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- Pakistan

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EDUCATION:

IDB Postdoctoral Research: Assessing Layer Waviness in Carbon-Epoxy Composites using Mechanical and Fiber Optic techniques. Department of Aerospace Engineering and Engineering Mechanics, Iowa State University, Ames, IA 50011 USA, 1996-97.

Ph.D. (Mechanical/Materials Engineering): Machining of Toughened Carbon-Epoxy Composite Materials (T800/924C) as part of Euro Fighter Development Program in collaboration with British Aerospace (Military Aircraft Limited). Department of Aeronautical and Mechanical Engineering, Salford University, M5 4WT, UK, 1988-91.

M.S. (Aeronautical Engineering): Major Field: Aerospace Structures, CGPA: 3.58/4.00 Department of Aerospace Engineering, Wichita State University, USA, 1986-88.

On-Job-Training: Helicopter Structural Rebuilt, Overhaul and Flight testing, Marks: 92%, Euro Copter Training Center, Marignane France, 1983-84.

B. Engg. (Aerospace), Department of Aerospace Engineering, College of Aeronautical Engineering, NED University, Karachi, Pakistan, 1975-79.

Higher Secondary Schooling/ Intermediate, Cadet College Kohat.

EXPERIENCE:

• Advanced Composites Research Center, Department of Mechanical Engineering, Univ. of Engineering and Technology, Texila, Pakistan, Founding Director, 2001-Present

Teaching composite manufacturing, mechanics and design to graduate students according to ABET standards, Successfully developed primary & secondary structural components for UAVs and aerospace vehicles such as wings, fuselage, air intake, exhaust scoop and control surfaces from carbon fiber composites, polystyrene and nomex sandwich using vacuum assisted processes according to NASA TRL.

Have successfully developed bullet proof jacket and PASGAT helmets using composite and ceramic materials according to NIJ standards level-III, III+ in collaboration with French company. The technology is being extended for protection of vehicles I-9, Nov 2001 – Present.

• National University of Sciences and Technology (NUST), College of Electrical & Mechanical Engineering, Peshawar Road, Rawalpindi, Pakistan. Assistant/ Associate Professor, Founding Chairperson & Associate Dean (Engineering), May 1992-Nov 2001

IDB POSTDOCTORAL RESEARCH ABSTRACT

Assessing Layer Waviness Defect in Carbon-Epoxy Composite Laminate using Mechanical Testing and Photonics Techniques

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As advanced composite materials having superior physical and mechanical properties are being developed, optimization of their production process is eagerly being sought. One of the most common defects in production of structural composites is layer waviness. Layer waviness is more pronounced in thick section flat and cylindrical laminates that are extensively used in missile casings such as submersibles and space platforms. Layer waviness undulates the entire layer of a multidirectional laminate in through-the-thickness direction leading to gross deterioration of its compression strength.

This research investigates the influence of multiple layer waviness in a double nest formation on the compression strength of a composite laminate using mechanical testing and photonics testing techniques. Different wave fractions of wavy 0° layer were fabricated in IM/8551-7 carbon-epoxy composite laminate on a steel mold using single step fabrication procedure. The laminate was cured on a heated press according to specific curing cycle. Static compression testing was performed using NASA short block compression fixture on an MTS servo hydraulic machine. The purpose of these tests was to determine the effects of multiple layer wave regions on the compression strength of composite laminate. The experimental and analytical results revealed that up to about 35% fraction of wavy 0° layers. The reduction in compression strength of composite laminate was constant after fraction of wavy 0° layers exceeded 35%. This analysis indicated that the percentage of 0° wavy layer may be used to estimate the reduction in compression strength of a composite laminate under restricted conditions. Furthermore the laser emitted diode was also used to launch the light through microbend fiber optic sensor. The reduction in light due to layer waviness was correlated to the degree of layer waviness.

Courses Taught are Composite Design and Manufacturing, Mechanics of Composites, Advanced Engineering Materials, Structural/Solid Mechanics, Mechanical Vibrations, and Strength of Materials. Research about cost effective composite manufacturing, ballistic protection of body/ vehicles according to NIJ standards, birefringent photoelastic stress analysis, polymer nanocomposites & optic fiber smart structures.

COURSES ATTENDED:

- Polymer Nanocomposites, Composite Design, Fabrication and Mechanical Testing during SAMPE Conference, Long Beach, California, May 2006, May 2004.
- Light RTM Close Mold Technology' at Plastech T. T. Ltd, Composite Manufacturing Technology Center, Cornwall, PL18 9AT, UK, Dec. 2004.
- 'Optic Fiber Sensors & Smart Structures', Portland University, Oregon, as part of NSF faculty enhancement program Jul. 1996
- 'Industrial Composites', International Center for Science and High Technology, Trieste, Italy, Dec. 1995.

EXPERTISE:

- Design, development, manufacturing and processing of advanced composite materials using cost effective vacuum assisted processes.
- Characterization, material selection and mechanical testing of engineering materials according to ASTM standards.
- Structural design and analysis using analytical and experimental techniques Structure-property relationship of advanced materials.
- Damage analysis, fractographic investigation and micro structural analysis of composites using scanning electron microscopy.
- Finite Element Modeling using COMPOSITE PRO, ANSYS, LS DYNA
- Fiber optic sensors and smart structures
- Ballistic protection of aerospace vehicles and human body using composites.

HONORS AND AWARDS:

- Postdoctoral Research, 1995-97
- PhD Research Award, 1989-91
- PhD Research Fellowship, 1990-91
- MS Academic Award, 1986-88
- 3 Research and Travel Grants
- Academic Awards, 1969-74
- Merit Scholarships

PROFESSIONAL ACHIEVEMENTS:

- Established Department of Mechanical Engineering, NUST as Founder Chairperson, 1995 and pioneered establishment of Advanced Composites Research Center as Founder Director, 2007.
- Developed aerospace components such as wings, canard, air intake, nose cone, horizontal and vertical tail from carbon, kevlar, glass fiber composites for Unmanned aerial Vehicles & high performance aerospace vehicles using vacuum assisted processes.

- Organized highly successful 6 International and national level Workshops about 'Industrial Composites Design and Applications' in collaboration with Dupont and ASEAN countries at NUST as Chief Resource Person and Principal Speaker.
- Delivered departmental seminar, Department of Materials, Structures and Mechanics, Michigan State University, May, 1996 and Department of Aerospace Engineering and Engineering Mechanics, Iowa State University, Oct, 1996.
- Have 38 publications in technical journals, conference proceedings and has made more than 100 presentations about fiber optics/ composites to leading institutions e.g. Michigan State University, Iowa State University and Saford University, UK.

PROFESSIONAL MEMBERSHIPS:

- American Institute of Aeronautics & Astronautics (membership #: 037370).
- The Royal Aeronautical Society, Life Membership.
- Society for Advancement of Material & Process Engineering (SAMPE), USA
- Canadian Association for Composite Structure and Materials (CAC SMA)

REFERENCES:

- Professor Thomas Rudolph, (Chairperson), Department of Aerospace Engineering and Engineering Mechanics, Iowa State University, Ames, Iowa 50011, USA. T: 515-232-6048, E: rudolph@iastate.edu
 - Professor Daniel Adams (Postdoc. Supervisor), Director: Composites Mechanics Laboratory, Department of Mechanical Engineering, University of Utah, Salt Lake City, Utah, USA. T: 801-585-9807, E: adams@mech.utah.edu
 - Dr. M. Javed Khan, Associate Professor, Aerospace Science Engineering Department, Tuskegee University, Tuskegee, AL 36088, T: (334) 727-8637, E: aeronaut_1@hotmail.com
 - Professor Walter J. Horn, (MS Supervisor), Department of Aerospace Engineering, Wichita State University, Wichita 67205 E: walter.horn@wichita.edu
 - Professor Shahab Khushnud, Chairman, Department of Mechanical Engineering, Department of Mechanical Engineering, University of Engineering and Technology, Taxila, Pakistan. T: 0092(51) 9047400, E: seesshahab@yahoo.com
 - Professor Ijaz Malik, Head of Mechanical Engineering Department, College of Electrical and Mechanical Engineering, National University of Sciences and Technology, Peshawar Road, Rawalpindi, Pakistan, T: 0092-51-9278046, E: drjazmalik@yahoo.com,
- SELECTED PUBLICATIONS (*: refereed publication 22):
1. Prospects, Potentials and Applications of Nanopolymer Composites in Next Generation Aerospace Structures, ASEAN-Pakistan Conference on Materials Science, Islamabad, Conference Proceedings, 15-16 Dec, 2008
 2. Development of On-Line Condition Monitoring System in Composite Structures using Fiber Optic Sensors, ASEAN-Pakistan Conference on Materials Science, Islamabad, Conference Proceedings, 15-16 Dec, 2008
 3. NANOCOMPOSITES – New Opportunities for Next Generation Aerospace Systems, Proc. 10th National Aeronautical Conference, PAF Academy, Risalpur, Pakistan, 20-21 April 2006.

4. The Mechanical Properties of Advanced Composite Materials for Aerospace Applications, 10th National Aeronautical Conference, PAF Academy, Risalpur, Pakistan, 20-21 April, 2006.
5. The Composite Armor for Ballistic Protection of Helicopters, 10th National Aeronautical Conference, PAF Academy, Risalpur, Pakistan, 20-21 April, 2006.
- 6* Development of on-line Condition Monitoring System in Aerospace Structure using Advanced Composite Materials'. ISBN 969-8122-17-6, Proc. 9th International Symposium on Advanced Materials, 2005, pp. 5-15.
- 7* Influence of Layer Waviness on Compression Strength of Carbon-Epoxy Composite Materials. Proc. 9th International Symposium on Advanced Materials, 2005, pp. 21-26.
- 8* Design and Development of Optic Fiber Smart Structure in Aerospace Vehicles, Proc, 3rd International Congress on Aeronautical Congress, Toronto, Canada, Sep. 8th - 13th, 2002.
9. Automated Manufacturing of Composite Materials, Conference Proceedings, International Workshop on Application of Emerging Technologies in Manufacturing Engineering, Best Western Hotel, Islamabad, 10-15 Jul 2003.
10. Design and Analysis of Composite Structures, Conference Proceedings, International Bhurban Conference on Applied Sciences and Technology, Hotel Pearl Continental, Bhurban, Murree, Jun 2003.
- 11* Fiber Optic Sensor for Assessing Layer Waviness in Smart Structures, Conference Proceedings, 3rd Canadian International Composite Conference, ISBN No. 1-58716-114-1, Montreal, Canada, Aug 21-24, 2001, pp 794-801.
- 12* The Dynamics of Academia-Industry Partnership in Developing Countries, Conference Proceedings, 8th World Congress about Continuing Engineering Education, University of Toronto, Canada, May 11-18, 2001, pp 544 - 550.
13. Optic Fiber Smart Structures and Intelligent Materials', Keynote Speaker, 2nd International Symposium on 'Mechanical Vibrations', Sep 25-28, 2000.
- 14*. The Influence of Double Layer Waviness on Compression Strength of Carbon Fiber Composite Materials, Proc., 5th International Conference on 'Advanced Materials', 1997, ISBN: 969-8122-07-9, pp. 66-72.
15. Compression Failure Mechanism in High Modulus Carbon Fibers Composites, Conference Proceedings, International Nathiagali Summer College on 'Physics and Contemporary Needs', Vol: 18, Jun 1997, pp. 271-282.
- 16 Drilling-Induced-Failure Modes in Carbon Fiber Composites, Proceedings SEM Congress on Experimental Mechanics, Nashville, USA, Jun 10 - 13, 1996.
17. NUST and Promotion of Advanced Composite Materials Technology, The daily 'NEWS' International, Jan 24, 1995.
18. Advanced Composite Materials', Published in Newsletter, 'The News', Pakistan Nuclear Society, Vol 4, No.1, Jan-Feb, 1995.
19. Pre-feasibility report about establishing composites industry', Technical Report for using composite as structural materials for boosting engineering industry, Project jointly funded by United Nations and Ministry of Science and Technology, Government of Pakistan, 1994.

20. The Impact of Composite Materials Technology on Emerging Industries, Proc. 1st International Workshop on Application of Emerging Technologies in Manufacturing Engineering, Islamabad, Pakistan, ISBN: 969-8819-00-2, 2003, pp. 6-19.
- 21*. Impact of Composite Materials on Engineering Industry, Journal of Science Technology and Development, Jan-Mar 1994, Vol 13, No: 1, pp16-22.
22. Composite Armor, First International Seminar on Tank Technology at HIT, Texila, Conference Proceedings, Vol 1, pp21-35.
23. Role of Advanced Carbon Fiber Composites in Stealth Technology, Presented in Technology Awareness Seminar-1992, Published in College of Electrical and Mechanical Engineering Journal, 'Technologist', 1993, pp. 37-44.
24. Prospects, Trends and Applications of Composite Materials in 21st Century, Poster Presentation in 3rd International Conference on Advanced Materials at Islamabad Hotel on 20-24 Sep 1993.
- 25*. The Influence of Microstructure and Physical Properties on Wear Mechanism of Cemented Carbides, Proc. 3rd International Conference, 'Advanced Materials', Islamabad, Pakistan, ISBN: 969-8122-07-9, 1993, pp178-188
- 26*. Design and Development of Advanced Carbon Fiber Composites, Presented at GIK Institute of Sciences and Technology on 06 Oct, 1992, published in Engineering Horizon, ISSN 1017-8260, Vol. 4, No. 5, May 1993, pp. 5-11
- 27*. Energy Efficient Design Materials in Aerospace and Automotive Vehicles, Presented in 3rd International Conference on Energy Conservation, 4/ 1992, published in Engineering Horizon, ISSN 1017-8260, vol-3, No. 6, Jun, 1992, pp 15-18.
- 28*. Drilling-Induced-Failure Modes in High Performance Carbon Fiber Composites, Proc. 2nd International Symposium on 'Advanced Material', 1991, ISBN 969-8122-02-8, pp. 19-29.
29. Comparative Analysis of Mechanical Properties of Thermoset - Thermoplastic Composite Materials, Technical Report, Department of Aeronautical Engineering, Wichita state University, Kansas 67208, May 1987.
- 30* Shahab Khushnood, Zaffar M. Khan, Zafarullah Koreshi, Haroon-ur-Rashid "Dimensional analysis of vibration of tube bundle in cross-flow" Proceedings of the 2nd International Symposium on Mechanical Vibrations (ISMV-2000), Islamabad, September 25-28, 2000.
- 31* Shahab Khushnood, Zaffar M. Khan, Muhammad Afzaal Malik, Zafarullah Koreshi and Mahmood Anwer Khan, "Vibration analysis of a multi-span tube in a bundle", ICONE 10 Proceedings of 10th International Conference on Nuclear Engineering, Arlington, Virginia, USA, April 14-18, 2002.
- 32* Shahab Khushnood, Zaffar M. Khan, Muhammad Afzaal Malik, Zafarullah Koreshi and Mahmood Anwer Khan, "Modeling and Analysis of cross-flow induced vibrations in a heat exchanger tube bundle" Proceedings of 4th International Conference on Mechanics and Materials in Design, M2-D4 Nagoya, Japan, June 5-8, 2002
- 33* Shahab Khushnood, Zaffar M. Khan, Muhammad Afzaal Malik, Zafarullah Koreshi and Mahmood Anwer Khan, "On the Effect of Void Fraction in Two-phase cross-flow induced tube bundles vibration: A review" Proceedings of the 3rd International Symposium on Mechanical Vibrations (ISMV-2002) Islamabad, Sept. 23-27, 2002.

- 34* Shahab Khushnood, Zaffar M. Khan, M.Afzaal Malik, Zafarullah Koreshi & Mahmood Anwar Khan, Cross-Flow Induced Vibrations in Tube Bundles: A Review, Proceedings of the 11th International Conference on Nuclear Engineering, Tokyo, Japan, ASME/JSME, April 20-23, 2003.
- 35* Shahab Khushnood, Zaffar M. Khan, M.Afzaal Malik, Zafarullah Koreshi & Mahmood Anwar Khan, A Review of Heat Exchanger Tube Bundle Vibrations in Two-Phase Cross-Flow, Proceedings of the 11th International Conference on Nuclear Engineering, Tokyo, Japan, ASME/JSME, April 20-23, 2003.
- 36* Shahab Khushnood, Zaffar M. Khan, M.Afzaal Malik, Zafarullah Koreshi & Mahmood Anwar Khan, Modeling Fluid Forces And Response Of A Tube Bundle In Cross-Flow Induced Vibrations, 11th International Conference on Nuclear Engineering, Tokyo, Japan, Under ASME/JSME, April 20-23, 2003).
- 37* Shahab Khushnood, Zaffar M. Khan, M.Afzaal Malik, Zafarullah Koreshi & Mahmood Anwar Khan, A Review of Heat Exchanger Tube Bundle Vibrations in Two-Phase Cross-Flow, Journal of Nuclear Engineering and Design, Reference NED-3985, Elsevier, Vol. 230, Issues 1-3, May 2004.
- 38* Shahab Khushnood, Zaffar M. Khan, M.Afzaal Malik, Zafarullah Koreshi & Mahmood Anwar Khan, Modelling and Simulation of Cross-Flow Induced Vibration in a Multi-Span Tube Bundle Proceedings of 12th International Conference on Nuclear Engineering, Arlington, Virginia, USA, April 25-29, 2004.
- 39* Shahab Khushnood, Zaffar Muhammad Khan, Muhammad Afzaal Malik, Zafarullah Koreshi, Mahmood Anwar Khan, & Khawaja Sajid Bashir, Experiments On Flow-Induced Vibrations In A Heat Exchanger Tube Bundle", Proceedings of 13th International Conf. on Nuclear Engineering, ICONE 13, Beijing, China, May 16-20, 2005
- 40* Shahab Khushnood, Zaffar Muhammad Khan, Muhammad Afzaal Malik, Ayaz Khan, Qamar Iqbal, Khalil M.S., "Modeling and Analysis of Thermal Damping in Heat Exchanger Tube Bundles", Proceedings of 14th International Conference on Nuclear Engineering (ICONE-14) Jul17-20, 2006, Miami, Florida, USA