Safety Benefits of Median Barrier and Roadside Guardrail
Outline

• Introduction
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  • Roadside Guardrail
• Implementation of Crash Testing Standards: *Manual for Assessing Safety Hardware (MASH)*
• Installation, Inspection, and Maintenance of Roadside Hardware
• Median Barrier Success Stories
• Roadside Guardrail Success Stories
• Summary
Introductions
America’s Roads is a Shared Responsibility

Road Safety Ecosystem

Federal Highway Administration
- Oversee federal funds for maintaining national highway system
- Review new products for reimbursement eligibility
- Issue eligibility letters
- Conduct in-service performance evaluations of roadside hardware

Elected Officials
- Appoint agency heads
- Set budgets and mandate priorities
- Pass laws related to transportation

State Departments of Transportation
- Design roadways
- Set standards and qualify products
- Select and award contractors
- Inspect and maintain roadside hardware
- Set speed limits

Vehicle Manufacturer
- Design vehicles to standard
- Test vehicles to standard
- Manufacture vehicles to standard

Device Manufacturer
- Design products to standard
- Test products to standard
- Manufacture products to standard
- Provide manuals and training resources

Motorist
- Drive safely and defensively
- Maintain vehicle
- Obey the laws

Contractor
- Bid approved products
- Train installation crews
- Install products

The Safety of America’s Roads is a Shared Responsibility.
Roadway Departure (RwD) Crashes

- Between 2014 and 2016, more than 18,700 lives were lost due to RwD crashes.
- FHWA recommends longitudinal barriers as countermeasures to reduce crash severity.
Longitudinal Barriers

- Longitudinal barriers are safety devices that can prevent vehicles from colliding with obstacles or running off the road

- Types of Barriers:
  
  A. Flexible/Cable
  B. Semi-rigid
  C. Rigid (c)
Cable Median Barrier

- High Tension Cable Barrier (HTCB) are in wide use across the country and are seen as more effective median barriers than low tension cable barriers
Roadside Barrier Guardrail

• Guardrails are the most common type of roadside barrier
• Two Key Components: (1) End terminal; and (2) Guardrail face
Crash Modification Factor (CMF)

- Multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site.

<table>
<thead>
<tr>
<th>Countermeasure</th>
<th>Crash Type</th>
<th>Crash Severity</th>
<th>CMF</th>
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</thead>
<tbody>
<tr>
<td>Roadside Guardrail</td>
<td>All</td>
<td>Fatal and Serious injury</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>ROR</td>
<td>Fatal and Serious injury</td>
<td>0.74</td>
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<tr>
<td></td>
<td>ROR (Dry weather)</td>
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<tr>
<td></td>
<td>ROR (Wet road)</td>
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<tr>
<td></td>
<td>ROR (Night-time)</td>
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Cable Median Barrier Safety Benefits

• Reduces cross-median fatal crashes by 66% and serious injury crashes by 81%

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<tr>
<td>Median Barrier</td>
<td>All</td>
<td>Serious injury</td>
<td>0.39</td>
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<td>All</td>
<td>Fatal</td>
<td>0.48</td>
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<tr>
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<td>Cross-Median</td>
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<td>Cross-Median</td>
<td>Fatal</td>
<td>0.34</td>
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<tr>
<td></td>
<td>Other</td>
<td>Serious injury</td>
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<td></td>
<td>Other</td>
<td>Fatal</td>
<td>0.45</td>
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(A Crash Modification Factor (CMF) reflects the safety effect of a countermeasure, whether it is a decrease in crashes (CMF below 1.0), increase in crashes (CMF over 1.0), or no change in crashes (CMF of 1.0).)

(Source: http://www.cmfclearinghouse.org/)
Roadside Barrier Safety Benefits

• Guardrails are effective in reducing fatal and serious injury crashes, ranging from 16%-47% in reducing such crashes

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(Source: http://www.cmfclearinghouse.org/)
Implementation of Crash Testing Standards

- Manual for Assessing Safety Hardware (MASH)
History of Device Testing

• History of Testing Procedures:
  – Highway Circular 482 (1962)
  – Manual for Assessing Safety Hardware (MASH (AASHTO 2009/2016))
Manual for Assessing Safety Hardware (MASH)

• MASH 2016 edition was published by American Association of State Highway and Transportation Officials (AASHTO)
  o Uniform guidelines for crash testing permanent and temporary highway safety features
  o Recommends evaluation criteria to assess test results
  o The size and weight of test vehicles are increased to reflect the increase in vehicle fleet size
    ➢ Vehicle types of 1100C (passenger car) and 2270P (pickup truck) replaced the 820C and 2000P test vehicles defined in NCHRP 350, respectively
  o An impact angle of 20 degrees is replaced by an angle of 25 degrees for 1100C (small car)
NCHRP Report 350 ➔ MASH Sunset Dates

- December 31, 2017: W-beam barrier and cast-in-place concrete barrier
- June 30, 2018: W-beam terminals
- December 31, 2018: Cable barrier, cable barrier terminals, and crash cushions
- December 31, 2019:
  - Bridge rails, transitions, all other longitudinal barriers (including portable barriers installed permanently), all other terminals, sign supports, and all other breakaway hardware
  - Temporary work zone devices
New Tests

- The ability of a cable barrier to:
  1. Contain and redirect light trucks and SUV’s as well as prevent barrier override
  2. Safely contain and redirect small passenger vehicles without resulting in excessive vehicular instabilities and/or rollover
  3. Safely contain and redirect small passenger vehicles as well as prevent barrier underride, component penetration into the occupant compartment, and excessive deformations of the A-pillar, roof, or windshield
  4. Safely contain and redirect small passenger after traveling across the center of a ditch and up the back slope
  5. Contain and redirect mid-size passenger sedans by preventing vehicle penetration through vertically adjacent cables
  6. Safely contain and redirect light trucks and SUV’s after traveling across the center of a ditch and up the back slope
Installation, Inspection, and Maintenance of Roadside Barriers

• Installation
  o Involves significant amount of time, effort, and expertise
  o Personnel trained specifically for this process is necessary

• Inspection
  o Height of barrier
  o Distance barrier to edge
  o Proper alignment
  o Tension in cables

• Maintenance
  o Three priority levels provided by NCHRP Report 656
Steps of Installation

a – Post Driving

b – Guardrail mounting
Steps of Inspection

• On site inspection of safety barriers is required

• Prior to the visit, information on traffic conditions, roadside features, work history and utility locations at the barrier site are all gathered

• At the site, the inspectors perform checks to ensure that,
  o The height of the barrier is compliant with the original plan
  o The distance from barrier to the edge of roadway is compliant with the plans
  o The terminal installations or transition sections are properly aligned, at specified height, have the required tension in cables etc.

• Trained professionals are needed to perform inspections on safety barriers
## Three Priority Levels for Maintenance

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<thead>
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<th>Priority Level</th>
<th>Description</th>
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<td>High</td>
<td>A second impact results in an unacceptable safety performance, including barrier penetration and/or vehicle rollover.</td>
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<tr>
<td>Medium</td>
<td>A second impact results in a degraded but not unacceptable safety performance.</td>
</tr>
<tr>
<td>Low</td>
<td>A second impact results in no discernable difference in performance from an undamaged barrier.</td>
</tr>
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Source: NCHRP Report 656
Median Barrier Success Stories

• Major Highway Disaster Averted by Median Cable

• Motorist Loses Control on Icy Road, Saved by Cable Median Barrier

• Cable Median Barrier Saves Mother of Three

• Cable Median Barrier Saves Family from Deadly Head-on Collision
Major Highway Disaster Averted by Median Cable

- Semi-truck driver suffered cardiac arrest
- Semi-truck slowed down and began to run adrift on the highway
- Semi-truck hit the cable median barrier stopping the vehicle from going into opposing traffic
- Not a single vehicle was hit by the semi-truck
Motorist Loses Control on Icy Road, Saved by Cable Median Barrier

• Driver was travelling on an icy road at speed limit
• The car hit a nasty patch of ice and the driver lost control
• The car was headed for opposing traffic, when the median steel cable barrier snagged the vehicle and cushioned the blow
• The car was brought to a complete stop
• The driver left the scene with no injuries
Cable Median Barrier Saves Mother of Three

- Driver travelling in the left most lane on a three lane segment on I-94
- Approached a section where one of the three lanes dropped and vehicles from an on-ramp are entering highway
- A coach bus was entering the highway and merged over onto the driver
- The driver lost control and was projected into the highway median, luckily caught by the median barrier
- After spinning around and scraped along the length of median barrier, the car came to a complete stop
- The median barrier saved a mother of three that day
Cable Median Barrier Saves Family from Deadly Head-on Collision

- The driver and family were traveling westbound on I-26 in the left lane one night
- All of a sudden, a SUV moving eastbound was coming straight for them
- The driver had no where to go because of the surrounding cars
- The SUV hit the median, and safely bounced back into its lane
- The cable barrier stopped the SUV from crossing over the median and into oncoming lanes of traffic
- The cable median barrier saved the driver and family that night
Roadside Guardrail Success Stories

➢ Swerving Vehicle Hits Guardrail, Driver Sustains Zero Injuries

➢ Drowsy Truck Driver Saved by Guardrail

➢ Guardrail Stops Errant Vehicle from Falling into a Ditch
Swerving Vehicle Hits Guardrail, Driver Sustains Zero Injuries

- Driver headed home on I-90, feeling tired and started to nod off
- The driver was stopping to get some coffee and as he was approaching the exit, he dozed off
- The driver woke up to his car hitting the guardrail
- The guardrail took most of the momentum from impact and deflected the vehicle away
- The driver left the scene uninjured even though his car was totaled
Drowsy Truck Driver Saved by Guardrail

- A tractor trailer was traveling southbound on I-85
- The truck was carrying a full load with a cargo of frozen foods
- The driver was fatigued and dozed off, having no control of the truck
- The truck swerved to the right and headed towards a bridge at 75 mph
- Instead of reaching the bridge, the guardrail shielded the truck from the bridge
- If the guardrail was not there, the bridge could have had structural damage and the driver could have been hurt worse
Guardrail Stops Errant Vehicle from Falling into a Ditch

- Driver was headed westbound on Highway 54 with a passenger in the car
- The driver was drowsy and as they were taking the exit, a few hundred feet along the ramp, he fell asleep
- The vehicle veered to the left hitting the guardrail that was protecting vehicles from falling into the ditch
- The collision with the guardrail caused the truck to run up on top of the guardrail and continue for a few yards until completely stopping
- The guardrail prevented the vehicle from approaching the ditch and causing possible loss of life
Hydroplaning Causes Vehicle to Swerve, Guardrail Prevents Deadly Collision

• Ms. Bianca Harris and her brother were headed northbound on Interstate-95 near Fredericksburg, VA.
• Due to sporadic rainfall on that day, the road surface was slick and prone to hydroplaning.
• As Ms. Harris was taking the exit towards her home, she lost the control of her car and swerved off the road.
• Ms. Harris noticed a guardrail to her left and steered her car towards the barrier, after taking her foot off the gas pedal.
• The vehicle ended up hitting the guardrail instead of trees on the roadside.
• Ultimately, the lives of the brother-sister duo were saved by a guardrail even in adverse weather conditions.
Summary

• Guardrails and cable barriers are effective safety countermeasures for reducing RwD crashes
• The new MASH test standards will continue to improve roadside barriers’ life-saving quality
• Trained personnel are essential for properly installing, inspecting, and maintaining these roadside devices
• Numerous life-saving stories by the roadside guardrails and cable median barriers