Mariusz Ziejewski, Ph.D., Inż.

Professor
Department of Mechanical Engineering
Director of Impact Biomechanics Laboratory, College of Engineering
Director of Automotive Systems Laboratory, College of Engineering
North Dakota State University
and
Clinical Faculty
Adjunct Associate Professor
Department of Clinical Neuroscience, School of Medicine
University of North Dakota

October 13, 2016

E. Todd Tracy
The Tracy Firm
5473 Blair Road, Suite 200
Dallas, TX 75231

RE: Matthew and Marcia Seebachan

Dear Mr. Tracy:

Pursuant to your request, I am setting forth my biomechanical opinions regarding the motor vehicle incident on December 21, 2013 involving Matthew and Marcia Seebachan. I am also providing a summary synopsis of my background and qualifications to render my opinions.

A. <u>BACKGROUND AND EXPERIENCE</u>

- Copy of CV outlining education and experience is attached.
- Professor in College of Engineering, Director of the Impact Biomechanics Laboratory and Director of Automotive Systems Laboratory, North Dakota State University (NDSU).
- Clinical Faculty and Adjunct Professor, Department of Clinical Neuroscience, University of North Dakota (UND) School Of Medicine.
- Involved in research and education in field of vehicle dynamics and biomechanics for over past 35 years.
- Research focus on human body biomechanics for last 25 years.
- Consulted, for past 25 years, in area of biomechanics, with various governmental agencies including National Highway Traffic Safety Administration (NHTSA), United States Air Force (USAF), United States Army, Department of Defense (DoD), and United States Product Safety Commission (USCPSC).
- Selected to conduct research for USAF at Armstrong Aerospace Research Laboratory (AARL)/Human Systems Division, Wright-Patterson Air Force Base (WPAFB) Dayton, OH, that included laboratory studies of entire human body responses to impact, biodynamic modeling and development of biodynamics injury criteria; and received six (6) research contracts, from USAF that involved biomechanical analysis of over 900 full scale laboratory tests with male and female pilots.

- Two (2) most current research contracts (over $1M), supported by DoD have been in area of biomechanical analysis of injury and injury protection for US soldiers returning from combat in Iraq and Afghanistan.
- Involved for several years in Emergency Room (ER) Biomechanical Brain Injury Evaluation Research, with Fargo-Moorhead (FM) Ambulance Service and MeritCare Trauma Center, sponsored, in part, by MeritCare Foundation, Fargo, ND.
- From 2007 to present, invited to chair three (3) scientific peer review committees, as well as serve as a scientific reviewer for numerous other committees for DoD Post Traumatic Stress Disorder/Traumatic Brain Injury (PTSD/TBI) Research Program.
- Current Chairman of North American Brain Injury Society (NABIS).
- Named founding chair of Blast Injury Institute.
- Received additional specialized training with certifications in areas of Abbreviated Injury Scale (AIS) and Crash Data Analysis.
- Professor for over past 35 years, of variety of subjects in field of engineering including, biomechanics, vehicle dynamics and dynamics.
- Invited to give many national and international presentations, including ones to governmental agencies such as USCPSC.
- Published four (4) book chapters on brain and neck injury and over one-hundred (100) peer-reviewed publications.
- Fully accredited Accident Reconstructionist, Accreditation Commission for Traffic Accident Reconstruction (ACTAR #1939).

B. <u>OBJECTIVE</u>

To perform a biomechanical analysis of the incident involving Matthew and Marcia Seebachan on December 21, 2013.

C. <u>MATERIALS REVIEWED:</u>

1. Records from Texas Department of Public Safety
2. Plaintiffs' Original Petition
3. Answer of American Honda
4. Defendant American Honda's Answers to Plaintiff's First Set of Interrogatories
5. Defendant American Honda's Objections and Responses to Plaintiff's First Set of Request for Production
6. Defendant American Honda's Response to Plaintiff's Request for Disclosure
7. Defendant J. Jordan's Answer to Plaintiff's First Set of Interrogatories
8. Records of Burnett Fire Department
9. Records of Lampass Fire Department
10. Records of Progressive Insurance
11. Exhibits of Trooper Leitz's Deposition
12. Deposition of Trooper Leitz
13. Deposition of Jack Jordan
14. Medical Records of Matthew Seebachan
    a. Baylor Rehabilitation
    b. Capital EMS
    c. Cardiac Surgery Specialists
    d. Family Medicine Associations of Texas
    e. Counseling Records
    f. Lifetime Family Medicine
    g. North Texas Gastroenterology
    h. S & W EMS

    i. Texas Vascular Associates
    j. Walgreens
    k. Loving Hands Home Health
    l. Parkland Hospital
    m. UT – Southwest
    n. Scott and White with Radiology
15. Medical Records of Marcia Seebachan
    a. Dr. Dillard
    b. Airrosti Rehab Centers
    c. Baylor Rehabilitation
    d. EMS
    e. Dr. Van Dell
    f. Family Medicine Association of Texas
    g. Metroplex Hospital (with Radiology)
    h. S & W EMS
    i. Texas Vascular Associates
    j. Home Health Care
    k. Scott & White with Radiology
    l. Buckner Children & Family
16. Video
17. Plaintiff's First Amended Complaint
18. American Honda Motor Co. Inc.'s Original Answer to Plaintiff's First Amended Complaint
19. Discovery Responses of American Honda Motor Co.
20. Deposition of Marcila Yanes
21. Deposition of Marcia Seebachan
22. Deposition of Matthew Seebachan
23. Defendant Eagle's Discovery Responses
24. Records of Garrison Property & Casualty
25. IIHS Tests of Small and Moderate Frontal Overlap Impact of the 2010 Honda Fit
26. FARO modeling of Subject Vehicle
27. Report of Mr. Neil Hanneman, Automotive Engineer
28. Photographs

D. <u>TASKS PERFORMED:</u>

For this analysis, I have done the following:

1. Studied the provided materials.
2. Determined vehicle parameters for the 2010 Honda Fit and 2010 Toyota Tundra.
3. Inspection of the subject vehicle on May 15, 2015.
4. Searched and measured an exemplar Honda Fit.
5. Performed surrogate fit analysis in exemplar Honda Fit.
6. Determined the stiffness characteristics for the backrest, headrest, seat cushion and roof of the exemplar Honda Fit.
7. Determined the coefficient of friction for the seat cushion of the exemplar Honda Fit.
8. Assessed the impact phase of vehicle dynamics.
9. Determined Matthew Seebachan's segments' geometric and mass properties, and the joints' locations and range of motion characteristics using the Generator of Body Data (GEBOD) AL/WPAFB computer program.
10. Performed Matthew Seebachan's body dynamics analysis for selected phases of event.
11. Determined Marcia Seebachan's segments' geometric and mass properties, and the joints' locations and range of motion characteristics using the Generator of Body Data (GEBOD) AL/WPAFB computer program.

12. Performed Marcia Seebachan’s body dynamics analysis for selected phases of event.
13. Reviewed the 3D FARO Laser Imaging

E. ANALYSIS:

E-1 General Concept

The area of biomechanics is a component of bioengineering. The biomechanical analysis is based on the principles of physics, engineering including viscoelastic properties of tissue as well as life sciences. Impact biomechanics is the study of damage (failure) of human body regions, organs, tissue or cells as a result of sudden application of forces. The concept of damage/failure can be structural or physiological which in clinical setting is referred to as “injury” or “trauma”.

One of the common objectives for a biomechanical analysis is to determine whether the injury mechanism for damage (failure) was present and whether or not the forces were sufficient to cause the damage. Biomechanical engineers do not perform clinical diagnoses they accept the diagnoses as presented in the medical records.

The procedure for biomechanical analysis (Figure 1) involves an understanding of the driving force that can be quantified in terms of generally accepted engineering parameters like change in the velocity, time duration of impact, and/or vehicle acceleration (VEHICLE DYNAMICS ANALYSIS). The quantification of impact severity from occupant perspective is the remaining portion of the biomechanical evaluation (HUMAN BODY DYNAMICS ANALYSIS). The meaning of the results from the biomechanical analysis is illustrated by comparison against the human tolerances (HUMAN TOLERANCE ANALYSIS).

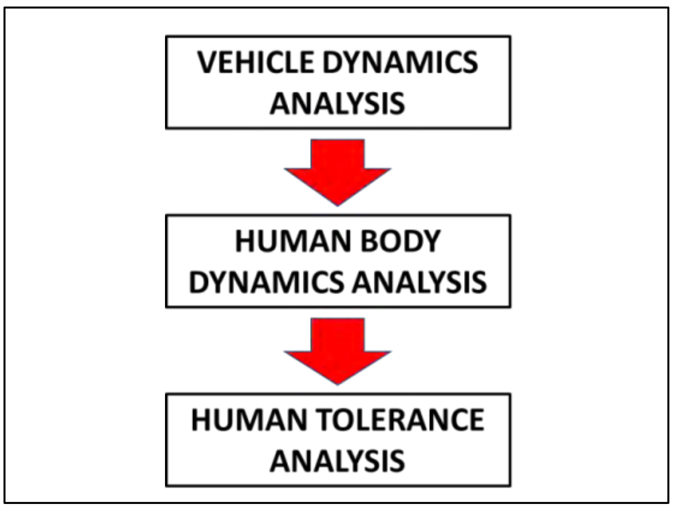

Figure 1 – Complete Procedure for Biomechanical Analysis

E-2 Accident Description

According to the narrative opinion provided in the Texas Peace Officer’s Crash Report (for identification, Unit 1 is the Toyota Tundra and Unit 2 is the Honda Fit):

> *“Unit 1 was traveling Northbound on US 281 in the inside Northbound lane. Unit 2 was traveling Southbound on US 281 in the Southbound outside lane. Unit 1 began to hydroplane due to the driver’s unsafe speed (rain/wet road). Unit 1 rotated counterclockwise and crossed into the Southbound lanes of US 281. While in a right side skid Unit 1 struck Unit 2’s front bumper area with Unit 1’s right front quarter area. At impact Unit 1 rotated counterclockwise striking Unit 2’s left rear quarter area with Unit 1’s right rear quarter area. Unit 2 traveled backwards from the impact with*

Unit 1 and came to rest facing Southbound in the west side ditch of US 281. Unit 1 continued it's [sic]counter clockwise rotation, rotating 360 degrees before coming to rest facing Northbound in the Southbound bar ditch of US281."

The officer's diagram is shown in Figure 2 (colors and labels added). The location of the incident was found on Google Earth (Figure 3) using latitudinal and longitudinal coordinates from the crash report. Selected scene photos are shown in Figure 4 and the Google Earth Image in Figure 5 depicts the area of the incident at street level.

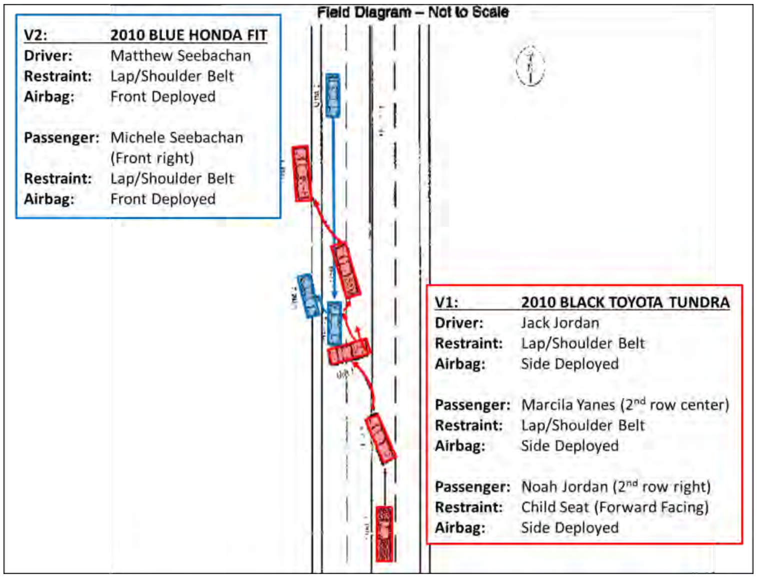

Figure 2 – Officer's Diagram

Figure 3 – Google Earth Image, Overview

Figure 4 – Selected Scene Photos

Figure 5 – Google Earth Image, Street View

E-3 <u>Vehicle Dynamics</u>

E-3.1 Inspection of Exemplar Honda Fit

An exemplar Honda Fit was located. The exterior of the exemplar vehicle was measured and photographed (Figure 6).

Figure 6 – Exemplar Honda Fit

E-3.2 Vehicle Damage Analysis

My inspection of the subject vehicle revealed extensive damage consistent with a small overlap frontal impact. From a trauma biomechanics perspective, in this case, the most relevant area of damage included but was not limited to the front, the roof, the driver's side cant rail, lower frame and the interior of the vehicle. Based on the nature and extent of the Honda Fit's damage, it is obvious the structural components were subjected to compressive forces exhibited by dynamic progressive buckling characteristics. The subject of dynamic progressive buckling has been extensively studied. There is a broad base of peer reviewed publications. For example:

McNay, G. H. II, "Numerical Modeling of Tube Crush with Experimental Comparison", Society of Automotive Engineers #8808

Mahmood, H. F., et al, "Design of Thin Walled Columns for Crash Energy Management – Their Strength and Mode of Collapse", Society of Automotive Engineers #811302

Mahmood, H.F. et al, "Crash Analysis of Thin Walled Beam-Type Structures", Society of Automotive Engineers #880894

Schmueser, D. W., et al, "Front Impact of Primary Structural Components of a Composite Space Frame", Society of Automotive Engineers #88090

Tundermann, J. H. Et al, "The Application of Elastometric Buckling Columns in an Energy Management Bumper System", Society to Automotive Engineers #750011

Selected references from the research work that I was personally involved in are:

Ziejewski, M., *B. Anderson, M. Rao and M. Hussain, "Energy Absorption for Short Duration Impacts", SAE Paper #961851, Indianapolis, IN 1996*

Ziejewski, M., *B. Anderson, "The Effect of Structural Stiffness on Occupant Response for A –Gx Acceleration Impact", SAE Paper #962374, Sao Paulo, Sp, Brazil, 1996.*

Ziejewski, M*, H. Goettler, "Effect of Structural Stiffness and Kinetic Energy on Impact Force", SAE Paper #961852, Indianapolis, IN, 1996*

Anderson, B., ***M. Ziejewski****, H. Goettler, "Method to Predict the Energy Absorption Rate Characteristics for a Structural Member", SAE Paper #982388, Detroit, MI, 1998*

Pan, X., ***M. Ziejewski****, H. Goettler, "Force Response Characteristics of Square Columns for Selected Materials at Impact Loading Combinations Based on FEA", SAE #982418, Detroit, MI, 1998.*

The damage assessment for the Honda Fit was carried out using two different approaches: laser based measurements and basic measuring tools. Selected images from the 3D FARO Laser System are shown in Figure 7. Example photographs taken during my inspection, with exterior measurements suitable for photogrammetric analysis are shown in Figure 8.

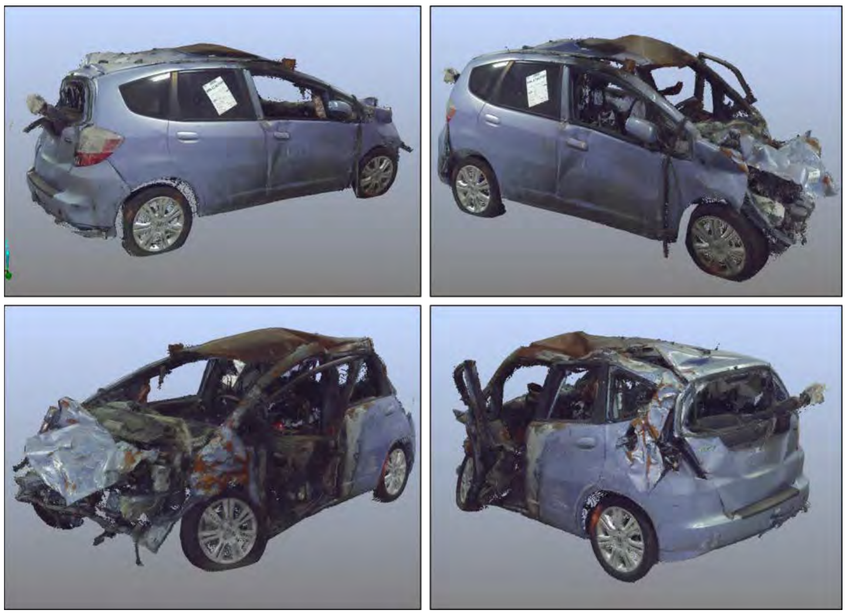

Figure 7 – FARO Laser Image for the 2010 Honda Fit

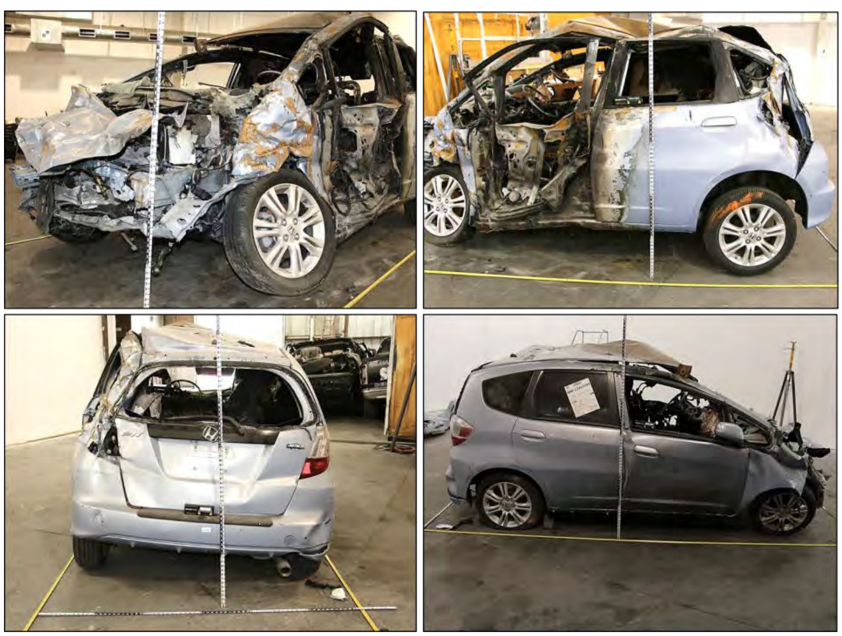

Figure 8 – Exterior Damage of Subject Honda Fit

I would like to provide additional information regarding the methodology used for the photogrammetry. The technique is based on the principle of technical drawing, geometric constructions and drawing perspectives. Photogrammetry is well known and recognized in engineering in general and in accident reconstruction including determination of the vehicle deformations. Part of the process involves superimposing the undeformed vehicle with a scale that will overlay the photograph depicting the deformed vehicle. The textbook “Technical Drawing” was, for many years, the choice textbook for many engineering colleges throughout the United States. Personally, I taught from this textbook for many years as well. It states, “this method utilizes actual photographs of the earth’s surface and of man-made objects on the earth….it issued for such activities as governmental and commercial surveying…It has the great advantage of being easy to use….”. “…it is possible not only to determine the relative positions of objects in a horizontal plane, but it is also possible to determine relative elevations.” Photogrammetry is also widely accepted in the Automotive Engineering Community. Peer reviewed articles are:

Kerkhoff, John F., “Photographic Technique for Accident Reconstruction”, Society of Automotive Engineers #850248, 1985.

Gillen, Larry, “Photogrammetric Mapping of Vehicle Deformation”, Society of Automotive Engineers #861421, 1986.

This method is widely accepted in the traffic accident investigation field. In “The Traffic Accident Investigation Manual – At Scene Investigation and Technical Follow-Up”, topic 830 is titled “Photogrammetry for Traffic-Accident Investigation.” There is also an example from the Accident Reconstruction Journal informing the readers about computerized photogrammetry techniques for assessment of vehicle damage.

The more current photogrammetry techniques I utilized are described and validated in the following SAE publications:

Chou, C., et al, “Image Analysis of Rollover Crash Test Using Photogrammetry”, Society of Automotive Engineers #2006-01-0723, 2006.

Fenton, S. et al, “Determining Crash Data Using Camera-Matching Photogrammetric Technique”, Society of Automotive Engineers 2001-01-3313, 2001.

Photogrammetry error rates in vehicle damage mapping are well within 5% and will depend only on the ability of the person being able to read the ruler accurately.

Physical evidence of the latch plate fused to the buckle can be seen on both the driver’s side and the front passenger side (Figure 9). Remnants of deployed front airbags are still identifiable on the steering wheel and passenger side dash (Figure 10).

As stated in Mr. Hannemann’s report (pp 7-10), the failure of the cant rails due to lack of proper welding by John Eagle Collision compromised the entire frame of the subject 2010 Honda Fit;

- “Z” buckling of the roof and cant rail caused deformation of the driver side and passenger side doors, subsequently jamming them shut and preventing any egress of the occupants without assistance (Figure 11).
- Lower frame rails were not able to manage the impact energy and became detached from the main vehicle structure (Figure 12).
- The left lower frame rail came in contact with the fuel tank causing fuel to escape.
- There was a missing fuel tank cover at the time of inspection.

Figure 9 – Latch Plate Engagement and Fusion

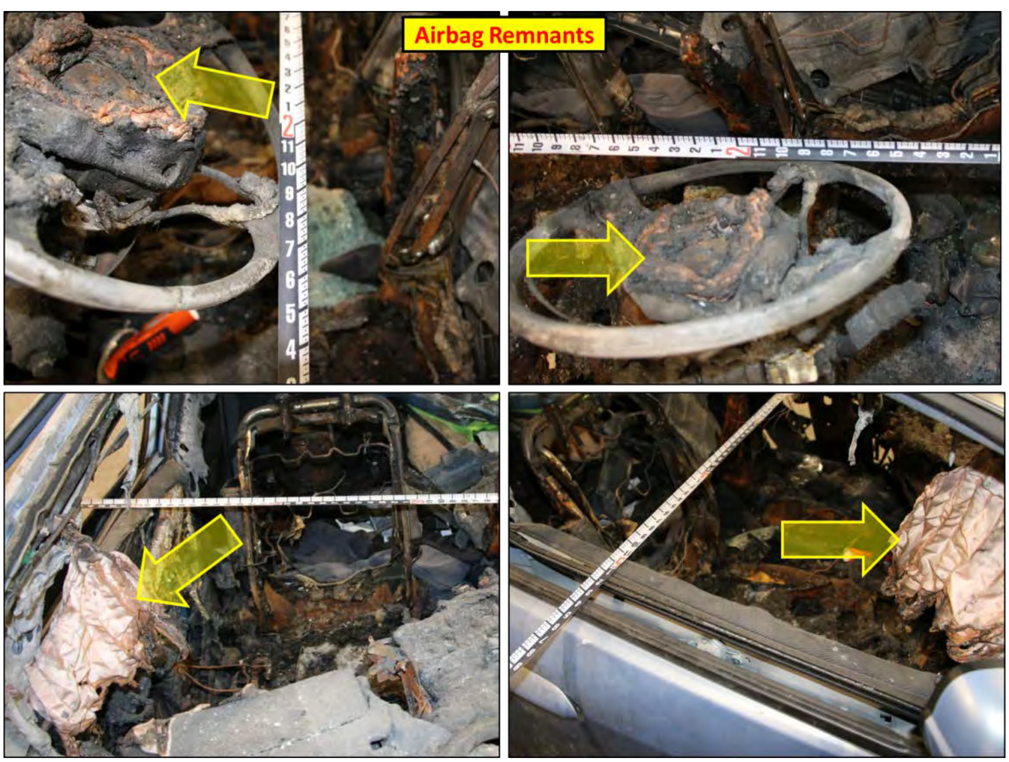

Figure 10 –Airbag Remnants

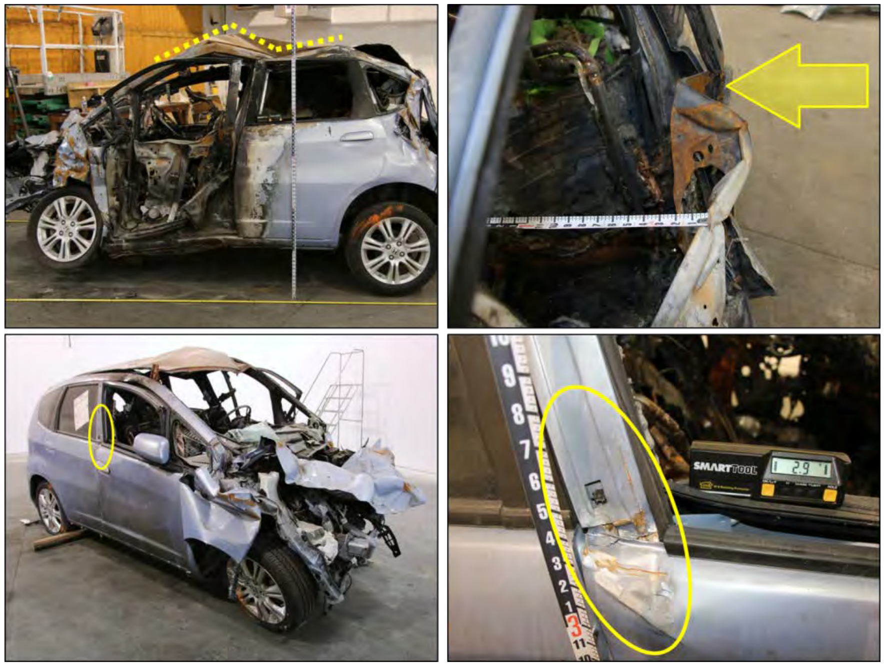

Figure 11 – Roof and Door Deformation

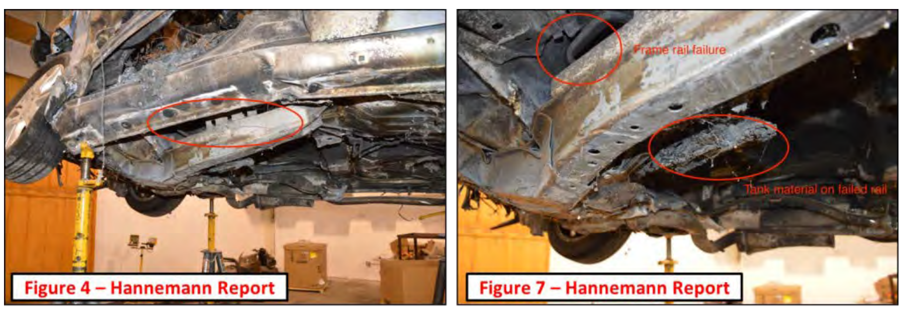

Figure 12 – Lower Frame Rail Deformation (Reproduced from Mr. Hannemann's Report)

Conclusion: Mr. and Mrs. Seebachan were properly seated and belted occupants in the Honda Fit. Delta-V was great enough to deploy frontal airbags. Lack of proper welding along the roof panel by John Eagle Collision caused a domino effect of structural failures, subsequently leading to the igniting of the fuel tank of the Honda Fit which had no fuel tank protector or shield present.

In comparison to a human body inertia loading scenario, direct interaction with intruding structural components results in more serious consequences, therefore the relation between the vehicle structure strength and the collision induced deformation is a vital component of crashworthiness.

E-3.3 Vehicle Kinematics

1. The Honda Fit was traveling southbound on US 281 and the Toyota Tundra was traveling northbound when the Toyota Tundra began to hydroplane and rotate counterclockwise.
2. The rotating Toyota Tundra struck the Honda Fit on its front bumper and left rear quarter area.
3. The Honda Fit traveled backwards from the impact, coming to rest facing southbound in the west side ditch of US 281.
4. The Honda Fit became engulfed in flames.

E-4 ***<u>Human Body Dynamics</u>***

Human body dynamics analysis requires a thorough understanding complex interaction between different parameters including but not limited to change in velocity (Delta-V), direction and duration of impact, gender, height, weight, body position and others. For several decades many research publications have addressed the complexity of the response of visco-elastic nature of the human body under a variety of loading conditions. As a part of my research work at the Armstrong Aerospace Research Laboratory at Wright Patterson Air Force Base I have been personally involved in the analysis of more than nine hundred (900) tests with male and female pilots under different loading conditions.

In Mr. and Mrs. Seebachan's case, I performed an analysis using engineering principles and methodologies generally accepted in the scientific community. Example references are listed below:

Hibbeler, R.C., "Engineering Mechanics – Dynamics", Twelfth Edition, Pearson Prentice Hall, Pearson Education, Inc. 2010

Nahum, A., Gomez M., "Injury Reconstruction: The Biomechanical Analysis of Accidental Injury", Society of Automotive Engineers, #940568.

Robbins, D.H., et al, "Biomechanical Accident Investigation Methodology Using Analytic Techniques", Society of Automotive Engineers, #831609.

The overall (resultant) forces/accelerations acting on different body parts are the cumulative effect of forces along and about the three axes'. A graphical illustration of the six force components in three directions is presented in the Figure 13.

Figure 13 – Types of Forces

E-4.1 Interior Measurements and Surrogate Fit

The interior of the exemplar vehicle were measured and photographed. The stiffness and friction characteristics of the driver's seat were determined. The following tests were performed:

-Force deflection for driver's backrest using test plunger
-Force deflection for driver's headrest using occipital plate
-Force deflection for driver's seat cushion using test plunger
-Force deflection of the roof using the occipital plate
-Coefficient of friction

In the above listed testing, the following equipment was used:

- Dillon Force Gauge BFG 2500N, Serial Number 05-0257-04, Certificate Number 516385
- Occipital Plate – Skull Cap, Machined, Part Number 78051-221; Skin, Cap Skull – Part Number 78051-229

The objective of the surrogate fit (Figures 14 and 15), was to relate geometrical dimensions of the Honda Fit to the heights of Mr. and Mrs. Seebachan of 69 inches and 68 inches, respectively. The GEBOD (AL/WPAFB) computer program was used to generate the body descriptions for Mr. and Mrs. Seebachan’s anthropometry. The GEBOD output indicates Mr. Seebachan’s seated height of 36.18 inches. The selected surrogate GEBOD output had a seated height of 36.54 inches resulting in a 0.36 inch greater seated height for the surrogate. The GEBOD output indicates Mrs. Seebachan’s seated height of 35.64 inches. The selected surrogate GEBOD output had a seated height of 35.91 inches resulting in a 0.27 inch greater seated height for the surrogate. Additionally, GEBOD output data set includes the body segments' geometric and mass properties and the joints' locations and range of motion characteristics that allows for detailed dimensional comparisons. Only the surrogate’s heights in comparison to the Mr. and Mrs. Seebachan’s are of relevance in static geometrical fit.

Figure 14 – Driver’s Surrogate Fit in Exemplar Honda Fit

Figure 15 - Passenger’s Surrogate Fit in Exemplar Honda Fit

E-4.2Medical Records / Biomechanical Perspective:
A review of the medical records was performed to assess Mr. and Mrs. Seebachan's injury patterns. Figures 16 and 17 are brief summaries of their injuries as documented in their medical records. For a complete description of the injuries please see all medical records.

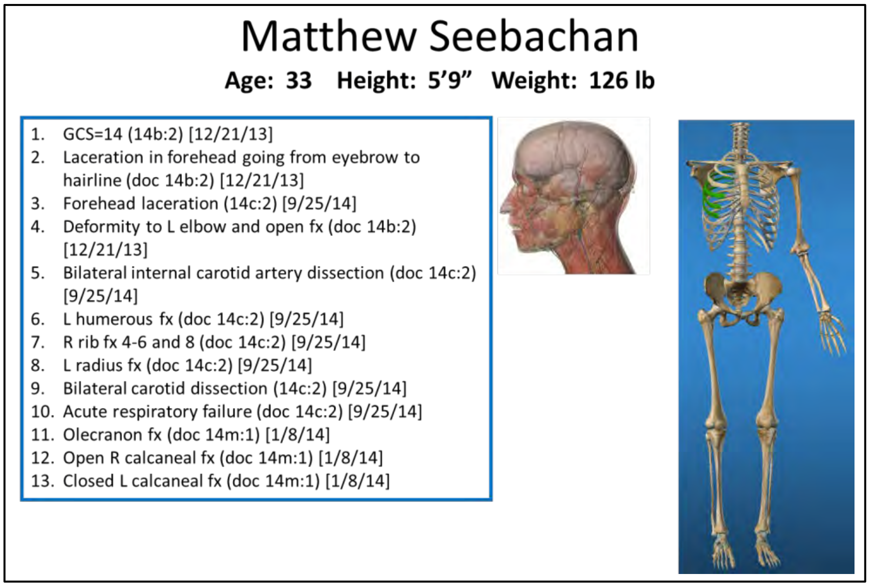

Figure 16 - Injury Pattern Analysis, Impressions (Matthew)

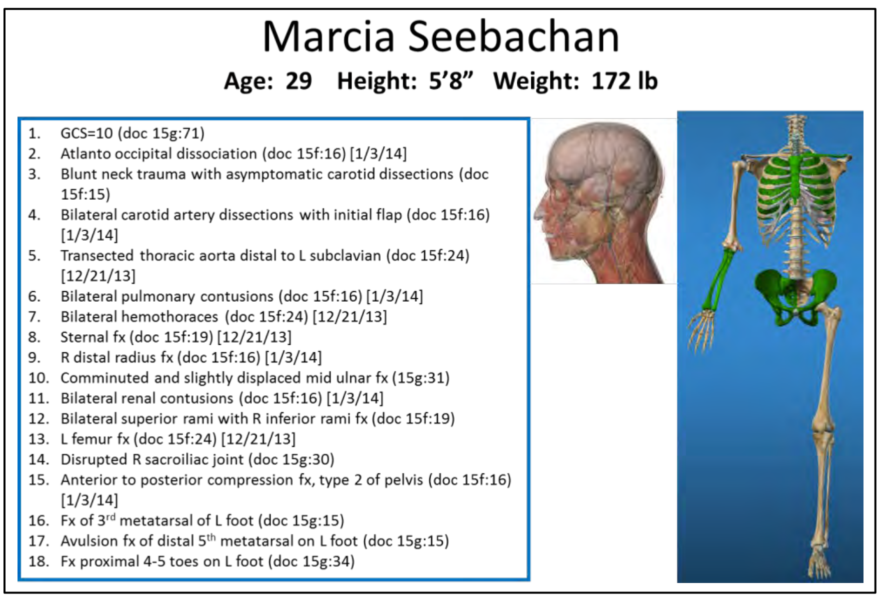

Figure 17 - Injury Pattern Analysis, Impressions (Marcia)

The severity of injury was evaluated based on an Abbreviated Injury Scale (AIS, 2008). The AIS scale includes rating from 1-6 (Level 1- Minor, Level 2 - Moderate; Level 3 – Serious, Level 4 – Severe, Level 5 – Critical and Level 6- Maximal).

> *Abbreviated Injury Scale (AIS) 2005, Association for the Advancement of Automotive Medicine (AAAM), Upde 2008.*

The overall outcome of the incident on December 21, 2013 for Mr. Seebachan was at a minimum AIS Level 2 (Moderate) and for Mrs. Seebachan, an AIS Level 5 (Critical).

Due to the roof's lack of proper welding, the entire structural system of the 2010 Honda Fit was compromised, including the A-pillar, toeboard, footwell, and floorpan which allowed excessive intrusion into the survival space of the driver and front seated occupant. Mr. and Mrs. Seebachan's torso injuries, upper extremity fractures, Mr. Seebachan's facial laceration, and Mrs. Seebachan's inner organ injuries are consistent with their bodies impacting and being crushed by the intruding components. The intruding footwell most likely was the injury mechanism of their lower extremity fractures, with entrapment preventing immediate escape thus causing them to sustain burn injuries.

Both Mr. and Mrs. Seebachan sustained different levels of bilateral internal carotid artery dissection, where mechanism of injury in traumatic scenarios is most often rapid deceleration, resulting in excessive bending and rotation of the neck, which stretches the internal carotid artery over the upper cervical vertebrae , producing a tear (Fabian et al, 1996).

Fabian TC, Patton J, Croce M, Minard G, Kudsk K, Pritchard F (1996). "Blunt Carotid Injury". Annals of Surgery. 223 (5): 519-20.

E-4.3 Human Body Kinematic / Kinetics
From a biomechanical perspective, Mr. and Mrs. Seebachan were thrown forward and to the left impacting the intruding vehicle's structures, and consequently trapped by the jammed doors and intruding footwell. The fire then caused enhanced injuries due to entrapment.

Conclusion: Had the roof been properly welded by Mr. John Eagle Collision, the vehicle's structure would have been able to appropriately distribute the impact energy and maintain the occupants' survival space. Had the survival space been maintained, Mr. and Mrs. Seebachan's injuries would not have been as severe, they would not have been trapped within their vehicle, and most likely their vehicle would not have caught fire.

F. SUBJECT COLLISION VS TEST DATA

The capability of the Honda Fit to manage energy is illustrated by National Highway Traffic Safety Administration (NHTSA) frontal impact test (Tables 1 and 2).

Table 1 - Vehicle Data for NHTSA Test

Test Number	Vehicle	Vehicle Weight	Impact Speed	Velocity Change	Maximum Crush
6517	2009 Honda Fit Sport 5 Door Hatchback	1325 kg = 2921.6 lb	56.02 kph = 34.8 mph	66.0 kph = 41.0 mph	524 mm = 20.6 in
7579	2012 Honda Fit 5 Door Hatchback	1310 kg = 2888.5 lb	56.5 kph = 35.1 mph	63.5 kph = 39.5mph	530 mm = 20.9 in

Table 2 - Biomechanical Parameters for NHTSA Test

Test Number	Occupant Information	Occupant Restraint Information	Occupant Injury Parameters
6517	Driver = 50^{th} % Hybrid III	3 Point Belt Airbag Deployment	HIC = 312.4 Head Accel = 47.7 g Chest Accel = 39.4 g

	RF Passenger = 50th % Hybrid III	3 Point Belt Airbag Deployment	HIC = 336.0 Head Accel = 51.4 g Chest Accel = 40.0 g
7579	Driver = 50th % Hybrid III	3 Point Belt Airbag Deployment	HIC15 = 203 Head Accel = 48.1 g Chest Accel = 44.2 g
	RF Passenger = 5th % Hybrid III	3 Point Belt Airbag Deployment	HIC15 = 294 Head Accel = 54.0 g Chest Accel = 47.8 g

All the biomechanical injury parameters for the tests presented are within the specified requirements.

Small overlap frontal impact testing for a Honda Fit was performed by the Insurance Institute for Highway Safety (IIHS). The impact conditions and test results are summarized below:

<u>IIHS Small Overlap Frontal Impact Test</u>

- 2013 Honda Fit Wagon
  - Vehicle Weight = 2,566 lb
- Impact Speed = 40 mph
- Engagement of 25% of total width
- Occupant Information:
  - Driver = Average size Hybrid III Dummy
    - HIC15 = 149
  - Restraint Information:
    - Driver
      - 3 Point belt
      - Frontal airbag

The test was performed at the speed of 40 mph. The calculated HIC for the Hybrid III test dummy was 149.

Moderate overlap frontal impact testing for a Honda Fit was performed by the Insurance Institute for Highway Safety (IIHS) and Honda. IIHS reported the results of this testing. The impact conditions and test results are summarized below:

<u>IIHS Moderate Overlap Frontal Impact Test</u>

- 2009 Honda Fit Wagon
  - Vehicle Weight = 2,592 lb
- Impact Speed = 40 mph
- Engagement of 40% of total width
- Occupant Information:
  - Driver = Average size Hybrid III Dummy
    - VTF0816
      - HIC15 = 335
    - CEF0820
      - HIC15 = 264
  - Restraint Information:
    - Driver
      - 3 Point belt
      - Frontal airbag

The tests were performed at the speed of 40 mph. The calculated HIC for the Hybrid III test dummy were 335 & 264.

G. REPAIR / ALTERNATIVE DESIGN ANALYSIS

According to Mr. Hannemann's report, his analysis reveals several issues:

1. Negligent repair

   The roof panel was not properly attached to the vehicle.

   The fuel tank protector and shield were not present at the time of the accident.
2. Negligent reporting to CARFAX

   CARFAX was not notified of the significant body damage and repairs made to the vehicle
3. Negligence by selling dealer

   The selling dealer failed to disclose prior vehicle damage

   The selling dealer failed to find the missing fuel tank protector and shield
4. Design analysis

   With proper repairs made, the vehicle provides reasonable crashworthiness protection in tests identical to the subject accident

Based on my education, training and experience as well as my knowledge of testing of these principles, I can state had the repairs been accurately performed, the chain of structural failures would not have occurred, the fuel tank would not have been compromised, and Mr. and Mrs. Seebachan would not have suffered loss of survival space type injuries, been entrapped, and consequently suffered burn type injuries. Had the repairs been properly made and if the fuel tank protector and shield had been installed, the Seebachans would have only sustained minimal injuries, like those sustained by the occupants of Toyota Tundra since, based on crash testing, the subject vehicle provides reasonable crashworthiness protection. Alternatively, had the prior vehicle damage been disclosed to the Seebachans, they would not have purchased the subject vehicle and would not have suffered their injuries.

H. ANTICIPATED DEFENSES

1. *Defense may claim, it did not cause the accident.*

While the defense did not cause the incident, John Eagle Collision did perform faulty repairs to the subject Honda Fit, making it dangerous and unsafe to be driven. The selling dealership, Huffines Kia, was negligent in performing a thorough inspection of the subject vehicle and providing Mr. and Mrs. Seebachan with enough information to make an informed purchase decision.

2. *Defense may claim the incident was too severe to escape injury.*

This is incorrect. The center of gravity acceleration the Honda Fit experienced was within human tolerance level; however, the sequence of structural failures resulting from the faulty repairs of John Eagle Collision Center caused Mr. and Mrs. Seebachan's survival space to be compromised, the doors to become jammed shut, and the vehicle to catch fire. All three occupants of the bullet vehicle had minimal injuries.

3. *Defense may claim the faulty repairs had nothing to do with the injuries suffered by Mr. and Mrs. Seebachan.*

This is incorrect. Had repairs been made correctly, the 2010 Honda Fit's frame would have maintained the survival space of Mr. and Mrs. Seebachan, and the remaining safety systems would have protected them and kept their injuries minimal as were the injuries to the 3 occupants of the Toyota Tundra.

I. ***OPINIONS***

All of my opinions and conclusions throughout this report are given to a reasonable degree of engineering, biomechanical and scientific certainty.

1. **Mr. and Mrs. Seebachan were both properly seated and belted occupants of the 2010 Honda Fit.**

2. **As a result of the incident on December 21, 2013, the subject 2010 Honda Fit experienced center of gravity (CG) acceleration that would have been within the human tolerance level.**
3. **John Eagle Collision Center failed to properly repair the roof of the subject 2010 Honda Fit, which in turn created structural and crashworthiness failures.**
4. **John Eagle Collision Center failed to report the extensive repairs to Carfax.**
5. **Huffines Kia was responsible for inspecting the subject 2010 Honda Fit, but failed to note the missing fuel tank cover, and thus failed to provide Mr. and Mrs. Seebachan with adequate data to make an informed purchase decision.**
6. **Based on my review of the provided materials, review of the available medical records and my knowledge in trauma biomechanics, it is my opinion that Mr. and Mrs. Seebachan sustained their injuries due to the vehicle's failure to maintain proper survival space. Specifically, the roof structure was not attached properly which caused a chain of structural events consisting of, but not limited to; deformation of the cant rails resulting in the jamming of the occupant's doors, excessive intrusion of the foot well, lower frame deformation compromising the fuel tank which wasn't properly protected by the tank cover, entrapment and subsequent fire started by leaking fuel.**
7. **Had John Eagle Collision Center properly performed the repairs, the Seebachans would not have suffered any injuries above AIS 1 based on the crashworthiness protection capabilities of the subject vehicle in crash testing.**
8. **Had John Eagle Collision Center reported the extensive repairs to Carfax, the Seebachans would not have bought the subject vehicle and would not have suffered their injuries.**
9. **Had Huffines Kia properly inspected the subject 2010 Honda Fit and advised the Seebachans advised of the prior damage or missing fuel system protectors and shields, the Seebachans would not have bought the vehicle and would not have suffered their injuries.**

I reserve the right to amend this report, to modify, change and/or to alter my opinions predicated upon further discovery and upon receipt of any additional materials.

Sincerely yours,

Mariusz Ziejewski, Ph.D., Inż.
Professor
Director of Impact Biomechanics Laboratory, College of Engineering
Director of Automotive Systems Laboratory, College of Engineering
North Dakota State University
and
Clinical Faculty
Adjunct Associate Professor
Department of Clinical Neuroscience, School of Medicine
University of North Dakota