Subject Index

A

Absorption, effect on interlaminar fracture toughness, 107
Adhesive joints, Mode I behavior under mixed-mode loadings, 187
Aligned carbon/epoxy laminates, fatigue failure, 686
Aluminum plies, fatigue properties, 772
Angle-ply laminates, 56
APC-2 composite, fiber microbuckling, 393
ARALL laminates, damage and performance, 772
ARALL-2 laminates, effective crack lengths, 791
Aramid aluminum laminates (see ARALL-2 laminates)
AS4/3501-6 carbon/epoxy composites, compression testing, 439
AS4 fibers, PEEK composites with, 70
AS4/PEEK composites effects of T-tabs and large deflections, 169
fatigue behavior, 581
fiber microbuckling, 393
Mode II delamination, 226
ASTM standards
D 695-80, 72
D 695-89, 550, 581
D 790-86, 667
D 3410-87, 439, 550
E 399, 211

B

Bending tests, for bulk flexural strength, 667
Biaxial fatigue, interlaminar stress effects, 659
Boron/aluminum composites, fracture, 696
Brittle fracture, ARALL-2 laminates, 806
Buckling, cylindrical composite panels with implanted delaminations, 373

C

Cantilever beams
double, fatigue delamination onset prediction, 312
split, Mode III delamination testing, 243
Carbon/bismaleimide laminates, fracture strength, 667
Carbon/epoxy laminates
fatigue failure, 686
fracture strength, 667
low-velocity impact damage, 457
stabilized end notched flexure test, 210
thick-sections, compression testing, 439
Carbon fiber composites, Mode II delamination, 226
Carbon fiber/PEEK composites, cooling rate effects, 70
Carbon fiber/polymer composites, mixed-mode fracture, 143
Carbon fiber-reinforced plastics, stacking sequence effects, 476
Circular delamination, 373
Compliance method, effective crack lengths for ARALL-2 laminates, 791
Composite laminates (see also specific laminate)
matrix cracking, 30
transverse ply cracking, 9
Composite plates, filament-wound, effects of quasi-static impact events, 528
Compression after impact strength, quasi-isotropic laminates, 476
Compression behavior
delamination effects, 359
fiber-reinforced composite materials, review, 550
Compression fatigue
CF/PEEK, 581
hole effect in T300/N5208 composites, 638
Compression strength
dge effects, 393
transverse, composite plates, 528
Compression testing
  fiber-reinforced composite materials, review, 550
  thick-section composites, 439
Computer-aided testing, for crack length and fracture toughness, 210
Cooling rate effects
  on carbon fiber/PEEK composites, 70
  on fatigue behavior of CF/PEEK composites, 581
Corner radii, tensile stress, porosity effects, 126
Crack bridging, in metal matrix composites, 711
Cracked-lap shear specimens, Mode I strain energy release rate, 187
Crack growth, interlaminar Mode II, 210
Crack lengths
  computer-aided testing system, 210
  effective, for ARALL-2 laminates, 791
Crack opening displacement, surface opening displacement and, 187
Crack shear displacements, direct measurement, 210
Creep, carbon fiber/PEEK composites, cooling rate effects, 70
Cross-ply laminates
  fatigue damage growth, 617
  with matrix cracks, 56
Crystallinity, cooling rate effects in CF/PEEK, 70
Cylindrical composite panels, effects of inserted circular delaminations, 373

Damage growth
  notched graphite/epoxy laminates, 617
  and strain energy release rate, 617
Damage mechanics
  ARALL laminates subjected to tensile cyclic loading, 772
  fatigue-related, notched graphite/epoxy laminates, 617
  notched strength modeling, 596
Damage modeling, damage zone in T300/N5208 composites, 638
Damage tolerance, low-velocity impacts, 457
Deflections, effects on double cantilever beam tests, 169
Delamination
  carbon fiber/PEEK composites, cooling rate effects, 70
  combined matrix cracking and free edge effects, 287
  direct measurement of crack shear displacements, 210
  edge, 89, 107
  effects of T-tabs and large deflections, 169
  effects on compression behavior, 359
  stress distribution in zero degree ply, 596
  free-edge, 269
  growth in compressively loaded composites, 359
  implanted within cylindrical composite panel, 373
  interply, in SCS-6/T1-15-3 composites, 732
  local, shear deformation model, 269
  Mode I under mixed-mode loadings, 187
  Mode II in toughened composites, 226
  in tapered composite laminates, 312
  transverse crack-tip, 269
Discontinuities, in fibrous metal matrix composites, 696
Double cantilever beams
  effects of large deflections and T-tabs, 169
  fatigue delamination onset prediction, 312
  Dropped ply, 312

Edge delamination
  moisture effects, 89
  partially saturated, tension test, 107
Edge effects, in fiber microbuckling, 393
Effective crack lengths
  for ARALL-2 laminates, 791
  and stress intensity factor, 791
End notched flexure test, stabilized, 210
Environmental effects
  jet fuel absorption on delamination, 107
  moisture and notch geometry effects on fracture toughness, 667

Fatigue behavior
  ARALL laminates subjected to tensile cyclic loading, 772
  carbon/epoxy laminates, 686
  carbon fiber/PEEK composites, cooling rate effects, 70
  uniaxial zero-to-tension, of graphite/epoxy tubes, 659
Fatigue cracks
growth in unidirectional SCS-6/Ti-15-3 composites, 711
growth rate testing, ARALL-2 laminates, 791
initiation, in notched SCS-6/Ti-15-3 composites, 753
Fatigue damage, growth modeling, 617
Fiber bridging, and crack growth in ARALL-2 laminates, 791
Fiber composites
fatigue failure, 686
mixed-mode fracture, 143
Fiberglass/epoxy composites, compression testing of thick sections, 439
Fiber-matrix debonding, in SCS-6/Ti-15-3 composites, 732, 753
Fiber microbuckling, edge effects, 393
Fiber-reinforced composites
compressive response, review, 550
notched, fatigue damage mechanics, 617
stabilized end notched flexure test, 210
tapered laminates, delamination analysis, 340
Fiber-reinforced phbes, fatigue properties, 772
Fiber shear, notched composite laminates, 393
Fiber stress, zero degree, 732
Fiber type, effects CF/PEEK fatigue behavior, 581
Fibrous metal matrix composites, fracture, 696
Fickian moisture diffusion, 89
Filament-wound composite plates, effects of quasi-static impact events, 528
Filament-wound motor cases, nonvisible damage and residual tensile strength, 501
Finite element analyses
fibrous metal matrix composites with discontinuities, 696
maximum delamination stress in thermomechanical fatigue, 732
splitting and delamination effects on stress distribution, 596
unidirectional tapered laminates with ply drops, 312
Finite element analyses, three-dimensional combined effect of matrix cracking and free edge, 287
prediction of delamination onset in compressively loaded composites, 359
split cantilever beam Mode III delamination testing, 243
weave effects on composite moduli and stresses, 417
Finite element modeling
fatigue damage growth, 617
plane strain, 373
Flange-web corners, porosity effects, 126
Flexural strength, effects of notch geometry and moisture, 667
Fracture behavior
carbon fiber/PEEK composites, cooling rate effects, 70
fibrous metal matrix composites with discontinuities, 696
Fracture strength, effects of notch geometry and moisture, 667
Fracture toughness, interlaminar absorption effects, 89, 107
computer-aided testing system, 210
effects of large deflections, 169
moisture, 667
notch geometry, 667
T-tabs, 169
fiber composite laminates, 143
Mode II, 226
Mode III testing of split cantilever beams, 243
Fracture toughness, translaminar, effects of notch geometry and moisture, 667
Free edge, and matrix cracking, combined effects, 287
Free-edge delamination, fracture analysis, 269

G
Geometric nonlinearity, large deflection-and T-tab-related, 169
Graphite/epoxy laminate composites, 30
edge delamination, 107
impacter shape effects, 501
notched, cross-ply, damage-based strength models, 596
Graphite/epoxy tubes, uniaxial zero-to-tension fatigue behavior, 659
Graphite/PEEK composites, edge delamination, 107
Growth law, notched graphite/epoxy laminate damage, 617
Hertz’s law, 501
Hole effect, in compression fatigue of T300/N5208 composites, 638
Holes, effect on fracture strength, 696
Hole size, effects on strength, 596

IM6/5245C composites, Mode II delamination, 226
IM6 fibers, PEEK composites with, 70
IM6/PEEK composites, fatigue behavior, 581
IM7/8551-7
  effects of T-tabs and large deflections, 169
  low-velocity impact damage, 457
  matrix cracking, 30
  Mode II delamination, 226
Impact
  carbon fiber/PEEK composites, cooling rate effects, 70
  low-velocity
effect on composite structures, 457
  impactor shape effects, 457
  temperature effects on ARALL-2 laminates, 806
Impact damage
  ARALL-2 laminates, temperature effects, 806
  resistance, stacking sequence effects, 476
  in stitched laminates, 457
Impact energy, effect on damage to bonded stiffened structures, 457
Impactors, shape effects, 501
Interlaminar fracture toughness, fiber composite laminates, 143
Interlaminar layers, resin-rich, 30
Interlaminar stresses, effects on graphite/epoxy tube fatigue, 659
Interlaminar tensile strength, porous structures, 126
Internal state variable concept, 56
Internal stresses, carbon fiber/PEEK composites, cooling rate effects, 70
Interply delamination, in SCS-6/TI-15-3 composites, 732
Isothermal fatigue, in quasi-isotropic metal matrix composites, 732

Jet fuel absorption, effect on interlaminar fracture toughness, 107

Linear elastic fracture mechanics
  damage-based notch strength modeling, 596
  effective crack lengths for ARALL-2 laminates, 791
Load-displacement curves, nonlinearity, 226
Loading tabs, effects on double cantilever beam tests, 169
Low-velocity impact
effect on composite structures, 457
impactor shape effects, 501

Matrix cracking
  and free edge, combined effects, 287
  in IM7/8551-7 composites, 30
  in SCS-6/TI-15-3 composites, 753
  upper bounds of reduced axial and shear moduli, 56
Matrix cracks, in composite laminates, 9
Matrix crack tip delamination, fracture analysis, 269
Matrix plasticity, ARALL-2 laminates, 806
Matrix structure, carbon fiber/PEEK composites, cooling rate effects, 70
Metal matrix composites
damage growth, 753
fatigue crack growth, 711
fatigue crack initiation, 753
temperature effects on impact damage and residual tensile strength, 806
Mixed-mode loading
  composite laminates, delamination onset of, 359
  delamination, Mode I behavior, 187
Mixed-mode tests, fiber composite materials, 143
Mode I strain energy release rate, 187
Mode II delamination, in toughened composites, 226
Mode II interlaminar crack growth, 210
Mode III delamination testing, split cantilever beams, 243
Moisture, effect on fracture strength, 667
Motor cases, nonvisible damage and residual tensile strength, 501

Nondestructive inspection
  porosity effects on flange-web corner strength, 126
stacking sequence effects on impact
damage and residual strength, 476
Nonlinearity
geometric, double cantilever beams, 169
Mode II delamination in toughened
composites, 226
Nonvisible damage, impactor shape effects, 501
Notched, cross-ply graphite/epoxy
laminates, damage-based strength
models, 596
Notched composites
fatigue crack initiation, 753
fiber microbuckling, 393
Notched strength modeling, damage-based, 596
Notches
effect on fracture strength in fibrous metal
matrix composites, 696
glometry, effect on fracture strength, 667
Open-hole/notched composites, fiber
microbuckling, 393
Plastic zone, from discontinuities, 696
Ply drops, 312
Ply group thickness, 30
effect on damage resistance and residual
strength, 476
Porosity, effects on flange-web corner
strength, 126
Pulse-echo ultrasonics, 476
Quasi-isotropic laminates
fatigue damage growth, 617
stacking sequence effects, 476
Quasi-isotropic metal matrix composites,
thermomechanical fatigue, 732
Quasi-static impact, effects on composite
plates, 528
Radiography, damage monitoring with, 596
Rayleigh-Ritz energy method, 528
Reduced axial, upper bounds, 56
Residual strength
ARALL-2 laminates, temperature effects, 806
and impact damage, 457
notched graphite/epoxy laminates, 617
stacking sequence effects, 476
thick graphite/epoxy composites,
impactor shape effects, 501
Residual stress, SCS-6/TI-15-3 composites, 732
Resin-rich interlaminar layers, 30
S
S2/3501-6 fiberglass/epoxy composites,
thick-sections, compression testing, 439
S2/SP250 glass/epoxy laminates, tapered,
delamination analysis, 340
Scanning electron microscopy
ARALL-2 impact damage, 806
damage modes to SCS-6/TI-15-3
composites, 732
for damage monitoring, 596
fatigue crack growth in metal matrix
composites, 711
SCS-6/TI-15-3 composites
fatigue crack growth, 711
notched, fatigue crack initiation and
growth, 753
thermomechanical fatigue, 732
Shear deformation model, for local
delamination, 269
Shear moduli, upper bounds, 56
Split cantilever beams, Mode III
delamination testing, 243
Splitting, effects on stress distribution in
zero degree ply, 596
Stabilized end notched flexure test, 210
Stacking sequence, effect on damage
resistance and residual strength, 476
Stiffness reduction
cross-ply laminates, 56
and fatigue damage, 772
Stitched laminates, impact damage, 457
Strain energy release rate, 9
and damage growth, power law
relationship, 617
mixed mode, 89, 107
Mode I, in cracked-lap shear specimens, 187
Mode III delamination testing, 243
notched graphite/epoxy laminates, 617
tapered laminates, 312
tapered laminates under tensile loading,
340
Strain measurement, optical, 596
Stress analyses, woven composites, 417
Stress distribution in zero ply, splitting and delamination effects, 596
Stress intensity factor
and effective crack length, 791
of transverse ply cracking, 9
Subcritical damage, effect on notched strength of cross-ply composites, 596
Surface opening displacement, calculation, 187

T

T300/914C carbon-fiber epoxy composites, fatigue damage mechanics, 617
T300/934 graphite/epoxy laminates, transverse crack-tip and free-edge delamination, 269
T300/5208 composites, effects of T-tabs and large deflections, 169
T300/N5208 composites, hole effect in compression fatigue, 638
Temperature effects
on ARALL-2 laminates, 806
on fatigue behavior of CF/PEEK composites, 581
Tensile loading, delamination of tapered laminates under, 340
Tensile residual strength
ARALL-2 laminates, temperature effects, 806
impactor shape effects, 501
Tensile strength, interlaminar, 126
Tension cyclic loading, ARALL laminates, 772
Tension fatigue, CF/PEEK, 581
Tension-tension cyclic loading, effects on T300/914C laminates, 617
Thermomechanical fatigue, in quas- isotropic metal matrix composites, 732
Thermoplastic composites, fatigue behavior, 581

T3/SCS composites (see SCS-6/Ti-15-3 composites)
Toughened matrices, stacking sequence effects, 476
Transverse microcracking, SCS-6/Ti-15-3 composites, 732
Transverse ply cracking, composite laminates, 9
Tropical exposure, effects of notch geometry and moisture, 667
Tubular specimens, interlaminar stress effects on fatigue behavior, 659
Two-degree of freedom model, composite plates subjected to transverse impacts, 528

U

Ultrasonic signals, attenuation loss, 126
Unidirectional boron/aluminum composites, fracture, 696
Unidirectional SCS-6/Ti-15-3 composites, fatigue crack growth, 711
Upper bounds, reduced axial and shear moduli, 56

V

Virtual crack closure technique, 287

W

Water absorption, effect on interlaminar fracture toughness, 107
Wavelength dispersive spectroscopy, thermomechanical fatigue of SCS-6/Ti-15-3 composites, 732
Weaves, effect on composite moduli and stresses, 417
Weibull statistics, residual strength calculation with, 617
Woven composites, three-dimensional stress analysis, 417