Crash Dynamics

2015 OPI – Montana Traffic Education Association

Michael DiBrizzi (MSU-Northern)

Overview

- General information
- Statistics
- Crash Scene Investigation
- The dynamics of a crash
- Strategies for education and prevention

Introduction

- A traffic crash – *that occurrence in a series of events which usually produces injury, death, and/or property damage that occurs on a trafficway*

- When dealing with the ***actual*** vehicle collision, there is no such thing as an “accident”

  - an accident relates to the intent of the Driver – not the result (crash)
  - just because there is no “intent” to cause the vehicle collision does not mean the Driver is blameless for their actions

Liability

- 14 ½ y/o – TELL license
- 15 y/o – Learner's Permit
- Provisional
- Full

- 16 y/o can be charged with negligent homicide
  - negligently causes the death of another human being
  - imprisoned not more than 20 years, and/or $50,000

MCA 41-5-206 (1)(b)(i)

Some basic statistics (MT DoT)

- In 2013:
  - 229 fatalities
  - 203 fatal crashes (171 auto – 32 motorcycle)
  - 186 dry pavement (91.6%)
  - 110 nighttime (54%)
  - 49 during Winter (24% - Jan/Feb/Nov/Dec)
  - 77 during Summer (38% - May/June/Jul/Aug)
  - male driver (70 – 85% depending on variables)
  - impaired driver (48%)
  - seatbelts (57% – not wearing or improperly wearing)
  - motorcyclist (16% – 31 of 32 on dry pavement)

Some basic statistics (MT DoT)

- In 2009:
  - 91% fatalities in rural areas (***221*** *total fatalities*)
    - 96% of roads in the State are rural
  - Of all fatalities in rural areas – 72% single-vehicle
  - Single-vehicle run off the road – 29% of all crashes and 59% of fatal crashes
  - Fatality rates in crashes are highest in SUVs and Pickups (approx. 60% of veh. registered in MT)

Some basic statistics (MT DoT)

- In 2009:
  - Vehicle type
    - fatality rates in Rollover crashes are highest in SUVs and Pickups
    - ejection rates for fatalities highest in SUVs and Pickups
      - for fatally-injured, unrestrained occupants:
      - SUVs – 49%; Pickups – 38%; Passenger veh. – 29%
  - **Drivers < 21 had highest rate of involvement in all crashes and fatal crashes per 1000 lic. drivers**
  - 3 million livestock (cattle, sheep, pigs) <10 fatalities from striking animals (including wild animals)

Crash Investigation Objectives

- The objectives of a traffic crash investigation are to attempt to determine:
  - **WHAT** happened (the type of crash)
  - **WHERE** the crash occurred
  - **WHEN** the crash occurred
  - **WHY** the crash occurred
  - **WHO** (and/or what) was involved
  - distinguish between possibilities and probabilities

Probable causes of crashes

- Impaired – due to substance(s)
- Poor judgment (speed, unfamiliarity, etc.)
- Distractions
- Collision with fixed object, other vehicle(s)
- Fatigue
- Environmental factors
- Mechanical cause

Crash Scene

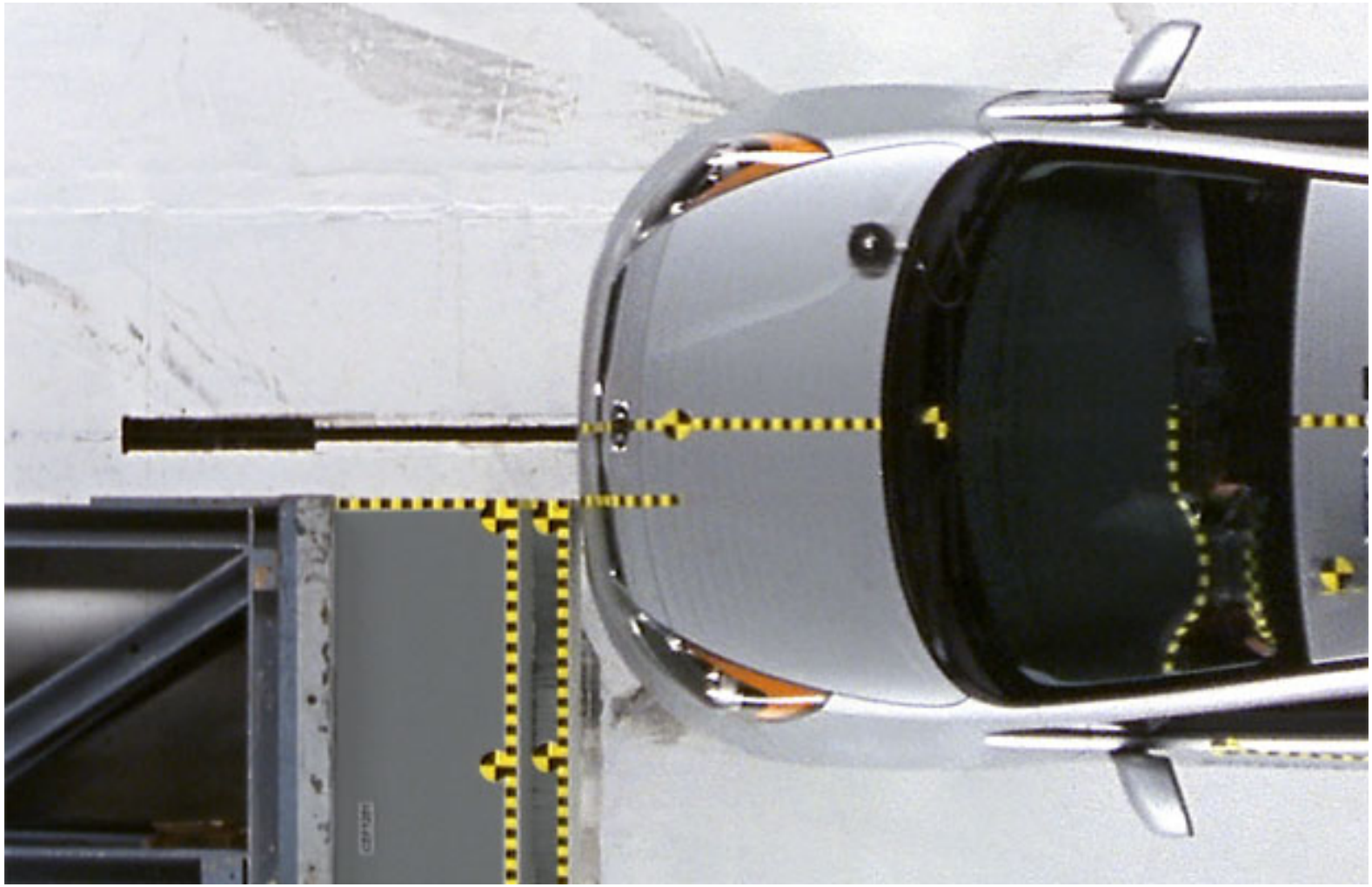
- The scene of a crash holds the richest and most abundant amount of evidence and information, including:
  - location of the resting point of the vehicle(s)
  - location of the occupant(s) inside and outside the vehicle (if they were ejected)
  - location of crash debris
  - location of skidmarks, or yawmarks from vehicle(s)
  - construction of the roadway – surface type
  - condition of the shoulders of the road
  - condition of the roadbed

Crash Scene

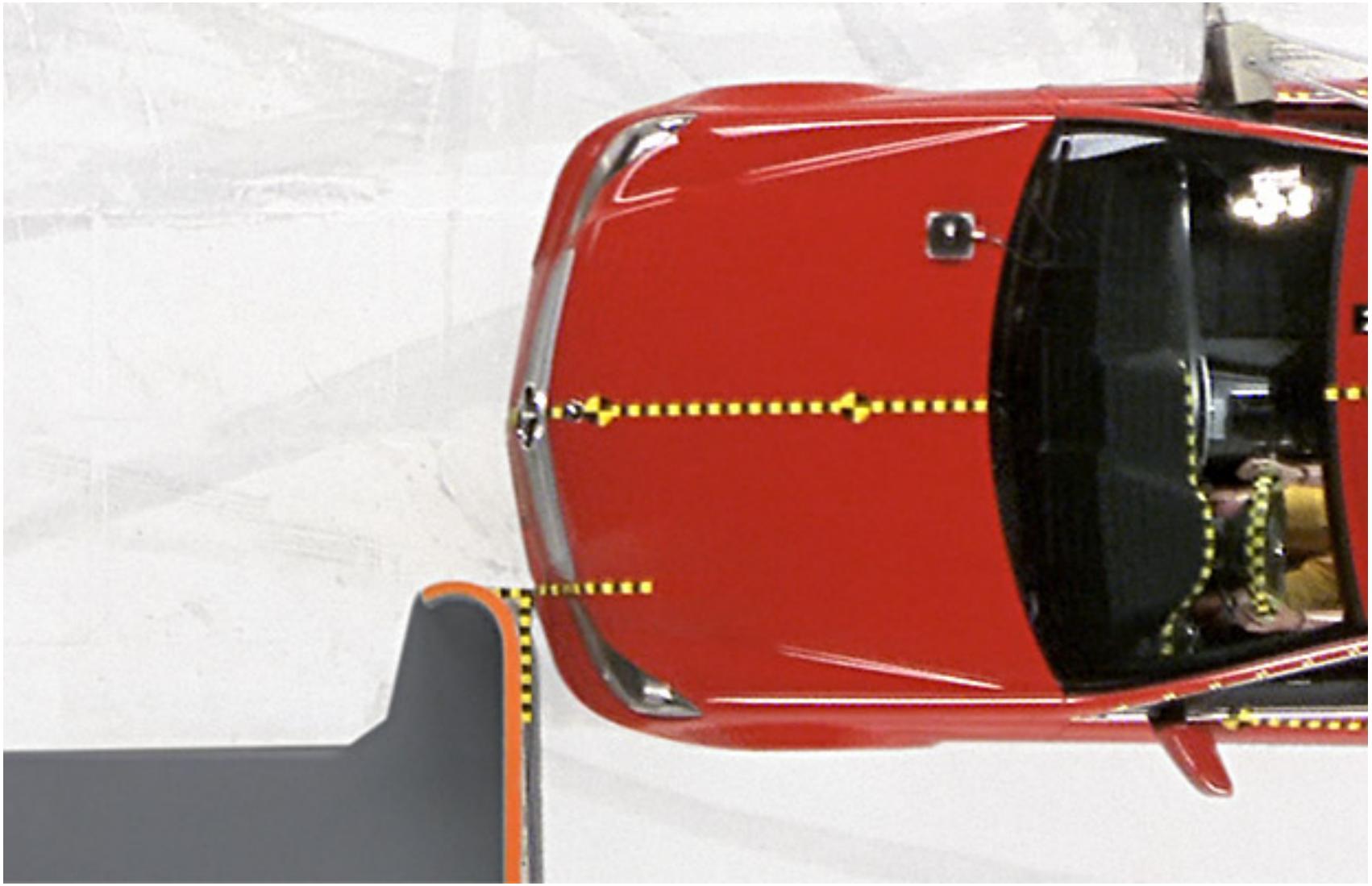
- The scene of a crash - evidence and information, including:
  - damage to the vehicle(s)
  - damage to other structures or fixed items
  - components missing from vehicle(s) and their location
  - damage to (marks on) the roadbed from the vehicle interaction
  - damage to the off-road environment from vehicle(s)
  - environmental factors – weather, lighting, road construction, animals, pedestrians, other obstructions

- 2015 Chevy Silverado 2500; front impact crash
  - 35 mph - full frontal impact
  - https://www.youtube.com/watch?v=9vW9pmd-u1c
- 2015 Chevy Silverado 2500; pole, side-impact crash
  - 20 mph - 75 degree angle side-impact
  - https://www.youtube.com/watch?v=tfQCcRE1nCg
- 2015 Chevy Silverado 2500; side-impact
  - 38 mph - 3,000 lb vehicle strikes stationary Pickup
  - https://www.youtube.com/watch?v=YE2WaV66G4o

- Insurance Institute for Highway Safety - IIHS moderate overlap



- IIHS - small overlap



Rarely when striking a fixed object, is the impact straight and full-frontal

Brief videos

- 2007 Ford Expedition - rollover crash
  - https://www.youtube.com/watch?v=hBOnjKm2sLQ
  - @ 3:00 - interior camera shot
- Anatomy of a Crash
  - https://www.youtube.com/watch?v=O_nNeO_TeYI

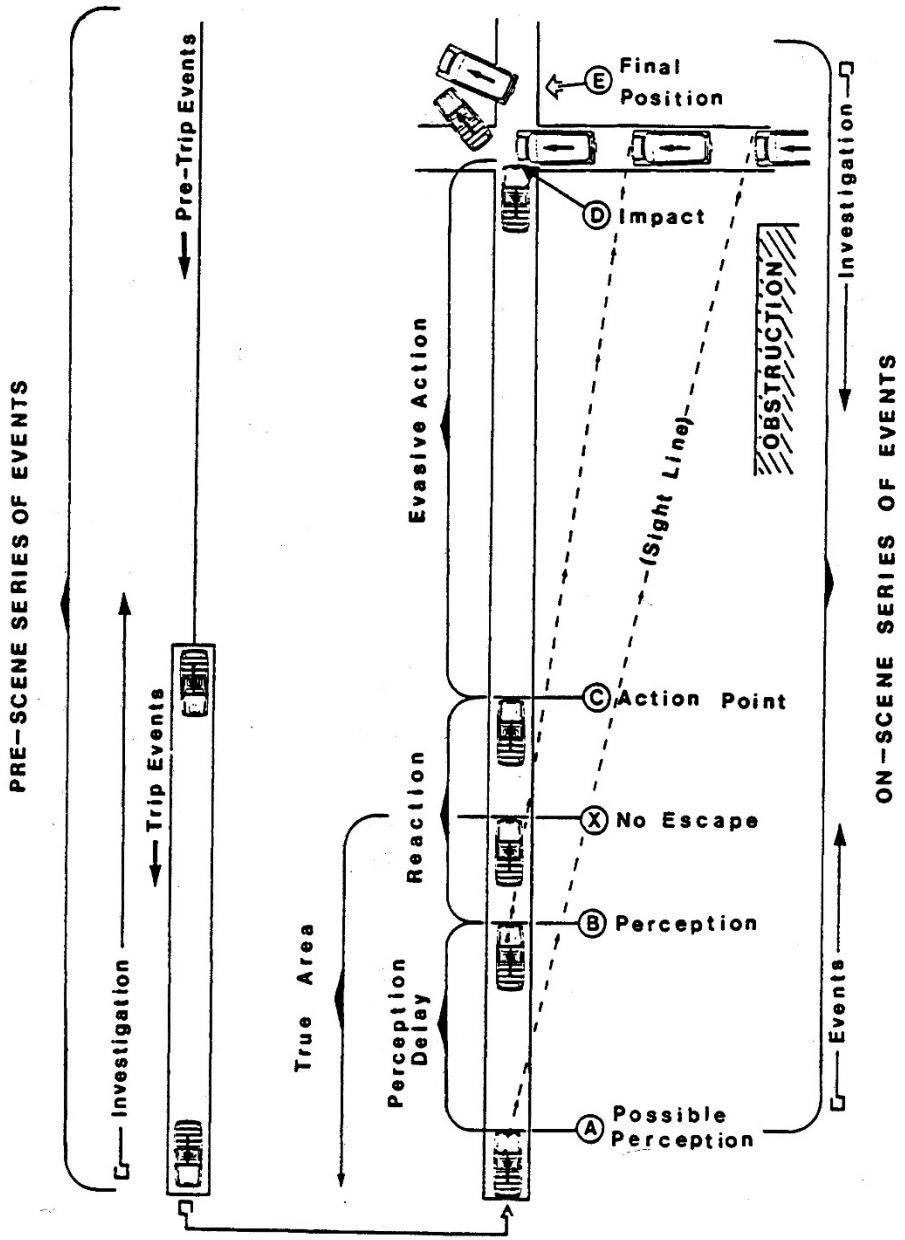
3 collisions in a crash

1) Vehicle collision

2) External human collision

3) Internal human collision

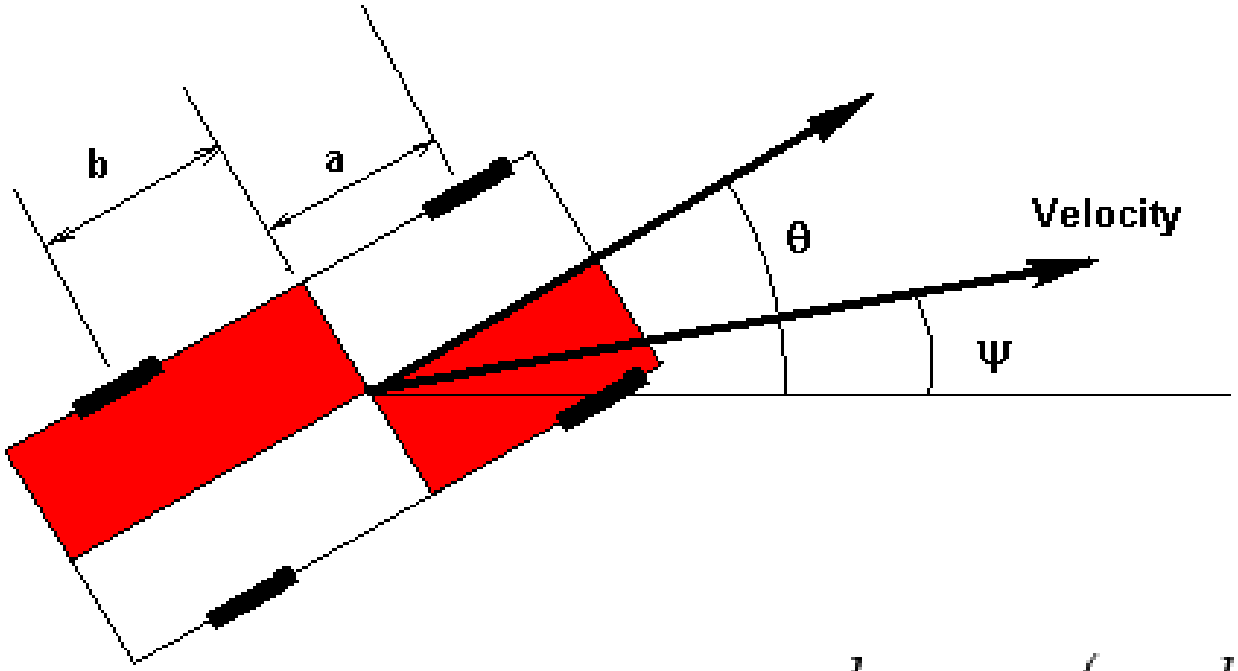
Series of Events



2-1. Series of events. Source: *Traffic Accident Investigators' Handbook* by Rivers.

Accident scene diagram

Some math…



Dynamics of Road Vehicle

$$\frac{d\omega}{dt} = 2k\frac{(a-b)}{I}\beta - 2k\frac{(a^2+b^2)}{VI}\omega$$

$$\frac{d\beta}{dt} = -\frac{4k}{MV}\beta + (1-2k)\frac{(b-a)}{MV^2}\omega$$

Strategies for Education and Prevention

Education

- make it relevant to young people in terms that they can understand
- don’t always focus on their death - speak about life-altering injuries and/or death of family members (parents, siblings, children)
- videos with teenagers - stories humanize the information and the message

Prevention

- vehicle redesign
  - physical dimensions and suspensions
  - seatbelts, and SRS
- reduce speed, especially if poor road conditions
- reduce distractions
- reduce or eliminate issues such substance impairment, fatigue, etc.

Jeeps over the years…

CJ 5 (1954 - 1983)

CJ 7 (1976 - 1986)
10 inch longer wheelbase
modified suspension

Jeep Wranglers

YJ (1987 - 1995)
wider track - length of axles
lower clearance - lower CoG

TJ (1997-2006)
modified suspension -
based on Cherokee

PARTS
Dr Pepper
Dr Pepper
Coca-Cola

Jeep Wranglers

JK (2007 - present)
wider track
longer wheelbase

Thank your for your attention!