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# Curriculum Vitae

**STEPHEN M. FORREST**  
Senior Engineer / Principal



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**EXPERTISE:**

Background encompasses over 19 years of diversified experience as a Senior Technical Engineer and Engineering Consultant with a solid track record of successful experience in the Government, Military, Corporate and Private sectors.

Key areas of expertise and knowledge:

- Analysis of Automotive Injury Accidents
- Automobile Safety Research & Design
- Occupant Kinematics
- Injury Mechanism and Mitigation
- Structural Design Analysis
- Advanced Computer Modeling

**EXPERIENCE:**

**SENIOR ENGINEER/PRINCIPAL  
SAFETY ANALYSIS & FORENSIC ENGINEERING (SAFE) (1994 - Present)**

[Formerly LIABILITY RESEARCH GROUP]

Providing expertise in the formulation of opinions from available factual data about vehicle trajectories, occupant kinematics, injury mechanisms, and structural design issues.

- Collection and analysis of field data for vehicular structural design analysis and occupant kinematics.
- Determination of mechanical and system failure analysis.
- Structural testing of automotive components and complete vehicles.
- Construction and testing of prototype automotive components.
- Evaluation and analysis of occupant kinematics.
- Advanced computer modeling analysis of occupant kinematics
- Production of comprehensive written reports.
- Expert testimony.

**PROFESSIONAL HISTORY:**

**ENGINEERING CONSULTANT  
STEPHEN M. FORREST CONSULTING  
(1986 - 1994)**

Expert consulting services in analysis and modeling of automotive injury accidents, occupant kinematics and related structural design considerations.

- Conducted vehicle structural evaluation, data collection and analysis.
  - Analysis of injuries and determination of injury mechanisms.
  - Evaluation of the characteristics and consequences of similar accidents using available crash test data as well as national accident files.
  - Occupant kinematic analysis using MVMA-2D & CVS-3D computer models.
  - Evaluation of preventive measures for eliminating injuries using available technology.
  - Incorporation of preventive measures in occupant kinematic analysis computer models
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**SENIOR ENGINEER, CRASHWORTHINESS & SAFETY  
MCR TECHNOLOGY, INC.**

(1981 - 1986)

Primarily responsible for the management, planning and execution of projects requiring engineering development and analysis expertise. Planned and reported many varieties of sled and vehicle crash tests and static test programs.

- Developed new sled testing procedures and hardware to correlate with crash test data (such as a side impact simulator sled and an adjustable driver's station sled).
- Developed vehicle safety components (such as the pedestrian front bumper).
- Responsible for the calibration and testing of Hybrid III, Part 572 and S.I.D. anthropometric test dummies.
- Experienced with cadaver sled testing. Other responsibilities included computer analysis and crash simulations, human factors studies, photogrammetric analysis and biomechanics.

**Project Experience:**

- Served as Program Manager and Principal Investigator on a D.O.T. program to study the effects of frontal impacts on unrestrained dummies/cadavers.
- Designed and developed an ultra light-weight, fully instrumented and adjustable steering column assembly to be used for steering system development for reducing injuries.
- Provided technical direction on a program to develop an adjustable driver's station which is a universal sled buck capable of simulations of a broad spectrum of vehicles.
- Served as Project Engineer on a program to build a series of special shuttle buses for the 16th Street Mall in Denver, CO, incorporating a loading ramp and restraint system for handicapped passengers.
- Served as Project Engineer on a D.O.T. program, which studied, using crash and sled tests as well as computer simulations, the problem of protecting unrestrained vehicle occupants in frontal and side impact crashes. Directly responsible for a large series of side impact crash tests with two vehicles, both of which were moving at high speeds and at oblique angles.
- Provided technical support on the construction of a water entry device used to permit lifeboats to be dropped from heights of up to 60 feet without damage to the lifeboat or injury to the occupants.
- Served as Project Engineer and Manager on a program to build an airbag landing system for military drone aircraft.
- Served as Project Engineer on a child safety seat effectiveness program. Studied current regulations as well as effects of higher speeds and misuse modes on seat performance.
- Provided technical support on a program to study the dynamic response of a 50th percentile male A.T.D. restrained in a rigid, non-yielding aircraft seat.

**PLANT ENGINEER, BEAMAR ELECTRONICS, INC., 1979 - 1981**

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ACADEMIC TRAINING:

Bachelor of Science, Mechanical Engineering - Automotive  
GENERAL MOTORS INSTITUTE OF TECHNOLOGY, 1979

SPECIALIZED TRAINING:

General Motors Cooperative Education Program, 1974-1979

Educated in various General Motors facilities including the Safety Research and Development Laboratory at the General Motors Proving Grounds.

Analyzed dynamic crash tests of vehicles and components as well as fuel system integrity testing.

PATENTS:

COVER CADDY, Spa Cover Handling Device  
Patent No. 4,991,238

PROFESSIONAL AFFILIATIONS:

Society of Automotive Engineers (SAE)  
American Society for Testing and Materials (ASTM)  
American Society of Mechanical Engineers (ASME)  
National Academy of Forensic Engineers (NAFE)

TECHNICAL PUBLICATIONS:

For a complete list of technical publications see attached addendum.

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## TECHNICAL PUBLICATIONS:

78. "Heavy Truck Rollover Testing Methods", B. Herbst, J. Bish, S. Meyer, A. Nelson, S. Forrest, L. Bell, C. Clarke, IMECE2012-88364 ASME International Mechanical Engineering Congress & Exposition, November 9-15, 2012 in Houston, Texas, USA.
  77. "Heavy Truck Rollover Crashworthiness Utilizing Sled Impact Testing", B. Herbst, J. Bish, S. Meyer, A. Nelson, S. Forrest, L. Bell, C. Clarke, Expert Symposium on Accident Research (ESAR), 5th International Conference, Hannover Medical School, September 7-8, 2012, Hannover, Germany.
  76. "Designing for Rollover Impacts with Narrow Objects" B. Herbst, S. Meyer, A. Oliver, L. Bell, S. Forrest, IMECE2011-64419 ASME 2011 International Mechanical Engineering Congress & Exposition, November 11-17<sup>th</sup>, 2011 in Denver, Colorado, USA.
  75. "Pendulum Animal Impact Testing" S. Forrest, J. Sodusta, B. Herbst, S. Meyer, IMECE2009-13057 ASME 2009 Conference International Mechanical Engineering Congress & Exposition, November 13-19<sup>th</sup>, 2009 in Lake Buena Vista, Florida, USA Presented by Steve Batzer.
  74. "Rear Impact Test Methodologies: Quasistatic and Dynamic," Meyer S, Hock D, Oliver A, Forrest S and Herbst B 09-0533-O, 21<sup>st</sup> ESV Conference, June 16, 2009; Stuttgart, Germany.
  73. "Webbing Sensitivity as a Means for Limiting Occupant Excursion in Rollovers," Meyer S, Hock D, Oliver A, Forrest S and Herbst B 09-0501-O, 21<sup>st</sup> ESV Conference, June 16, 2009; Stuttgart, Germany.
  72. "The Effect of Vertical and Multiplanar Accelerations on Differing Production Seat Belt Sensor Designs," IMECE2008-68931, Proceedings of IMECE2008, 2008 ASME International Mechanical Engineering Congress and Exposition, October 31-November 6, 2008, Boston, Massachusetts, USA.
  71. "Quasi-Static and Dynamic Testing as a Basis for Determining Seat Back Strength," IMECE2008-66222, Proceedings of IMECE2008, 2008 ASME International Mechanical Engineering Congress and Exposition, October 31-November 6, 2008, Boston, Massachusetts, USA.
  70. "Rollover Roof Strength Improvements using Epoxy Reinforcement" presented at ICrash Conference on July 22, 2008 in Kyoto, Japan.
  69. "Parametric Analysis of Rollover Occupant Protection Using A Deformable Occupant Compartment Testing Device" presented at ESV Conference on June 18-22, 2007 in Lyon, France.
  68. "Head and Neck injury Potential In Inverted Impact Test" presented at ESV Conference on June 18-22, 2007 in Lyon, France.
  67. "Inverted Drop Testing As A Mechanism to Evaluate Rollover Occupant Injury Potential" presented at Rocky Mountain Bioengineering Symposium & International ISA Biomedical Sciences Instrumentation Symposium 13-15 April 2007, Denver, Colorado.
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TECHNICAL PUBLICATION (CONTINUED)

66. "Additional Comments to DOT Docket No. NHTSA-2005-22143 (FMVSS 216: Roof Crush Resistance) - Potential Roof Rack Issue," April 12, 2006.
  65. "90-day follow-up for previously submitted petition for review of Ford Explorer Compliance with FMVSS 216 - Docket No. NHTSA-2005-22904," April 11, 2006.
  64. "Investigation of Injury Potential Through Matched Pair Drop Testing." Rocky Mountain Bioengineering Symposium & International ISA Biomedical Sciences Instrumentation Symposium, Terre Haute, Indiana, April 7-9 2006.
  63. "Comments to DOT Docket No. NHTSA-2005-22904: PowerPoint Presentation of Petition for Review of Ford Explorer Compliance with FMVSS 216," January 2006.
  62. "Comments to DOT Docket No. NHTSA-2005-22904: Additional Information Regarding Previous Petition for Review of 1999-2001 Ford Explorer Compliance with FMVSS 216 Submitted to the NHTSA in September 2005," January 2006.
  61. "Comments to DOT Docket No. NHTSA-2005-22143 (FMVSS 216: Roof Crush Resistance (NPRM))," November 21, 2005.
  60. "Comments to DOT Docket No. NHTSA-2005-22143 (FMVSS 216: Roof Crush Resistance (NPRM))," November 20, 2005.
  59. "Comments to DOT Docket No. NHTSA-2005-22904: Safety Analysis and Forensic Engineering (SAFE) Petition for Review of Ford Motor Company Compliance with FMVSS 216," September 2005.
  58. "The Influence of Roof Crush on Glazing Retention and Occupant Containment in Rollovers," 2005 Summer Bioengineering Conference, June 22-26, 2005, Vail, CO.
  57. "The Effect of Roof Strength on Reducing Occupant Injury in Rollovers," 42nd Annual Rocky Mountain Bioengineering Symposium, Biomedical Sciences Instrumentation, Volume 41, ISA Volume 455, Copper Mountain, Colorado, April 8-10, 2005.
  56. "Evaluation of Motor Vehicle Seatbelt Retractor Locking Devices," ASME International Mechanical Engineering Congress, Anaheim, California, November 13-19, 2004.
  55. "Epoxy Reinforcing for Rollover Safety," ASME International Mechanical Engineering Congress, Anaheim, California, November 13-19, 2004.
  54. "Roof Crush Mitigation Techniques to Enhance Occupant Protection," International Symposium on Biomedical Engineering 2004, Bangkok, Thailand, November 16-18, 2004.
  53. "Testing and Injury Potential Analysis of Rollovers with Narrow Object Impacts," 41st Annual Rocky Mountain Bioengineering Symposium, Biomedical Sciences Instrumentation, Volume 40, ISA Volume 449, Fort Collins, Colorado, April 2004
  52. "Acceleration Amplification in Safety Belt Buckle Systems," IMECE2003-43159, American Society of Mechanical Engineers (ASME) International Mechanical Engineering Congress & Exposition, November 16-21, 2003, Washington, D.C.
  51. "Design and Evaluation of a System for Testing and Analysis of Rollovers with Narrow Objects," IMECE2003-43104, American Society of Mechanical Engineers (ASME) International Mechanical Engineering Congress & Exposition, November 16-21, 2003, Washington, D.C.
  50. "Factors in Rollover Neck Injury Potential," American Society of Mechanical Engineers (ASME), Summer Bioengineering Conference, June 25-29, 2003, Key Biscayne, FL.
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TECHNICAL PUBLICATION (CONTINUED)

49. "Evaluating 'Real World' Roof Strength Through Inverted Drop Testing," American Society of Mechanical Engineers (ASME), Summer Bioengineering Conference, June 25-29, 2003, Key Biscayne, FL.
  48. "Comments to Docket No. NHTSA-1999-5572; Notice 2, 66 Fed. Reg. 204, October 22, 2001, Federal Motor Safety Standard No. 216 (Roof Crush Resistance)," May 19, 2003.
  47. "Inverted Drop Testing and Neck Injury Potential," 40th Annual Rocky Mountain Bioengineering Symposium, Biomedical Sciences Instrumentation, Volume 39, ISA Volume 437, Biloxi, Mississippi, April 2003.
  46. "Motor Vehicle Seat Belt Restraint System Analysis During Rollover," 40th Annual Rocky Mountain Bioengineering Symposium, Biomedical Sciences Instrumentation, Volume 39, ISA Volume 437, Biloxi, Mississippi, April 2003.
  45. "Supplemental Comments to Docket No. NHTSA-1999-5572; Notice 2, 66 Fed. Reg. 204, October 22, 2001, Federal Motor Vehicle Safety Standards (FMVSS); Roof Crush Resistance," February 25, 2003.
  44. "Analysis of Structural Deformation in Vehicular Drop Studies," IMECE 2002-32644, American Society of Mechanical Engineers (ASME) International Mechanical Engineering Congress & Exposition, Nov. 17-22, 2002 New Orleans, LA.
  43. "Alternative Roof Crush Resistance Testing with Production and Reinforced Roof Structures," SAE 2002-01-2076, International Body Engineering Conference and Exhibition, (IBEC), Paris, July 9-11, 2002.
  42. "Restraints And Occupant Kinematics In Vehicular Rollovers," 39th Annual Rocky Mountain Bioengineering Symposium, Biomedical Sciences Instrumentation, Volume 38, ISA Volume 419, Copper Mountain, Colorado, April 2002.
  41. "Curb Impacts - A Continuing Study In Energy Loss and Occupant Kinematics," Society of Automotive Engineers (SAE) 2002, Paper No. 2002-01-0557.
  40. "Biomechanical Modeling of Motor Vehicle Collisions and Overview of Belt Restraint Analysis," BioVision, India, International Conference on Biomedical Engineering (ICBME), December 21-24, 2001.
  39. "Comments to 49 CFR Part 571, Docket No. 1999-5572, Notice 2, Federal Motor Vehicle Safety Standards (FMVSS); Roof Crush Resistance," December 6, 2001.
  38. "Simulated Tests of Large Animal Impacts," IMECE 2001/BED-23101, American Society of Mechanical Engineers (ASME) International Mechanical Engineering Congress and Exposition, November 11-16, 2001 New York, NY.
  37. "Dynamic Analysis of ELR Retractor Spoolout", Society of Automotive Engineers (SAE) 2001, and the Automotive and Transportation Technology Congress and Exhibition (ATTCE) 2001, Paper No. 2001-01-3312, Barcelona, Spain, October 1-3, 2001.
  36. "Improving Rollover Crashworthiness Through Inverted Drop Testing", Society of Automotive Engineers (SAE) 2001, and the Automotive and Transportation Technology Congress and Exhibition (ATTCE) 2001, Paper No. 2001-01-3213, Barcelona, Spain, October 1-3, 2001.
  35. "An Analytical Method of Calculating Dynamic Roof Strength Characteristics And Equivalent Drop Height," The Fourth International Conference on Accident Investigation, Reconstruction, Interpretation and the Law (AIRIL) Vancouver, British Columbia, 2001, August 13-16, 2001.
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TECHNICAL PUBLICATION (CONTINUED)

34. "Curb Impacts - A Study In Occupant Kinematics And Energy Loss", The Fourth International Conference on Accident Investigation, Reconstruction, Interpretation and the Law (AIRIL) Vancouver, British Columbia, 2001, August 13-16, 2001.
  33. "Test Methods For Evaluating Seatbelt Retractor Response In Multiplanar Acceleration Environments", BED- Vol. 50, 2001 Bioengineering Conference, American Society of Mechanical Engineers (ASME) 2001.
  32. "An Assessment of Narrow Object Frontal Impact Calculation Methods," 2001 Society of Automotive Engineers (SAE) International Congress and Exposition, Detroit, MI, 2001, March 5-8, 2001.
  31. "Failure of Seatbelt Retractors with Vertical Acceleration," 10th International Conference on Biomedical Engineering, Singapore, December 2000.
  30. "The Relationship of Roof Crush and Head Clearance on Neck Injuries in Rollovers," 10th International Conference on Biomedical Engineering, Singapore, December 2000.
  29. "The Effect of Vertical Acceleration on Emergency Locking Seatbelt Retractors," American Society of Mechanical Engineers (ASME), 2000 International Mechanical Engineering Congress & Exposition, Orlando, Florida, November 2000.
  28. "Vehicle Crashworthiness in Vertical Drop Tests," American Society of Mechanical Engineers (ASME), 2000 International Mechanical Engineering Congress & Exposition, Orlando, Florida, November 2000.
  27. "Studies of Vehicular Padding Materials," 44th Annual Proceedings of the Association for the Advancement of Automotive Medicine, Chicago, Illinois, October 2-4, 2000.
  26. "An Analytical Method for Calculating Roof Stiffness Factors from Roof Performance During Dynamic and Quasi-Static Loading Tests," Paper No. 00SAF007, International Symposium on Automotive Technology and Automation (ISATA) 2000, Dublin, Ireland, September 25-27, 2000.
  25. "Reinforcing Automotive Roofs with Composite Materials," Paper No. 00SAF008, International Symposium on Automotive Technology and Automation (ISATA) 2000, Dublin, Ireland, September 25-27, 2000.
  24. "Vehicular Padding and Head Injury," Seoul 2000, The Federation Internationale des Societes d'Ingenier des Techniques de l'Automobile (FISITA) World Automotive Conference, June 12-15, 2000.
  23. "Accident Reconstruction of Rollovers - A Methodology," Society of Automotive Engineers (SAE) 2000-01-0853, 2000 SAE International Congress and Exposition, Detroit, MI, March 6-9, 2000.
  22. "Three-Point Restraint System Design Considerations for Reducing Vertical Occupant Excursion in Rollover Environments," SAE 2000-01-0605, 2000 Society of Automotive Engineers (SAE) International Congress and Exposition, Detroit, MI, March 6-9, 2000.
  21. "Modeling of Frontal and Rollover Collisions and Restraint Analysis," Intl. Conference on Mathematical and Computer Modeling and Scientific Computing,(ICMCM), Chicago, IL, August 1999.
  20. "Biomechanical Analysis of Padding" Advances in Bioengineering, American Society of Mechanical Engineers (ASME), BED Vol.43, 1999, P281-282.
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TECHNICAL PUBLICATION (CONTINUED)

19. "Fidelity of Anthropometric Test Dummy Necks in Rollover Accidents," Paper No. 98-S9-W-20, Sixteenth International Technical Conference on the Enhanced Safety of Vehicles, June 1998.
  18. "Head Injury Reduction with Roll Bar Padding" IEEE-Biomedical Engineering Society/Engineering in Medicine and Biology Society, 1st Joint Conference, Atlanta, GA, October 1999.
  17. "Computers in the Courtroom," presented at Arizona Trial Lawyers Association (AZTLA) Seminar, December 1998.
  16. "Strength Improvements to Automotive Roof Components," SAE 980209, 1998 Society of Automotive Engineers (SAE) International Congress & Exposition, February 23-26, 1998.
  15. "Comments to Docket No. 94-97; Notice 2, Federal Motor Vehicle Safety Standards (FMVSS); Roof Crush Resistance," April 28, 1997.
  14. "Restraint Effectiveness During Rollover Motion," 1996 International Conference on the Biomechanics of Impact International Conference on the Biomechanics of Impact (IRCOBI), September 11-13, 1996, Dublin, Ireland.
  13. "The Ability of 3 Point Safety Belts to Restrain Occupants in Rollover Crashes," Paper No. 96-S5-0-12, Fifteenth International Technical Conference on the Enhanced Safety of Vehicles, May 1996.
  12. "Comments to Docket No. 95-84, Proposed Revision to FMVSS 202, Head Restraint Performance," December 1995.
  11. "Comments to Docket No. 94-97, Notice 1, on Roof Crush and Proposed Revisions to FMVSS 216 and FMVSS 220," February 1995.
  10. "Enhanced Safety for Light Trucks and Vans," 14th Experimental Safety Vehicle Conference, Munich, Germany. Paper No. 94-54-W-24, May 1994.
  9. "A Preliminary Comparison of the Performance of Cadavers and the Hybrid III Dummy in Laboratory Simulations of the Unrestrained Driver in Frontal Impact."
  8. "Live Subject Safety Research: Side-Impact," SAE 890382, March 1989.
  7. "Interaction of Human Cadaver and Hybrid III Subjects with a Steering Assembly," (with R. Morgan, et al), SAE 872202, Proceedings of the 31st Stapp Car Crash Conference, November 1987.
  6. "Design and Development of a Modified Production Vehicle for Enhanced Crashworthiness and Fuel Economy," (with R. Schwarz), Phase II, Final Report, Contract No. DTNH22-81-C-07085, National Highway Traffic Safety Administration of the Department of Transportation, March 1984.
  5. "New Vehicle Assessment and Standards Enforcement Indicant Testing - Chevrolet Cavalier," Reports #212-MCR-81-003, 219-MCR-81003, 301-MCR-81-003, Contract No. DTNH22-81-C-27113, National Highway Traffic Safety Administration of the Department of Transportation, January 1983.
  4. "New Vehicle Assessment and Standards Enforcement Indicant Testing - Mazda GLC," Reports #212-MCR-81-002, 219-MCR-81-002, 301-MCR-81-002, Contract No. DTNH22-81-C-27113, National Highway Traffic Safety Administration of the Department of Transportation, January 1983.
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TECHNICAL PUBLICATION (CONTINUED)

3. "Dynamic Testing of a 50th Percentile Adult Male Dummy, Lap Belted and Seated in a Rigid, Non-Yielding Aircraft Seat," Final Report (with A. Khadilkar), Project No. 2CY205967-9, Interiors Engineering of Douglas Aircraft Co., December 1982.
  2. "Design and Development of a Modified Production Vehicle for Enhanced Crashworthiness and Fuel Economy," (with R. Schwarz, S. Syson, et al), Phase I, Final Report, Contract No. DTNH22-81 -C-07085, National Highway Traffic Safety Administration of the Department of Transportation, October 1982.
  1. "Oxygen Sensor Controlled Carburizing," Metallurgy Department, New Departure-Hyatt Division of General Motors Corporation, June 1979. Also authored or co-authored a large number of technical reports
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