399–86, 246
 E 561–86, 246
 E 1304–89, 58, 62–63, 440
 Asymptotic fields, 206, 333
 Axial surface flaws in pipes, 29

B

Bending loads, 19, 183, 368, 421
 Bimaterials, 333
 Boron/aluminum, 410
 Boundary element methods, 314
 Boundary integral equations, 314
 Brittle slow crack growth, 257

C

Caustic measurements— T^* -integral, 170
 Chevron-notched specimens, 58
 CMOD (*see* Crack mouth opening displacements)
 Cohesive zone model—nonlinear plastic behavior, 135

Compact tension specimens, 289
 Computer image processing, 289
 Constitutive relationships, 368
 Constraint, 368
 Continuum damage mechanics model—
 nonlinear plastic behavior, 135
 Crack closure behavior, 46, 206
 Crack face displacements, 19–20
 Crack growth
 analysis—aluminum alloy, 246
 ductile, 289
 polyethylene gas distribution piping systems, 257
 prediction methods, 115
 Crack initiation and propagation, 206, 257
 Crack length, 246
 Crack measurement, 5, 46, 108, 110–112, 135, 289
 Crack opening displacements, 19, 83, 135, 395, 439
 Crack propagation (*see* Crack initiation and propagation)
 Crack resistance curve, 368
 Crack surface, 83
 Crack tip behavior, 289
 Crack tip deformation fields, 225
 Crack tip opening displacement, 368
 Crack trajectory, 69
 Cracked pipe, 183, 200–201
 Cracked structures—failure, 206
 Cracking in welded structures, 115
 Cracks, 19, 29, 314
 Cross-ply laminates, 421
 CTOD (*see* Crack tip opening displacement)
 Cyclic loading, 206

D

Damage mechanics, 368
 Damage mechanics techniques, 368
 Damage tolerance analysis, 19
 Defect assessment, piping systems, 183
 Deformation and fracture behavior, 368
 Deformation fields, 225
 Delamination, 333, 421
 Design against structural failure, 246

Design of welded structures, 115
Displacement correlation, 69
Dominant eigenvalues, 5
Ductile crack growth, 289
Ductile fracture, 135, 183, 206, 368
Dynamic load, 395

E

Effective crack length, 246
Eigenvalue analysis, 333
Elastic plastic behavior
 crack mouth displacements, 19
 crack tip fields, 206
 near crack-tip deformation fields, 225
 surface cracks in pipes, 183
Elastic plastic fracture mechanics, 135, 170, 183
Elastic plastic primary creep crack model, 29
Elastic unloading effects, 289
Elliptical corner, 83
Elliptical crack, 347
Embedded crack, 347
EPFM (*see* Elastic-plastic fracture mechanics)
Estimation scheme, 183

F

Failure of cracked structures, 206, 257, 368
Fatigue
 aircraft repairs, 154
 crack closure measurement, 46
 crack face displacements, 19
 elastic plastic crack tip fields, 206
 elliptical crack, 347
 fracture parameters, 5
 fracture tests, 19
 materials, 19, 46, 69, 83
 aluminum alloys, 135, 137
 elliptical crack, 347
 fiber composites, 381
 filamentary composites, 410
 laminates, 421
 layered media, 395
 polyethylene piping systems, 257
 pressure vessels and piping systems, 183
 stainless steel—type 304, 206, 289
 strain-hardening material, Al 20424–O, 225
 thermal stress, 274
 welded structures, 115

 mixed mode stress-intensity factors, 69
 nonplanar and multiple cracks, 314
 striations, 46
Fatigue design studies, 115
Fatigue striations, 46
FEAM (*see* Finite element alternating method)
FEIM (*see* Finite element iterative method)
Fiber composites, 381, 410
Filamentary composites, 410
Finite element alternating method, 19, 22, 29, 439
Finite element analysis
 ADINA program, 368
 computer image processing, 289
 crack tip deformation fields, 225
 elastic plastic crack tip fields, 206, 210
 quasi three-dimensional procedure, 421
 simulation, 170
 stress-intensity factors, 395
 thermoelastic fracture problems, 274, 279
 three dimensional singularities, 333
Finite element iterative method, 333, 335
Finite element method, 19, 21, 29, 115, 154
Finite element simulation, 170
Flat plate, 347
Fracture behavior—piping systems, 183
Fracture failure, 333
Fracture initiation, 246
Fracture mechanics
 aircraft repairs, 154
 computer image processing, 289
 crack closure behavior, 46
 crack-growth analysis, 246
 crack-mouth displacements, 19, 135
 ductile cracks, 289
 elastic-plastic crack-tip fields, 206
 elliptical crack, 347
 failure, 333
 fiber composites, 381
 hybrid finite element method application to aircraft repairs, 154
 laminates under torsion loading, 421
 micromechanicals to predict ductile failure, 368
 mixed mode stress-intensity factors, 69, 395
 near crack-tip deformation fields, 225
 nonplanar and multiple cracks, 314
 notched compositess, 410

polyethylene gas distribution piping systems, 257
 stainless steels, 289
 strength of notched composites, 410
 stress-intensity factors, 69, 395
 testing, 58
 three dimensional analysis, 5, 83, 274
 welded structures, 115

Fracture toughness testing, 58
 FRAMATOME stress-intensity factor, 183
 Free surface, 333
 Frozen stress photoelastic method
 fracture measurement, 5

G

Gas pipe lines
 polyethylene piping systems, 257
 proof tests, 9
 General stress gradients, 83
 Geometric moiré, 225
 Geometry effects, 368
 Green's function, 395
 Gurson model, 368

H

High-density moiré method stress
 measurement, 5
 HRR fields, 135, 225, 289
 Hybrid finite element method
 application to aircraft repairs, 154
 dynamic stress-intensity factors, 395
 experimental numerical method, 439
 Hydrotesting gas transmission pipe lines,
 29

I

Image processing, 289
 Inelastic behavior, 29
 Interface cracks, 333, 395
 Interferometry
 fracture parameters, 5
 Interlaminar stress, 421
 Interphase failure, 381
 Inverse calculation, 46

J

J integral, 69, 206, 289
 J_R -curves, 135
 J values, 183

K

K_R (resistance curve), 246
 K field, 225

L

Laminates, 421
 Layered medium, 395
 LEFM (*see* Linear elastic fracture mechanics)
 Line spring fracture mechanics (*see also* Fracture mechanics), 115
 Linear elastic fracture mechanics (*see also* Fracture mechanics)
 elliptical crack, 347
 mixed-mode stress-intensity factors, 69
 nonplanar and multiple cracks, 314
 stress-intensity factors, 69
 three-dimensional problems, 5
 Loads
 elliptical crack, 347
 J -integral application, 206
 K_R resistance curve, 246
 laminates under torsion, 410
 Local mesh refinement, 69

M

Markov process, 410
 Matrix cracks, 381
 Maximum loads, 246, 252
 Measurement techniques
 crack closure, 46
 fracture toughness, 58
 Metals, 58
 Micromechanical models
 nonlinear plastic behavior, 135
 prediction of ductile fracture, 368
 Mixed-mode fracture, 347
 Modes of analysis, 5
 Modified crack closure, 69
 Moiré interferometry, 5, 135, 139, 141, 225

N

Nonlinear plastic behavior, 135, 170
 Nonplanar and multiple cracks
 applications of boundary integral equation, 314
 Notch sensitivity, 410
 Numerical methods, 333, 368

O

- Offshore structures, 115
- Optical methods
 - for crack measurement, 5–6, 439

P

- Part-through crack, 274
- Partial elliptical crack, 347
- Path independent integral, 170, 274
- Photoelastic measurement
 - of fracture parameters, 5
- Pipes
 - stress-intensity factors for cracks, 29
- Piping systems, 183, 257
- Plane-strain fracture toughness, 58
- Plastic pipe, 257
- Plastic zone—deformation fields, 225
- Plasticity induced fatigue crack closure, 46
- Polyethylene gas distribution piping
 - systems, 257
- Power law hardening model—nonlinear
 - plastic behavior, 135
- Pressure vessels, 183, 347
- Proof testing
 - for certifying safety critical structural
 - components, 29
- Pure bending, 183

Q

- Quasi three-dimensional finite element
 - procedure, 421

R

- Radial matrix cracking, 381
- Rapid crack propagation, 257
- RCP (*see* Rapid crack propagation)
- Resistance (K_R) curve, 246
- Resonance, 395
- RH/R6 rule, 183

S

- SCG (*see* Slow crack growth)
- Semielliptical surface crack, 183
- Shadow spot method
 - measurements of the T^* -integral, 170
- Slow crack growth, 257
- Stainless steel, type 304
 - ductile cracks, analysis, 289
 - elastic-plastic behavior, 206

- Standards (*see also* ASTM Standards), 58
- Statistical fracture model, 410
- Steels, 115, 368
- Stochastic fracture model, 410
- Strain energy release rate, 421
- Strength prediction—notched composites, 410
- Stress-intensity factors
 - crack opening displacements, 19
 - FRAMATOME, 183
 - micromechanical models to predict
 - ductile fracture, 368
 - nonplanar and multiple cracks, 314
 - outer surface cracks in pipes, 29
 - three-dimensional problems, 5, 83
 - weight-functions, 83
- Stress-intensity measurement
 - fatigue crack closure behavior, 46
 - fiber composites, 410
 - mixed-mode comparison, 69
- Surface and subsurface cracks, 19, 29, 83, 108, 347

T

- T^* -integral
 - caustic measurements, 170
 - elastic plastic crack tip fields, 206
- Tensile strength prediction, 410
- Tension, 19, 368
- Test procedures, polyethylene pipe, 257
- Thermal stress-intensity factor, 274
- Thermoelastic fracture analysis, 274
- Three dimensional cracks
 - elliptical crack, 347
 - finite element model, 19, 21–22, 183
 - measurement techniques, 46, 183
 - near crack tip deformation fields, 225
 - nonplanar and multiple cracks, 314
 - nonlinear region, 135
 - surface cracks in pipes, 183
- Three-dimensional (quasi) finite element
 - procedure, 421
- Three-dimensional photoelasticity, 5
- Three-dimensional singularities, 333
- Through thickness, 46
- Torsion loads, 421
- Tough materials, 29
- Toughness measurement, 58
- Tubular connections, 115
- Two-dimensional cracks, 19
- Two-dimensional finite element
 - computation, 225

U

u and v displacement fields, 135
Unidirectional laminates, 421

V

Viscoelasticity, 257

Void coalescence, 368
Void growth, 368

W

Weibull distribution function, 410
Weight functions, 83
Welds, 115