Traffic Collision Investigation Advanced

Los Angeles County Sheriff's Department

ADVANCED TRAFFIC COLLISION

INVESTIGATION COURSE

80 HOURS

Course Outline

COURSE DESCRIPTION

This course is designed to improve the students' skills and knowledge of the advanced techniques used to determine the sequence of events that result in a traffic collision and how to properly document the available information. The students will have the opportunity to become proficient in the following areas:

1. Advanced collision photography and photogrammetry

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1. Environmental examinations and collision scene measurements
2. Techniques for preparing scale diagrams
3. Vehicle systems and vehicle related collision factors
4. Human factors and mechanisms of injury
5. Mathematics, time-position analysis and freefall analysis

COURSE GOALS

1. To develop a relatively high degree of technical expertise in traffic collision investigation.

1. To recognize, interpret and prepare physical evidence for further use in collision reconstruction.

COURSE PREREQUISITE

Intermediate Traffic collision Investigation Course

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RECOMMENDED TEXTS

1. Basic Collision Analysis and Scene Documentation, Casteel and Moss, P.M., 1982
2. Traffic Accident Investigation Manual, J. Stannard Baker, 1985

SUGGESTED REFERENCES

1. Accident Causation, SAE SP-461, 1980
2. Accident Reconstruction, James Collins, 1979
3. Auto-Pedestrian Collision Experiments, Severy, SAE 660080
4. California Vehicle Code
5. CHP Handout, “Stopping Distances for Vehicles Equipped with Air Brakes”
6. CHP Speed From Skid Chart
7. Classical Mechanics: A Modern Perspective, Barger and Olsson, McGraw-Hill, 1973
8. Comparative Study of Vehicle Roll Stability, Ervin, UMTRI
9. Crash Avoidance, SAE SP-544, 1983
10. Crash III Users Guide and Technical Manual
11. Demonstrative Evidence Handbook, Filter, 1985

12. AAA Club Handout, “Electronic Detonator”
13. Energy Basis for Collision Severity, Campbell, SAE 740565
14. Field Accidents. Data Collection, Analysis, Methodologies and Crash Injury

1. Reconstruction, SAE P-159, 1985
2. Fundamentals of Physics, Halliday and Resnick, Wiley, 1981
3. Handbook for the Accident Reconstructionist, M.J. Lofgren, 1983
4. Human Factors in Highway Traffic Safety Research, Forbes, 1972
5. Human Factors, Johansson, Gunnar and Rumar Drivers Brake Reaction Times
6. Manual on Uniform Traffic Control Devices, US DOT 5001-0021
7. Mechanics of Vehicle Collisions, Reizes, C. Thomas Publishing
8. Motor Vehicle Accident Reconstruction and Cause Analysis, Rudolf Limpert, 2nd Edition, 1984

1. Motorcycle Accident Cause Factors and Identification of Countermeasures, US DOT HS-5-01160, 1979

1. Motorcycle and Recreational Safety, Hurt, US DOT 73051
2. Motorcycle Collision Experiments, Severy, SAE 700897
3. Pedestrian impact Injury and Assessment, SAE P-121, 1983
4. Scientific Automobile Accident Reconstruction, Barzelay and Lacy, 1987
5. Traffic Accident Field Measurements and Scale Diagrams, R.W. Rivers, 1983
6. Traffic Accident Investigation Handbook, R.W. Rivers, 1980
7. Vehicle System Components, Limpert, John Wiley Publishing, 1982

EQUIPMENT

1. Scientific Calculator

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1. Drafting Instruments

    a. Template
    b. Flexcurve
    c. Engineers Scale
    d. Protractor
    e. Compass
    f. Pencil
    g. Eraser

METHODS OF INSTRUCTION

1. Lecture/Demonstration

1. Visual Aids (Overhead Projector, Slide Projector, VCR/Monitor, Chalkboard)
2. Practical Application

METHODS OF EVALUATION

1. Practical Exercises

1. Comprehensive Written Examination

1. Case Studies

TOPICAL OUTLINE

Recommended

Minimum Hours

I.	Introduction and Orientation	1.0
II.	Legal Aspects	4.0
III.	Photography	8.0
IV.	Environmental Factors	8.0
V.	Diagramming	8.0
VI.	Vehicle Factors	16.0
VII.	Human Factors	8.0
VIII.	Mathematics and Basic Physics	7.0
IX.	Time-Position Analysis (Kinematics)	8.0
X.	Freefall Analysis	8.0
XI.	Final Examination and Critique	4.0

Total 80.0

EXPANDED COURSE OUTLINE

I. **Introduction and Orientation** **1 Hour**
- A. Orientation
- B. Overview of Course
- C. Schedule
- D. Course Goals

II. **Legal Aspects** **4 Hours**
- A. Vehicle Code
  1. Updates
  2. Relevant Sections
- B. Penal Code
  1. Updates
  2. Relevant Sections
- C. Search and Seizure Review and Updates
  1. Discussion of current changes in search and seizure laws and court decisions.
  2. Review of evidence code and case law relevant to the collection of evidence.
  3. Elements of Major Violations
- D. Definition and elements of: Homicide/Felonies
  1. Murder
  2. Manslaughter (Gross/ordinary negligence)
  3. Felony hit and run
  4. Felony driving-under-the-influence
  5. Other major violations
- E. Civil Aspects
  1. Criminal procedures
  2. Civil procedures
- F. Case Law
  1. Introduction to case law research procedures
  2. Discussion of applicable decisions

III. **Photography** **8 Hours**

A. Review of Photographic Equipment
   1. Use of the digital camera
   2. Lenses and filters
   3. Flash equipment
   4. Other accessories

B. Advanced Techniques
   1. Advanced shutter/aperture techniques
   2. Advanced flash techniques
   3. Infrared photography
   4. Aerial photography

C. Introduction to Photogrammetry
   1. Perspective grid photography
   2. Terrestrial photogrammetry

I. **Environmental Factors** **8 Hours**

A. Definitions of engineering terms relevant to the roadway environment

B. Examination of the Scene
   1. Roadway environment
   2. Roadway configuration
   3. Roadway delineation
   4. Controls
   5. Roadway surface compositions
   6. Weather and temperature

II. **Diagramming** **8 Hours**

A. Purpose of scale diagrams
   1. Medium for graphically recording collision site and physical evidence measurements.
   2. Provides the collision investigator with a perspective of the collision site, the evidence it contains, and their relation - ships that can be used to enhance the determination of collision cause factors.
   3. Utilized in all phases of collision reconstruction from the interpretation of physical evidence to the determination of area of impact, direction of travel, and velocities of collision-involved vehicles.

B. Equipment
   1. Traffic template

2. Compass
3. Protractor
4. Engineer's scale (scale rulers)
5. Curves (French, flex, templates)
6. Straight edges, triangles, etc.
7. Pencils, paper, erasers, etc.
8. Lettering templates/devices
9. Computer Programs
10. Other implements

C. Information Required
   1. When to prepare scale diagrams
   2. Purpose of a scaled diagram

D. Information needed in a diagram

E. Diagramming Techniques
   1. Planning the diagram
   2. Straight roadways

F. Curved roadways

G. Intersections
   1. Center and lane lines
   2. Edge lines, pavement edges and shoulders
   3. Fixed objects
   4. Vision obscurements
   5. Tangent points
   6. Angle of intersection
   7. Crosswalks, curbs, sidewalks and other features
   8. Intercept points
   9. Traffic controls
   10. Physical evidence

H. Special circumstances
   1. Off-road collisions
   2. Parking lots
   3. Cross-sectional diagrams
   4. Vertical curves
   5. Roadway collisions
   6. Freefall collisions

A. Practical Exercises
   1. Physical evidence
   2. Points of rest

3. Tire marks
4. Gouge marks
5. Debris
6. Fluid spatter, trails, pools, and other collision scene evidence

J. Measuring the Roadway Environment
1. Straight roadways
2. Curved roadways

K. Coordinate method
1. Linear
2. Polar

AX. Spot-coordinate method

ALL. Trilateration (Triangulation)

N. Grid method

O. Use of photogramametry techniques

P. Engineering Diagrams
1. Use of engineering diagrams (As-built plans)
2. Interpretation

Q. Photography
1. Photographing the roadway
2. Photographing physical evidence

R. Case Law
1. Examination and measurement of roadway site
2. Engineering diagrams
3. Environmental photography

III. Vehicle Factors — 16 Hours

A. Major Components
1. Tires and wheels
2. Brakes
3. Steering
4. Suspension
5. Glass
6. Electrical
7. Power trains
8. Exhaust
9. Restraints

B. Lighting

C. Reasons for Inspection
    1. Record damage
    2. Determine force lines
    3. Possible mechanical defects
    4. Occupant contact

D. Inspection Process

E. General walk around
    1. Establish what basic factors are involved
    2. Note unusual conditions

F. Vehicle Damage
    1. Exterior
    2. Contact damage
    3. Definition
    4. How to record
    5. Vehicle outline sketches
    6. Vehicle profiles
    7. Vehicle damage records

G. Interior
    1. Contact damage
    2. Induced damage
    3. Reason for distinguishing between contact and induced
    4. Imprints and transfers

H. What to measure
    1. All damage, whether new or old
    2. Emphasis on major component displacement
    3. Importance of not overlooking minor component damage
    4. Horizontal, vertical and crush dimensions
    5. Establishment of pre-crush dimensions
    6. Occupant contact damage

A. How to measure
    1. Station line method through longitudinal axis of vehicle
    2. Body line extension
    3. Base line along the side or front of the vehicle
    4. Rectangular stationing
    5. Stand and cord

J. Motorcycle damage measurements
    1. Measurement of wheelbase displacement
    2. Examination of fork damage to determine extent of braking at impact
    3. Usefulness in speed analysis

K. Force Line Determination
   1. Methodology
   2. Explanation of changes in force magnitudes during impact
   3. Resultant force or direction of principle force
   4. Flow of the damage
   5. Occupant kinematics
   6. Accuracy of determination
   7. Force line estimates and their use in the accident reconstruction process

AX. Collision Deformation Classification (CDC)

ALL. Photography
   1. Exterior
   2. Interior
   3. Mechanical defects

N. Vehicle Damage Diagrams
   1. Selection of appropriate scale
   2. Plotting measurements from reference lines
   3. Vehicle damage profiles
   4. Use in the accident reconstruction process

O. Use of Mechanics and Automotive Engineers as Experts
   1. Mechanical inspections of vehicles
   2. Analysis of component parts and systems failures
   3. Expert witness testimony

P. Lamp Analysis to Determine On or Off at Impact

Q. Legal Aspects of Vehicle Inspections

R. Practical Exercises
   1. Measure, Diagram, and photograph a damaged vehicle
   2. Determine lines of force
   3. Lamp analysis

I. Human Factors — 8 Hours

A. Introduction to Human Factors/Overview

B. Psychological Factors
   1. Cultural
   2. Emotional Suicidal Homicidal

C. Physiological Factors
   1. Nervous system
   2. Senses
   3. Reaction times

4. Perception
5. Decision
6. Reaction

D. Physical handicap
E. Medical condition
F. Alcohol and drugs
G. Fatigue
H. Review of the Nine-Cell Matrix
   1. Human Factors
   2. Vehicle Factors

A. Environment
J. Witnesses
   1. Ability to perceive
   2. Field of view
   3. Education and experience
   4. Emotional condition
   5. Bias/Prejudice

K. Mechanisms of Injury
   1. At-scene investigation
   2. Hospital follow-up
   3. Description
   4. Photographs
   5. Medical records

AX. Morgue follow-up
   1. Description
   2. Photographs
   3. Medical records
   4. Autopsy evidence
   5. Collision trauma
   6. Intentional versus accidental

ALL. Case Law

I. **Mathematics and Basic Physics** **7 Hours**
   A. Mathematics
      1. Algebra review
      2. Right-angle trigonometry
      3. Quadratic equations
      4. Cartesian coordinate systems

B. Basic Physics
    1. Laws of motion
    2. Inertial reference systems
    3. Velocity and acceleration
    4. Constant, average, and instantaneous
    5. Objects in freefall
    6. Resultant drag factor

I. **Time – Position Analysis: Kinematics** **8 Hours**

A. Equations of motion with constant acceleration
    1. Refer to Advanced Traffic Accident variable list and' equation sheet
    2. Outline and demonstration of solution process
    3. Time-position analysis problems

I. **Freefall Analysis** **8 Hours**

A. Freefall equation and derivation
    1. Refer to Advanced Traffic Accident variable list and equation sheet
    2. Trigonometry review

B. Evidence associated with freefall accident
    1. Evidence of launch
    2. Evidence of trajectory
    3. Evidence of landing

C. Freefall analysis problems

D. Means to ensure the calculated speed is consistent with all parameters of the collision

I. **Final Examination** **4 Hours**

A. Test
    1. Theory
    2. Mathematics

B. Case Study - A combination of no more than one hour cognitive evaluation and no less than three hours of case evaluations

C. Number of cases will be based on case complexity

D. Practical Application
    1. Photography
    2. Diagramming
    3. Damage Profile