

GEORGE LAIRD PhD, PE

Principal Mechanical Engineer and Founder
Languages: English (native), Spanish (C1), German (A2)
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FOCUS

- »» Idealization of engineered structures and systems into predictive numerical models.

EDUCATION

- Ph.D. Dissertation: *"Micromechanics of Heterogeneous Materials under Compressive Loading"*, 1993
- M.S. Mechanical Engineering, Oregon State University, 1987
- B.S. Mechanical Engineering, Oregon State University, 1982

CONSULTANT ACTIVITIES

- »» FEA and CFD for the design of structurally and thermally optimized components and systems. FEA experience: linear and nonlinear dynamics from normal modes to PSD, seismic analysis of large vessels per ASCE 4-98 and ASME Section VIII, Div. 2 requirements, satellites, turbine burst containment, drop-test analysis, composite analysis (stress and thermal) using linear or progressive failure analysis, elastic-plastic analysis of plastics, elastomers and foam materials and general analysis of a wide-range of consumer, automotive, aviation and medical products. Fracture and fatigue analysis has been performed on structures ranging from glass windshields to deep-diving submarines to composite structures for commercial and military uses.

CFD experience: analysis of electronic assemblies, wind load predictions on structures (solar panels, antennas, buildings), thermal/flow analysis of large power plant buildings, hospitals, and data centers. Other CFD work has studied nozzle jet design to thermal-radiant heating within industrial ovens.
- »» In brief, 25+ years of industrial FEA/CFD/mechanics experience. See PredictiveEngineering.com for further details on professional experience.
- »» Finite element analysis training and coaching services to a broad range of industries.
- »» Material science expertise in metals, ceramics and common plastics, elastomers, and foams.
- »» Metallurgical consulting on the design of new alloys for the mining, mineral processing, steel industry and pulp and paper industry. Alloy optimization for severe wear environments using standard optical and electron microscopy tools along with analytical chemistry methods for wear and failure analyses.
- »» Lead Author of Abrasion-Resistant Cast Iron Handbook.
- »» Author of over 40 publications on wear, fracture mechanics and finite element analysis.
- »» Cited 174 times in www.DYNAlook.com for LS-DYNA publications, conference presentations and FEA Information Articles.

RESEARCH
EXPERIENCE &
INTERESTS

U.S. Bureau of Mines: November 1984 to February 1996 - Mechanical Engineer

- »» Mechanical and material engineering research and development with an emphasis on composites (metal-matrix and polymeric), ceramics, and ferrous alloys. Research has concentrated on the linkage of experimental (laser moire interferometry and a variety of other mechanical tests) and modeling techniques to explore the mechanical behavior of layered, fiber, particulate or carbide reinforced materials.
- »» Wear-related failure phenomena such as those associated with abrasive, corrosive, impact wear mechanisms, or mechanical/thermal stress conditions. Understanding the mechanisms and material/environment interactions that lead to improved materials or processes.
- »» Skills in elasticity, plasticity, vibration, fracture mechanics, effects of material processing (interfaces and liquid-solid and solid-solid transformation behavior in ferrous alloys), static and dynamic contact phenomena, and heat transfer (solidification, solid-state transformations and thermal/stress modeling).

TEACHING
EXPERIENCE

- »» **LS-DYNA Handbook: Explicit and Implicit Structural Mechanics.**
FEA short courses (Femap, Simcenter Nastran and ANSYS LS-DYNA) on finite element technology, dynamics, heat transfer, nonlinear analysis technics and general FE modeling.
- »» Instructor at Oregon State University, fall 1990 (Statics 211) and winter 1991 (Dynamics 212).
- »» Whitewater kayak instructor (American Canoe Association).

HONORS &
AWARDS

- 1995 Allan B. Dove Medal Award (Wire Association International) for paper titled "Development of an Instrumented Impact Test for Wire," by K.K. Schrems, G. Laird II, and N.W. Duttlinger.
- 1994 Invited keynote talk to the 13th Biennial Conference of the Australian Society for Electron Microscopy and Institute of Metals and Materials Australasia.
- 1992 Best paper award for American Foundrymen's Society Transactions paper on "Microstructures of NiHard I, NiHard IV and High-Cr White Cast Irons." This paper was subsequently translated and published by Gießerei-Praxis (a German Foundry Magazine).
- »» USBM outstanding performance awards for 1986,'88,'89,'90,'91, '93, '94, and '95.

PROFESSIONAL
ACTIVITIES

- »» Registered Professional Engineer, License No. 13327, Oregon.
- »» 1979 to present—member of the American Society of Mechanical Engineers (ASME); ASME OSU Student Chapter, Chairperson 1981, and ASME Willamette Valley Section, Chairperson 1991.
- »» 1988 to 2004—member of the American Foundrymen's Society 5-D Special Irons Committee on Abrasion Resistant Irons.
- »» Chairman of the Finite Element Applications Session at the 1990 ASME International Computers in Engineering Conference.

C.V. George Laird

Dissertation

George Laird II, Micromechanics of Heterogeneous Materials under Compressive Loading, 1993, Oregon State University

Publications

1. G. Laird II, W. K. Collins, and R. Blickensderfer. *Crack Propagation and Spalling of White Cast Iron Balls Subjected to Repeated Impacts*, in Wear of Materials 1987, ed. K.C. Ludema, ASME **2** (1987) 797-806; and *Wear* **124** (1988) 217-235.
2. R. Blickensderfer and G. Laird II. *A Pin-on-Drum Abrasive Wear Test and Comparison With Other Pin Tests*, in Tribological Mechanisms and Wear Problems in Materials, eds. P. S. Godavarti, A. T. Santhanam, and K. L. Murty, ASM International (1987) 71-83; and *J. Test. Eval.* **16** (1988) 516-526.
3. R. Blickensderfer, J. H. Tylczak, B. W. Madsen, and G. Laird II. *Wear Measurements in an Ore Feed Chute*, in Antiwear '88, Institute of Metals, London (1988) 7.1-7.7.
4. G. Laird II. *NiHard 4 Revisited*, AFS Trans. **96** (1988) 799-806.
5. G. Laird II. *An Investigation of Ball-On-Ball Impact*, *Experimental Mechanics* **29** (1989) 300-306.
6. R. Blickensderfer, J. H. Tylczak, and G. Laird II. *Spalling of High-Chromium White Cast Iron Balls Subjected to Repetitive Impact*, in Wear of Materials 1989, ed. K. C. Ludema, ASME **1** (1989) 175-182.
7. N. H. Macmillan and G. Laird II. *An Approximate Description of the Temporal Evolution of a Hertzian Impact*, *Mater. Sci. Engr.* **A108** (1989) L1-L3.
8. T. C. Kennedy and G. Laird II. *The Effect of Fiber Properties on Fracture Strength in Continuous-Fiber Ceramic Composites*, in Proc. ASME Computers in Engineering Intl. Conference, eds. D. R. Riley and T. J. Cokonis, **2** (1989) 291-296.
9. G. Laird II and T. C. Kennedy. *Three-Dimensional Finite Element Analysis of a Crack in a Ceramic Composite*, in Proc. ASME Computers in Engineering Intl. Conference, eds. G. L. Kinzel and S. M. Rohde, **2** (1990) 233-241.
10. G. Laird II and T. C. Kennedy. *Crack Wake Toughening Mechanisms in a Whisker-Reinforced Ceramic*, in Proc. 4th International ANSYS Conference, Pittsburgh, PA., **1** (1989) 13.24-13.40; and *Intl. J. Finite Elements in Analysis and Design* **9** (1991) 113-124.
11. G. Laird II, R. E. Nielsen, and N. H. Macmillan. *On the Nature of Eutectic Carbides in Cr-Ni White Cast Irons*, *Metall. Trans. A* **22** (1991) 1709-20.
12. G. Laird II, R. R. Brown, and R. E. Nielsen. *Factors Affecting the Solidification of Cr-Ni (-Si-Mn) White Cast Irons*, *Mat. Sci. Tech.* **7** (1991) 631-42.
13. G. Laird II and T. C. Kennedy. *The Role of Interfacial Cohesion on the Micromechanics of Composites Containing Spherical Inclusions*, *J. Mater. Sci. Lett.* **10** (1991) 772-773.
14. G. Laird II and J. C. Rawers. *Finite Element Analysis of a Laser Processed Fracture Specimen*, *Intl. J. Fracture* **53** (1992) 91-99.
15. G. Laird II and T. C. Kennedy. *Micromechanics of Compressive Fracture in Particulate Ceramics*, in Ceram. Eng. Sci. Proc. **13**(7-8) (1992) 107-120.
16. G. Laird II and J. S. Epstein. *Fracture Mechanics and Finite Element Analysis*, *Mechanical Engineering* **114**(11) (1992) 69-73.
17. G. L. F. Powell and G. Laird II. *Structure, Nucleation, Growth, and Morphology of Secondary Carbides in High Cr and Cr-Ni White Cast Irons*, *J. Mater. Sci.* **27** (1992) 29-35.
18. G. Laird II. *Microstructures of NiHard I, NiHard IV, and High-Cr White Cast Irons*, AFS Trans. **99** (1991) 339-357. (Translated

into German and published in Giesserei-Praxis **13/14** (1992) 204-220.)

19. G. Cox and G. Laird II. *Recent Advances in Ni-Hard 4*, Intl. Foundry Trade J. **166(3448)** (1992) 155-158.
20. G. Laird II, J. C. Rawers, and A. Adams. *Fractal Analysis of Carbide Morphology in High-Cr White Cast Irons*, Metal. Trans. **23A** (1992) 2941-2946.
21. G. Laird II and G. L. F. Powell. *Solidification and Solid-State Transformation Mechanisms in Si Alloyed High Chromium White Cast Irons*, Metall. Trans. **24A** (1993) 981-988.
22. V. Randle and G. Laird II. *A Microtexture Study of Eutectic Carbides in a White Cast Iron Using Electron Backscatter Diffraction*, J. Mater. Sci. **28** (1993) 4245-4249.
23. Timothy C. Kennedy and George Laird II. *Three-dimensional Micromechanical Analysis of Cracks in a Ceramic Composite*, Finite Elements in Analysis and Design **13** (1993) 237-248.
24. G. Laird II. *Some Comments on White Cast Iron Microstructures and Wear Properties*, AFS Trans. **101** (1993) 497-504.
25. G. Laird II and T. C. Kennedy. *Micromechanics of Imperfect Interfaces in Heterogeneous Materials*, Composites, **25** (1994) 593-603.
26. G. Laird II, J.E. Epstein, and T.C. Kennedy. *Micromechanics of a Model Heterogeneous Material System under Compressive Loading*, accepted: Exp. Mech. (1994).
27. G. Laird II and T.C. Kennedy. *Micromechanics of Composite Materials under Compressive Loading*, Engr. Fracture Mechanics, **51**, (1995) 417-430.
28. R.M. Anderson, G. Laird II. J.A. Hawk *Effect of Specimen Thickness on the Impact Resistance of Alumina*, J. Mater. Sci., **30**, (1995) 2571-2576.
29. R.D. Wilson, G. Laird II, R.R. Vogt and R.A. Bauer. *Modeling the Capacitor Discharge Welding Process for Tube and Plate Geometries*, in Proc. Intl. Conf. on Modeling and Control of Joining Processes American Welding Society, Orlando, FL, Dec. (1993).
30. G. Laird II and T.C. Kennedy. *Poisson's Ratio and the Interfacial Behavior of Composite Materials*, accepted: Composites (1995).
31. K.K. Schrems, G. Laird II, and N.W. Duttlinger, *Development of an Instrumented Impact Test for Wire*, Wire Journal Intl., **28** (1995) 68-75. (Selected for the Allan B. Dove Medal Award by the Wire Assoc. Intl.)
32. G. Laird II, *Repetitive and Single-Blow Impact Testing of Wear-Resistant Alloys*, J. of Testing and Evaluation, **23**, (1995), 333-340.
33. G. Laird II, R.F. Schleiden, Phil Belding, R.A. Dowell, and R.P. O'Donnell, *Round-Robin Study on the Behavior of Equotip (LD) Hardness Measurements on White Cast Irons of Varying Hardnesses*, AFS Transactions, **103**, pp. 171-182 (1995).
34. G. Laird II, Ö.N. Dogan, and J. R. Bailey, *Impact Testing of Wear-Resistant Cast Alloys*, AFS Transactions, **103**, pp. 165-169, (1995).
35. Ö.N. Dogan, G. Laird II, and J.A. Hawk, *Abrasion Resistance of the Columnar-Zone in High-Cr White Cast Irons*, Wear, **181-183**, (1995) 342-349.
36. G. Laird II and J.A. Hawk, *Ceramic as Replacement Parts in Traditional Manufacturing Processes*, submitted to Bulletin of the Am. Cer. Soc. (1994).
37. G. Laird II and K.K. Schrems, *Mechanical Modeling and Analysis of the Impact Fracture of Wire*, Experimental Mechanics, **37**, pp. 258-263 (1997).

38. G. Laird II and Ö.N. Dogan, *Solidification Structure versus Hardness and Impact Toughness in High Chromium White Cast Irons*, Int. J. Cast Metals Res., **9**, pp. 83-102 (1996).
39. Ö.N. Dogan, J. A. Hawk, and G. Laird II, *Solidification Structure and Abrasion Resistance of High Chromium White Irons*, Metall. Trans., **28A**, pp. 1315-28 (1997).
40. J.D. Gates, J.A. Hawk, J.H. Tylczak, G.J. Gore, and G. Laird, *Microstructural Factors Controlling Spalling in the Ball-on-Ball Repeated Impact Test*, Wear 2001, to be published.

Books

1. G. Laird, R. Gundlach, and K. Röhrig, *Abrasion-Resistant Cast Iron Handbook*, American Foundry Society, December 2000.

Non-Refereed Reports

1. G. Laird II, *Metallurgical Investigation of Wear Resistant Tool Steel Alloys for Steel Mill Rolls*, Cooperative Research and Development Agreement Report, pp. 25, July (1994).
2. G. Laird II and K.K. Schrems, *Impact Toughness of Vanadium Alloyed Wear/Corrosion Resistant Irons*, Cooperative Research and Development Agreement Report, pp. 17, July (1995).
3. G. Laird II and Fritz Friedersdorf, *Microstructural and Corrosion Analysis of Exotically Alloyed Wear-Resistant Irons*, Cooperative Research and Development Agreement Report, pp. 12, July (1995).
4. G. Laird II, *Coefficient of Thermal Expansion (CTE) Analysis for Bi-Material Mill Rolls*, Cooperative Research and Development Agreement Report, pp. 8, September 5, (1995).

Presentations

1. G. Laird II. *NiHard 4 Revisited*, 1988 American Foundrymen's Society (AFS) Casting Congress, 25-29 April 1988, Hartford, CT.
2. G. Laird II. *An Investigation of Ball-on-Ball Impact*, ASME International Conference on Computers in Engineering, 1-4 August 1988, San Francisco, CA.
3. G. Laird II and W. K. Collins. *Improved Microstructures for Impact Resistance*, International Conference on Wear of Materials, 9-13 April 1989, Denver, CO. (poster)
4. G. Laird II and T. C. Kennedy. *Crack Wake Toughening in a Whisker-Reinforced Ceramic*, 4th International ANSYS Conference, 1-5 May 1989, Pittsburgh, PA.
5. G. Laird II and T. C. Kennedy. *Three-Dimensional Finite Element Analysis of a Crack in a Ceramic Composite*, ASME International Conference on Computers in Engineering, 31 July - 3 August 1989, Boston, MA.
6. G. Laird II and T. C. Kennedy. *Micromechanics of Compressive Fracture in Particulate Reinforced Ceramics*, 16th Annual Conference on Composites and Advanced Ceramics, 7-10 January 1992, Cocoa Beach, FL.
7. G. Laird II. *Some Comments on White Cast Iron Microstructures and Wear Properties*, presented at AFS 97th Casting Congress, 24-27 April 1993, Chicago, IL.
8. G. Laird II and W. K. Collins. *Microstructures for Improved Impact Resistance*, presented at Pacific Northwest Minerals and Materials Conference, 3-4 May 1993, Portland, OR. (poster)
9. J. A. Hawk and G. Laird II. *Advanced Ceramics for Impact and Abrasion*, presented at Pacific Northwest Minerals and Materials Conference, 3-4 May 1993, Portland, OR.
10. G. Laird II, J. A. Hawk, and J. S. Epstein. *Micromechanics of Wear-Engineered Materials*, presented at Pacific Northwest Minerals and Materials Conference, 3-4 May 1993, Portland, OR. (poster)
11. G. Laird II. *Comments on Microstructures and Wear Properties of White Cast Irons*, presented at Pacific Northwest Minerals and Materials Conference, 3-4 May 1993, Portland, OR.
12. T. A. Adler, J. A. Hawk, and G. Laird II. *Impact Fracture and Abrasive Wear at the U.S. Bureau of Mines*, presented at Pacific

Northwest Minerals and Materials Conference, 3-4 May 1993, Portland, OR.

13. G. Laird II and T. C. Kennedy. *Micromechanics of Imperfect Interfaces in Heterogeneous Materials*, presented at the International Conference on Interfacial Phenomena, 13-15 September 1993, Cambridge, UK.
14. G. Laird II. *Developments and Usage of Wear Materials*, ACEM-13 -- Bridging the Sciences, 6-11 February 1994, Queensland, Australia. (Invited Keynote Address).
15. G. Laird II, R.F. Schleiden, Phil Belding, R.A. Dowell, and R.P. O'Donnell, *Round-Robin Study on the Behavior of Equotip (LD) Hardness Measurements on White Cast Irons of Varying Hardnesses*, presented at AFS 99th Casting Congress, 23-26 April 1995, Kansas City, Mo.

Significant Reviews of Refereed Materials:

1. Book Review of *Engineering Materials Technology, Structure, Processing, Properties & Selection*, by Jacobs and Kilduff for ASTM J. Testing Evaluation, **23**, (1995) 397-398.