NTSB National Transportation Safety Board

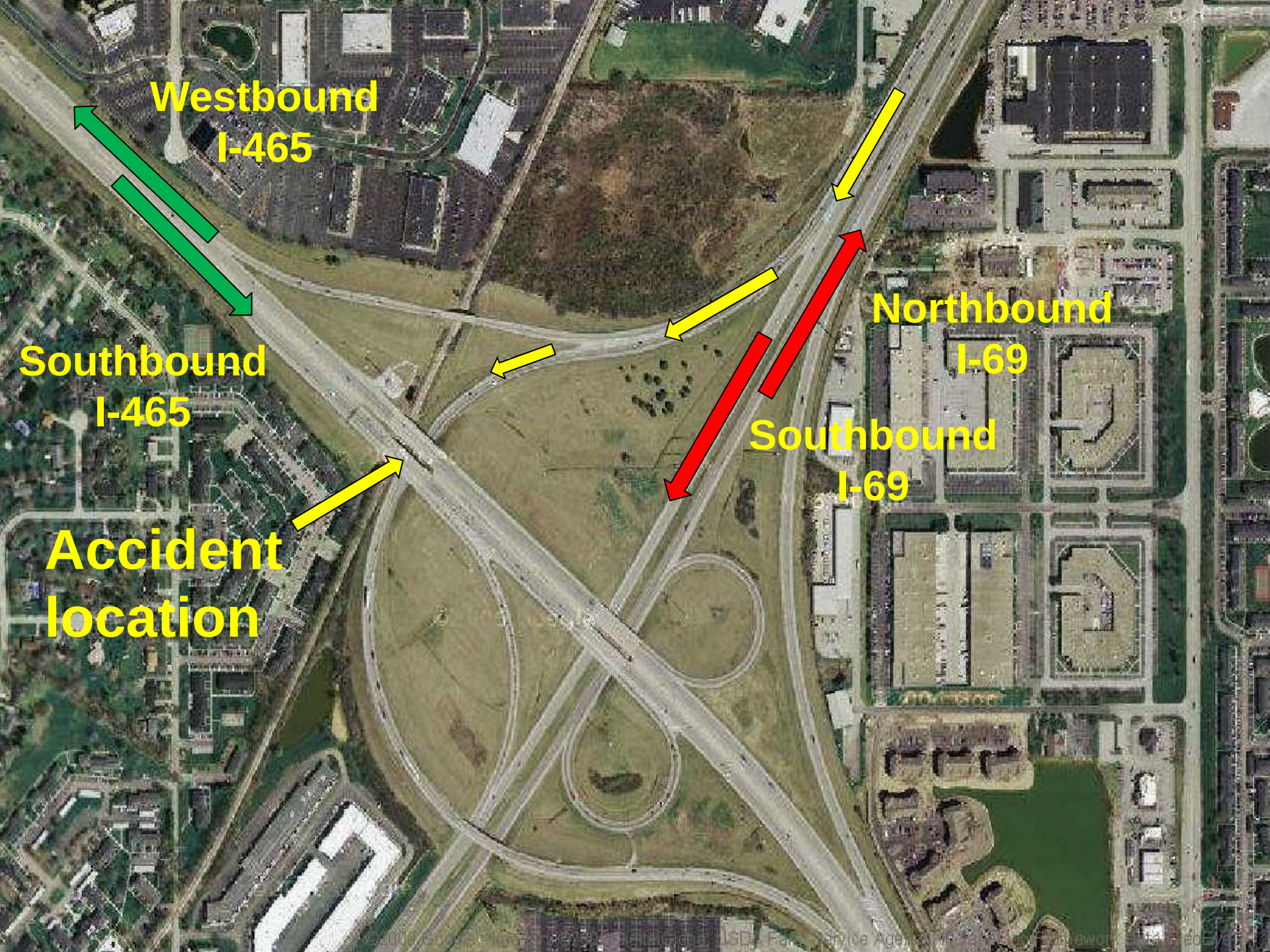
Office of Highway Safety

Truck-Tractor and Cargo Tank Semitrailer Rollover and Fire
Interstate Highway 69
Indianapolis, Indiana
October 22, 2009

NTSB National Transportation Safety Board

Office of Highway Safety

Opening Statement


Westbound
I-465
Southbound
I-465
Accident
location
Northbound
I-69
Southbound
I-69

NTSB National Transportation Safety Board

Office of Research and Engineering

Truck-Tractor and Cargo Tank Semitrailer Rollover Animation

Indianapolis, Indiana

October 22, 2009

HWY-10-MH-001


J
O
D
C
B
R


LIQUEFIED PETROLEUM

Injuries

- Truck driver
  - Seriously injured

- Passenger vehicle occupants
  - 1 serious injury (Volvo driver)
  - 3 minor injuries

Parties to the Investigation

- Federal Highway Administration
- Indiana Department of Transportation
- Lawrence Township Fire Department
- Indiana State Police
- Mississippi Tank Company
- AmeriGas Propane

Safety Issues

- Driver fatigue management and rollover prevention programs
- Stability control systems and vehicle design
- Cross-slope breaks and protection of bridge pier columns
- Crashworthiness of Department of Transportation specification cargo tanks

NTSB

NTSB National Transportation Safety Board

Office of Highway Safety

Human Performance Factors

Driver Information

- Current license and endorsements
  - Cargo tank and hazardous materials
  - Corrective lens restriction
- 45 years driving trucks, 15 with cargo tanks
- Current medical card
- No evidence of drug/alcohol use
- No evidence of distractions

Consideration of Fatigue

- Driver could set work hours
- Uncertainty in sleep opportunity
- Uncertainty in sleep obtained
- Wide range of possibilities
- Insufficient information to determine fatigue

Fatigue Management Programs

- Displayed poor fatigue management
- Role of fatigue in rollovers
- Fatigue management programs
- AmeriGas practices
- Driver may be representative

Rollover Prevention Program

- Rollover is a problem
- “Vehicle Incident Prevention Program” not effective for rollovers
- Rollover awareness efforts
- Comprehensive rollover prevention program
- Australian program successful

Summary

- Cannot determine whether driver was fatigued
- Poor fatigue management by driver
- Rollover is a problem

NTSB

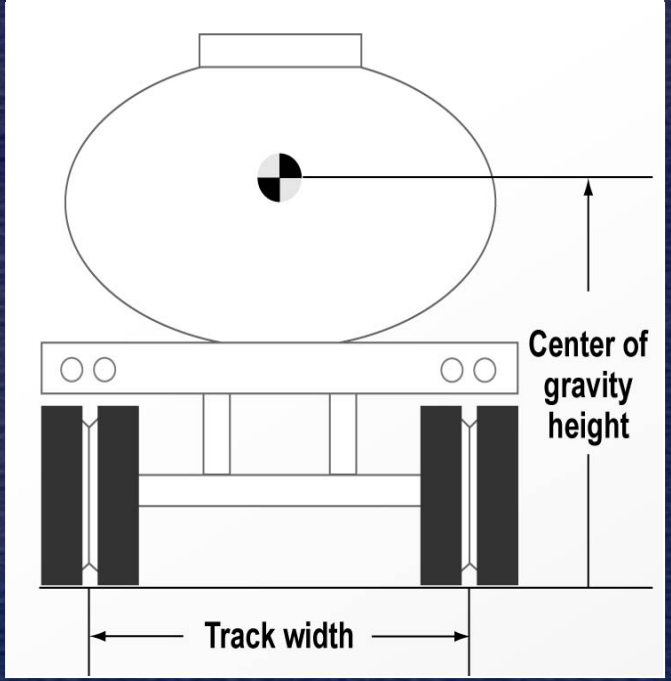
NTSB National Transportation Safety Board

Office of Highway Safety

Vehicle Factors

Rollover Prevention

Cargo tanks prone to rollover:
6% of fleet, 31% of fatal rollover accidents



Approaches

1. Stability control systems
   - Adding technology
   - Prevent excessive curve speed rollovers
   - Prevent loss of control from oversteer and understeer
2. Vehicle design
   - Lower and wider
   - Prevent all types of rollovers

Stability Control Systems

- Roll Stability Control (RSC)
  - Tractor or trailer based
- Electronic Stability Control (ESC)
  - Tractor based

With ESC

Without ESC

Images courtesy of Bendix Commercial Vehicle Systems LLC

Stability Control Systems

- Market facts
  - Bendix, Meritor WABCO, Haldex
  - Available on all new tractors and trailers
  - Cost range $600 - $2,000
  - On the market for 10 years
  - 100,000 RSC and ESC units installed as of 2009 (ATRI)
  - 25% of tractors will have ESC by 2012 (NHTSA)
  - No current requirement for ESC on heavy vehicles

Stability Control Systems

- ESC required for passenger vehicles
  - Loss of control accidents reduction (NASS data)
    - 40% with cars, 70% with SUVs
  - NHTSA issued final rule in April 2007
    - All vehicles be equipped with ESC by model year 2012
- Benefits of RSC and ESC for heavy vehicles
  - 2009 NHTSA Study
    - RSC could prevent 3,489 crashes, 106 fatalities, and 4,384 injuries each year - $1.4 billion savings
    - ESC could prevent 4,659 crashes, 126 fatalities, and 5,909 injuries each year - $1.7 billion savings

Summary

- Previous NTSB recommendations on stability control standards (Dolan Springs)
- Stability control systems for ALL commercial vehicles

NTSB

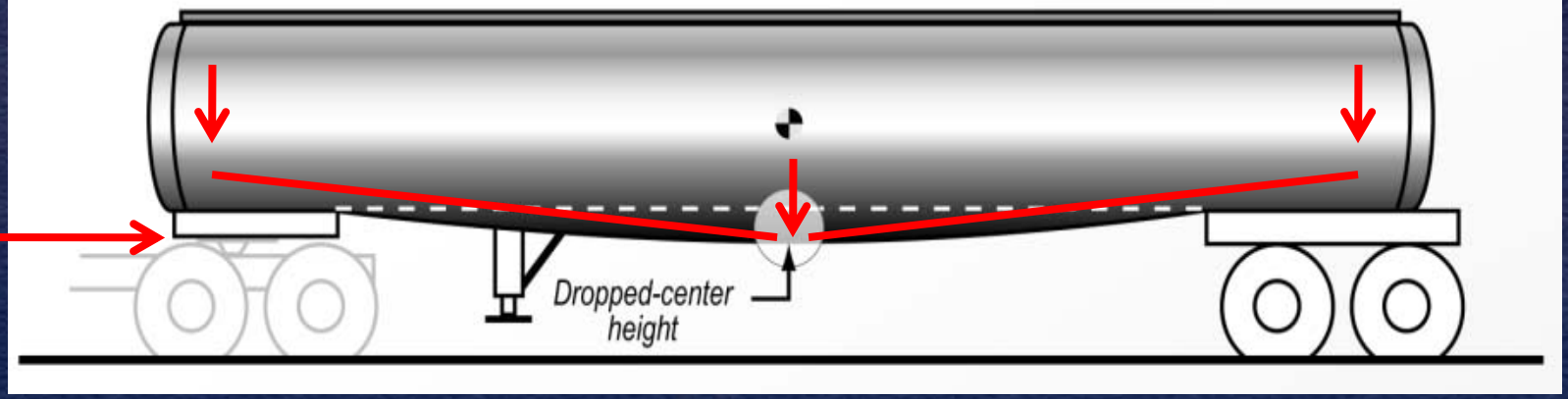
Vehicle Design

- Design considerations
  - Tank structural integrity
  - Ground clearance
  - Loading heights
  - Size and weight
- Roll Stability can be improved by
  - Lowering center of gravity height (CG)
  - Increasing track width

Vehicle Design

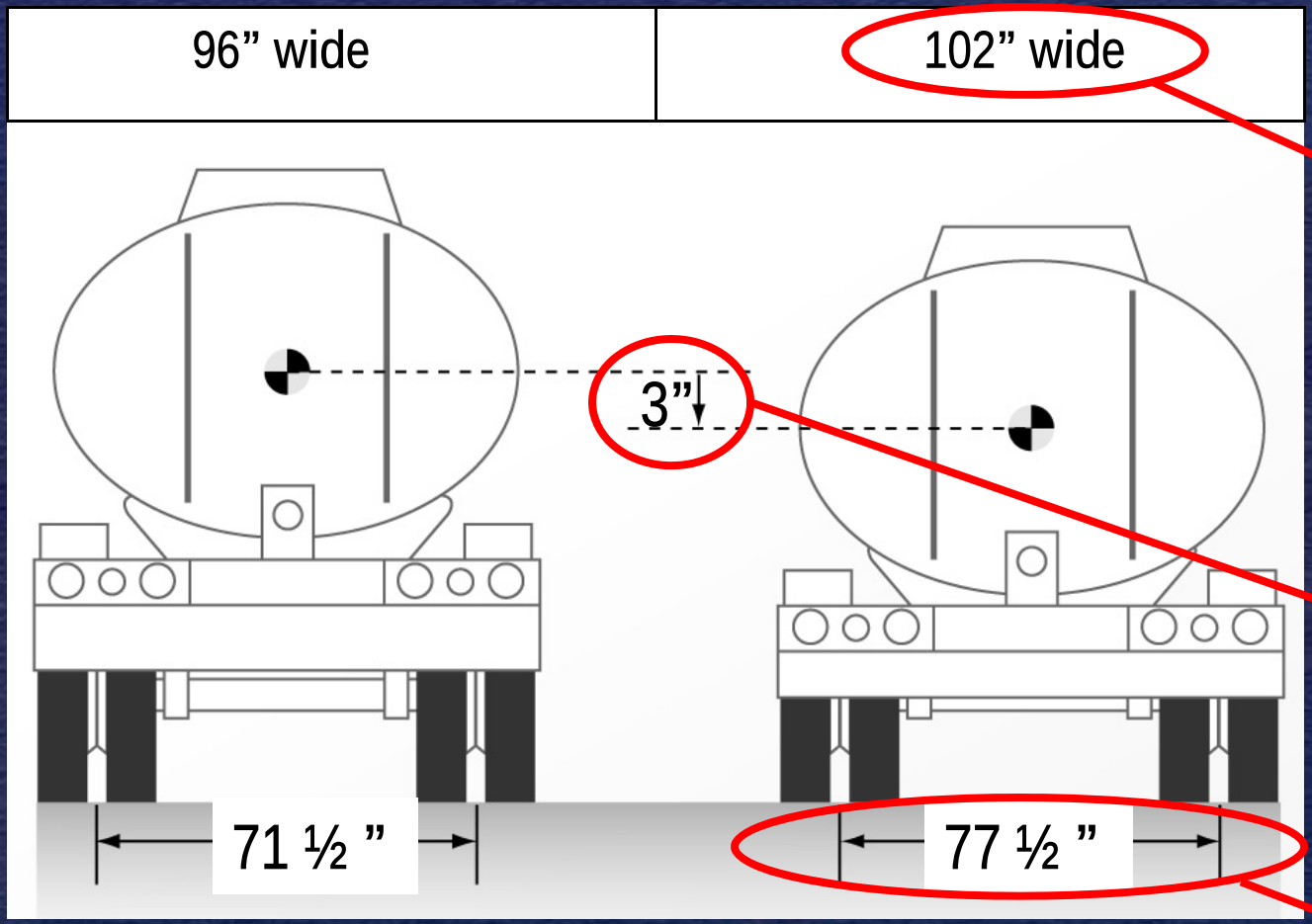
- Lowering CG
  - Fifth wheel height reduction
    - From 49 - 50 inches to 40 inches
  - Changing tank shape
    - Wider, elliptical, and drop-center

Double Taper Design



NTSB

Vehicle Design



Less than 30% in United States

More than 90% in Canada

12% accident reduction

17% accident reduction

NTSB

Summary

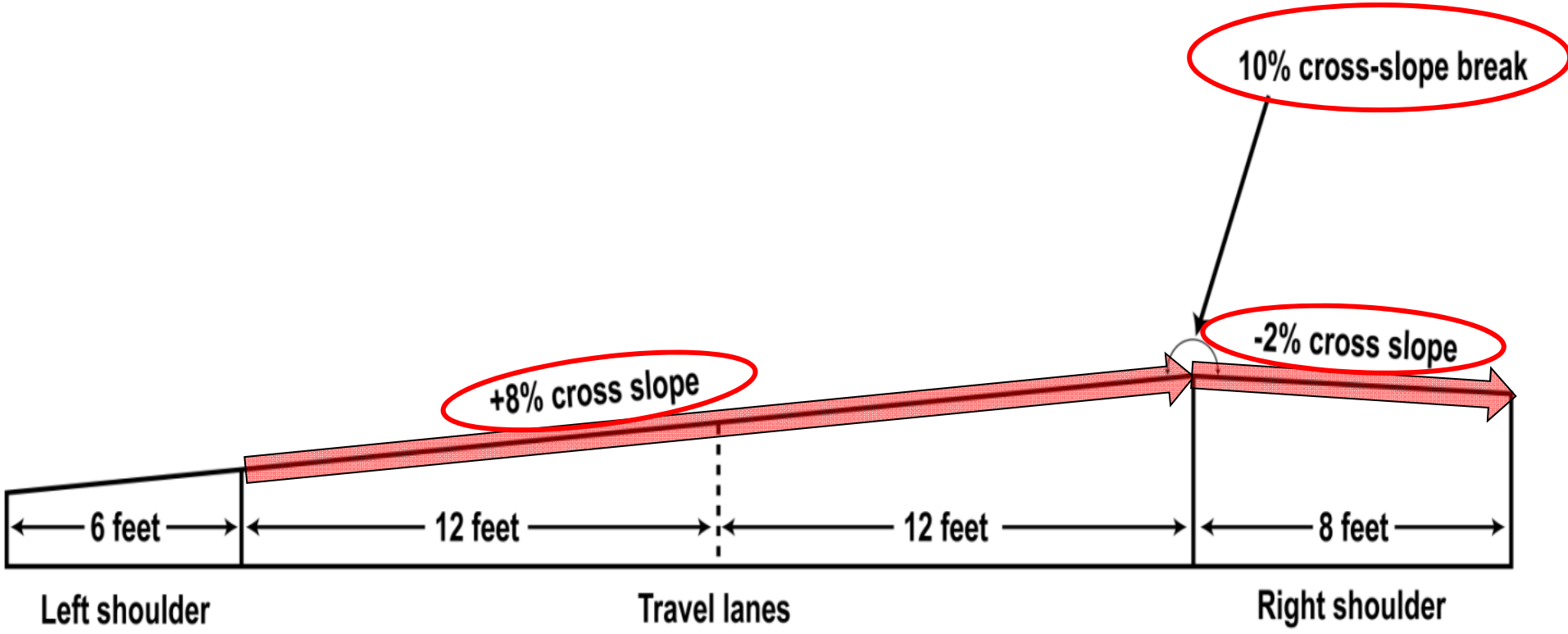
- Performance-based standards
  - Design rollover resistant characteristics
  - Direct attention to vehicle design

NTSB

NTSB National Transportation Safety Board

Office of Highway Safety

Highway Factors

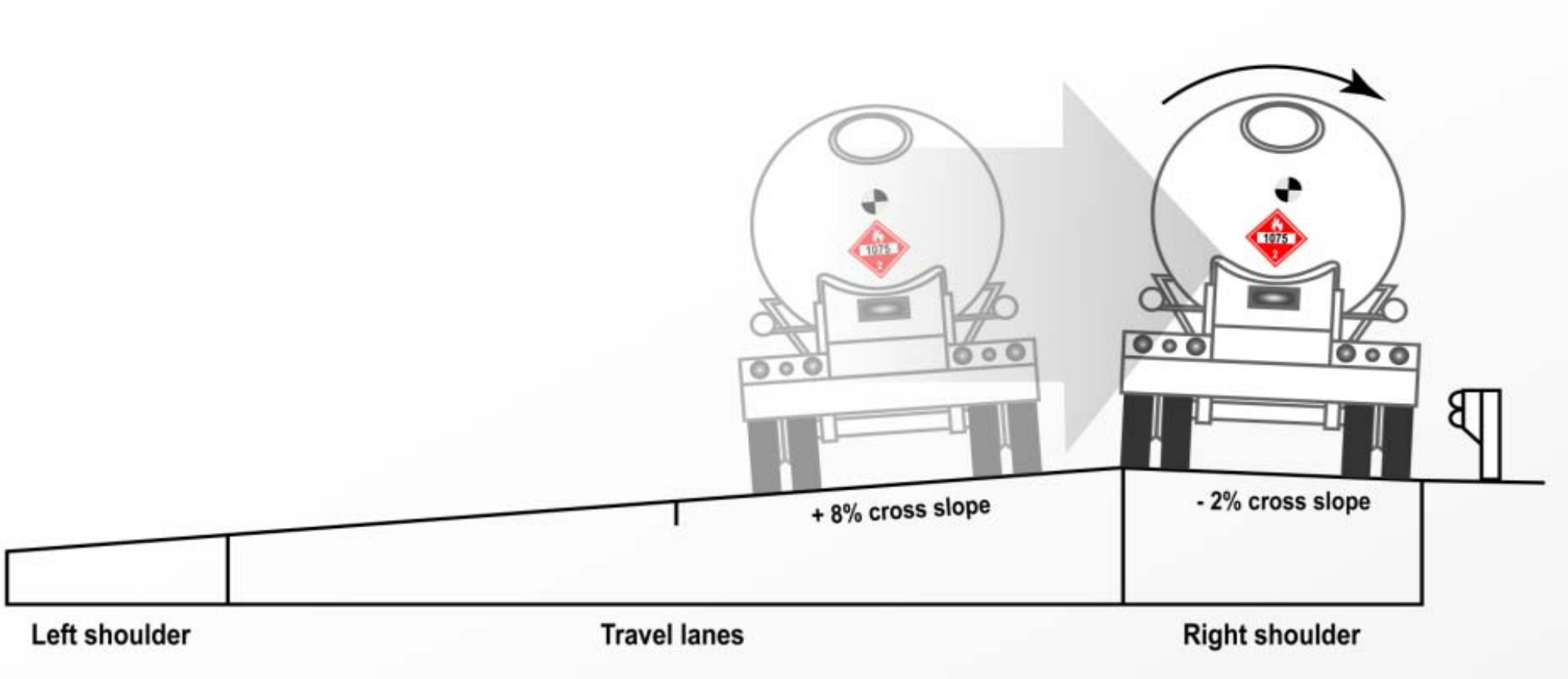

10% cross-slope break
-2% cross slope
+8% cross slope
6 feet
12 feet
12 feet
8 feet
Left shoulder
Travel lanes
Right shoulder

Cross-Slope Break

- AASHTO standards
  - 7 percent (1950s and 1960s)
  - 8 percent (current standard)

Cross-Slope Break Research

- Limited research conducted
- 1981 FHWA study
  - Simulation used a passenger car
  - Driver discomfort increased with shoulder slope
- No research found to address heavy trucks


1075
1075
+ 8% cross slope
- 2% cross slope
Left shoulder
Travel lanes
Right shoulder

Summary

- Best practices approach
- Knowledge gained at NTSB Public Hearing
- Options to assist state transportation agencies

NTSB

W-Beam Guardrail

- Primarily designed to redirect passenger cars and pickup trucks
- Overall height – 30 inches
- Bridge columns located within clear zone
  - 14 feet from the edge of traveled way
  - 6 feet from the guardrail

Risk Assessment

- Existing bridges
- Higher standard of bridge column protection
- Documentation limited
- New construction represents small percentage of overall number of bridges

Indianapolis Connection Ramp

- Level of protection had not changed in 40 years
- Upgrading existing roadside barriers generally not high on list of priorities
- If new bridge, 42-inch-high concrete barrier would be required

Before and After Condition

NTSB

NTSB Safety Recommendations

- H-94-5, Evergreen, AL, 1993
  - Closed–Acceptable Alternate Action
- H-95-32 & 33, White Plains, NY, 1994
  - H-95-32, Closed–Acceptable Alternate Action
  - H-95-33, Closed–Acceptable Action

Attributes of Risk Assessment

- Two specific attributes
  - Redundancy and continuity
- Prevented I-465 overpass from collapsing
- Prioritize bridges in terms of vulnerability to collapse and damage

Summary

- FHWA position in the past
- Target the most unsafe locations
- Focused and strategic
- Proactive instead of reactive

NTSB

NTSB National Transportation Safety Board

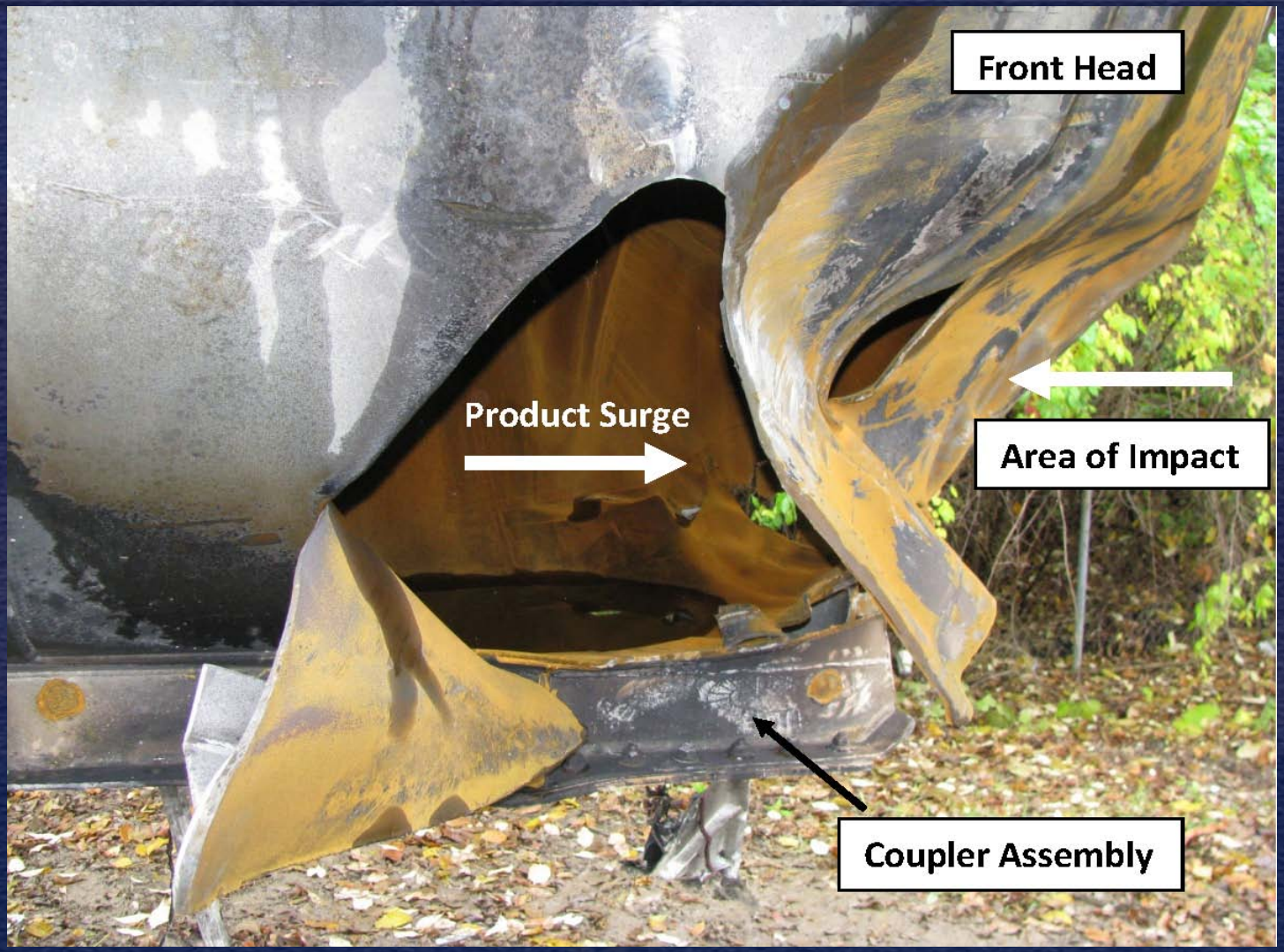
Office of Highway Safety

Hazardous Materials Factors

Hazardous Materials Release

NTSB

Cargo Tank Damage



NTSB

Structural Integrity Requirements

- Stress to the cargo tank must account for
  - Maximum working pressure, plus
  - Liquid surge force of twice the weight of a full load
- Varying degrees of relevance to different tank types
- Federal regulations do not address external impacts to tank surfaces

Summary

- Cargo tank accident performance standards needed
- Analyze accident data to identify susceptible cargo tank structures
- Modeling and testing
- Develop improved design criteria

NTSB

Trend Analyses

- Population of cargo tanks by DOT specification unknown
- Data must be normalized to conduct risk analyses
- DOT and industry studies based on uncertain cargo tank population estimates

Statistical Data

NTSB

Summary

- Absence of distribution data for DOT-specification cargo tanks
- Limited ability to perform accurate trend analyses
- Insufficient information collected from motor carriers

NTSB