

# Cable Barrier Layout and Design



# Cable Barrier Systems

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# Cable Barrier Systems

## COURSE OUTLINE

1. An Introduction to Cable Barriers
2. History , Background, and Future Direction of Cable Barrier Systems (NCHRP Project 22-25)
3. Layout and Design of Cable Barrier Systems

# Cable Barrier – Introduction

**Cable Barrier Systems**

**Are**

**Longitudinal Roadside Safety Devices**

**Used to**

**Contain and/or Redirect Errant Vehicles**

# Cable Barrier – Properties



**Can an Errant Vehicle Recover from a Run-Off-the-Road Accident at this Location?**

**Let's Explore the Possibility!**



**Crash Test: Cable Barrier Shields a Drop-Off Hazard**

# Cable Barrier – History

**Cable Barrier Systems  
Have Been Used on America's  
Highways and Byways  
For More Than  
65 Years!**

# Cable Barrier – Crash Tests



# Cable Barrier – Background

## A Typical Low Tension Cable Barrier System



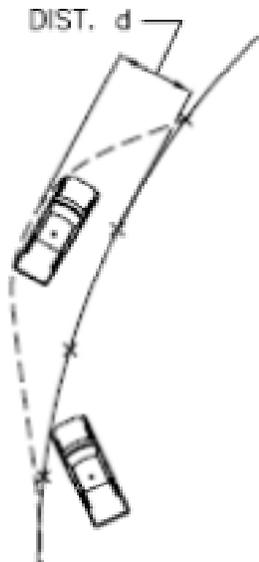
# Cable Barrier – Background

**Prior to 2000,  
All Cable Barrier Systems  
In the United States were  
Low Tension, Non-Proprietary Systems**

# Cable Barrier – FDOT

Florida Department of Transportation  
Uses

High Tension “Weak-Post” Pre-Stretched  
Cable Barrier Systems



# Cable Barrier – Current Status

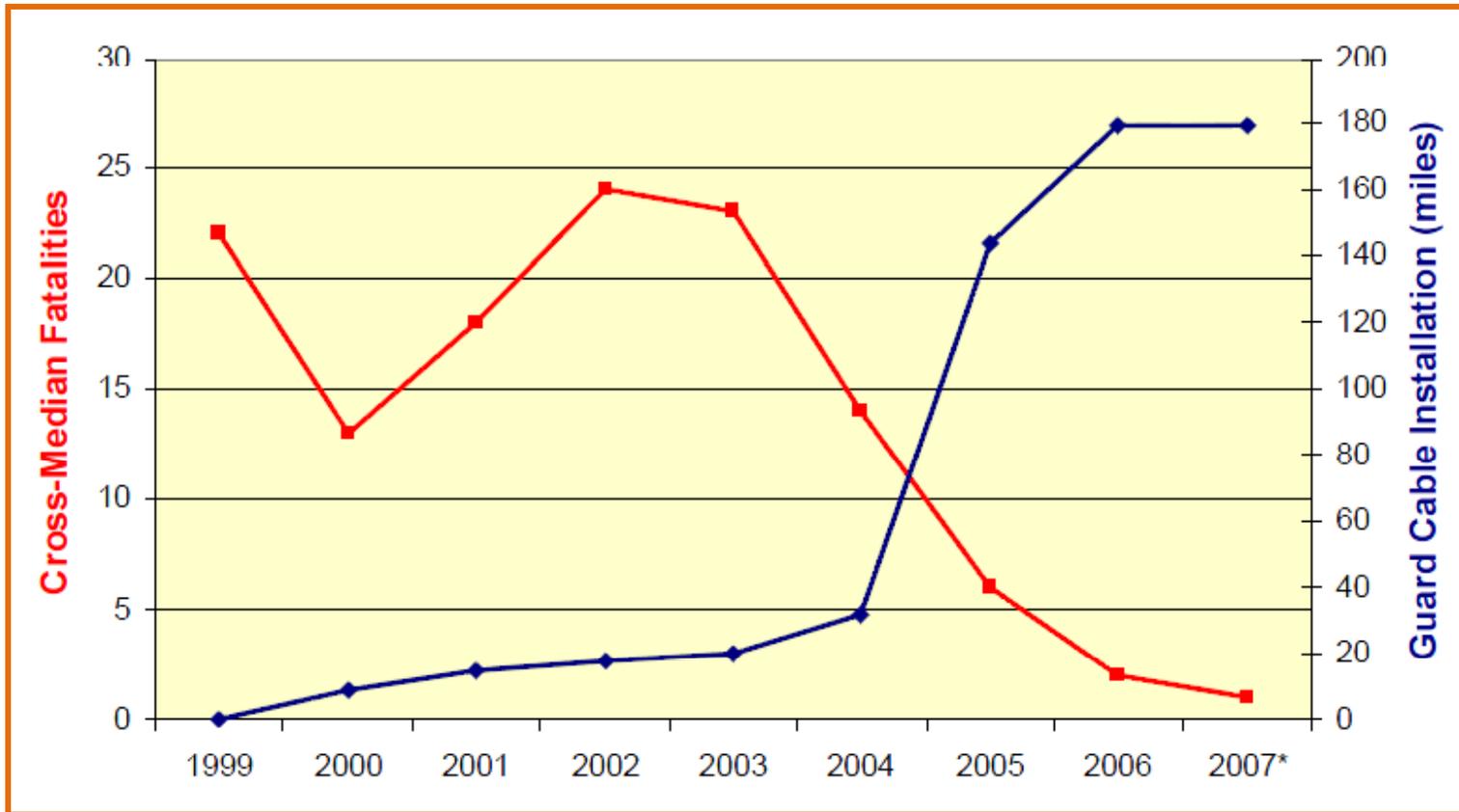
## NCHRP Project 22-25:

- Nation-Wide, High Tension Cable Barrier Use is on the Rise

All Manufacturers	April 2006	April 2008
Total Miles Installed	1,048	2,675

*From 2006 to 2008  
High Tension Cable Barrier Installations  
Increased by 155% Nationally*

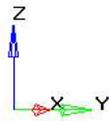
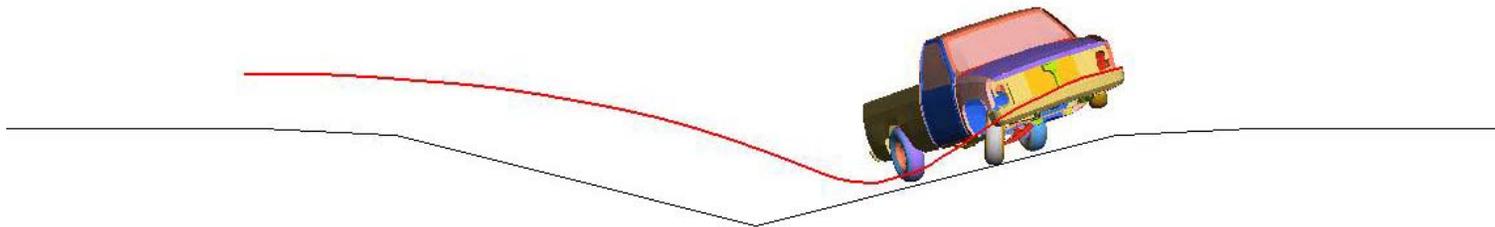
# NCHRP Project 22-25 – Statistics



Graph Depicts the Relationship between Cable Barrier Installations and the Reduction in Fatal Cross Median Crashes for I-70 in Missouri.

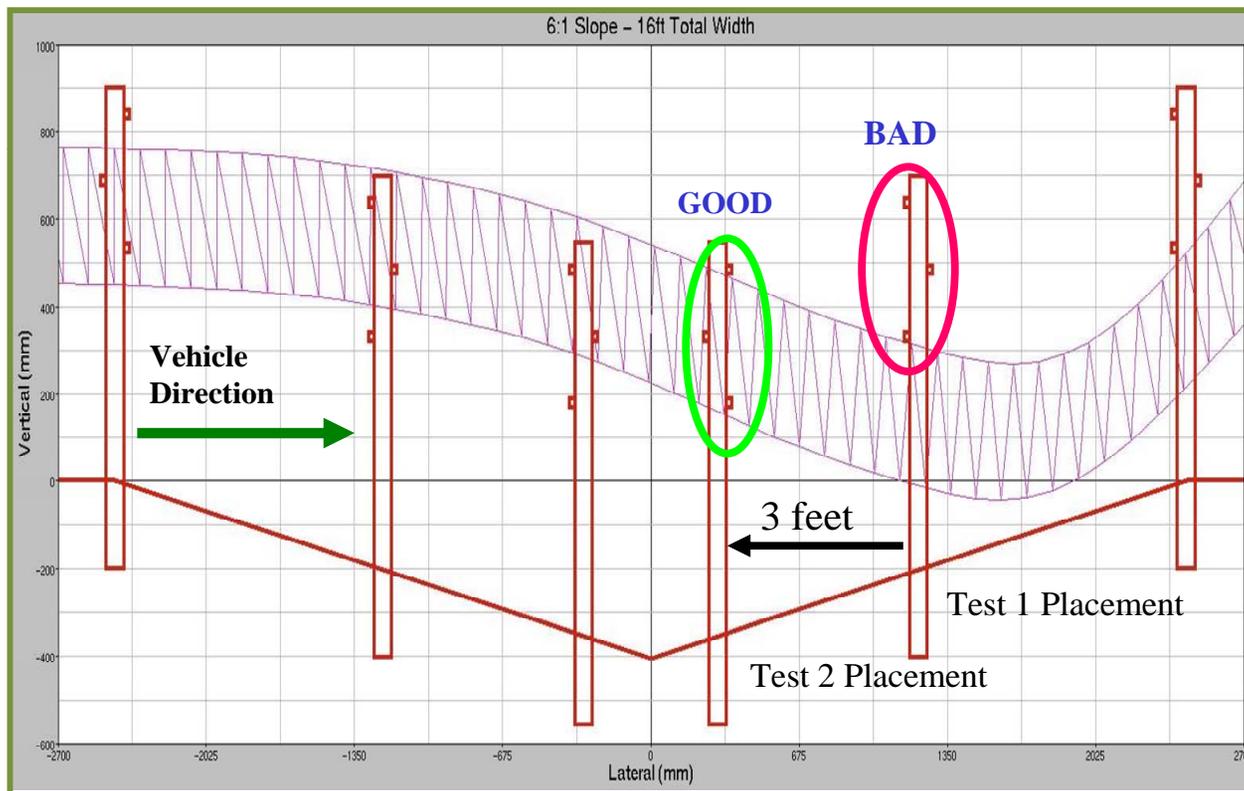
# Cable Barrier – Exclusion Zones

## Determining Exclusion Zones For Lateral Cable Barrier Placement



# Cable Barrier – Exclusion Zones

## Exclusion Zone for a 16' Median on a 6:1 Cross Slope



# Vehicle Dynamics Analysis

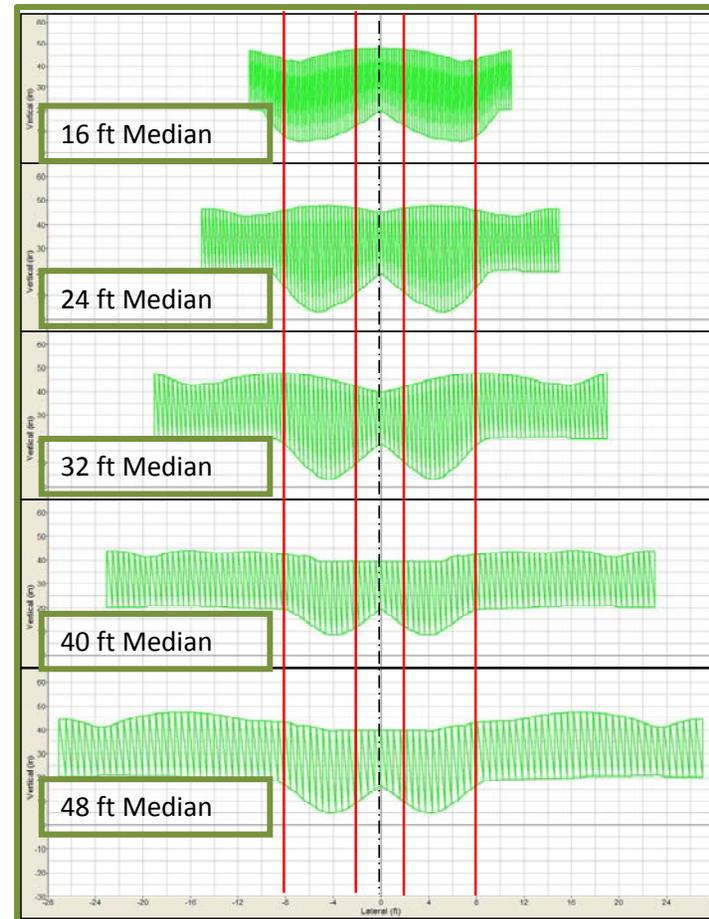
V-Shaped

6:1 Medians →

Exclude Barrier

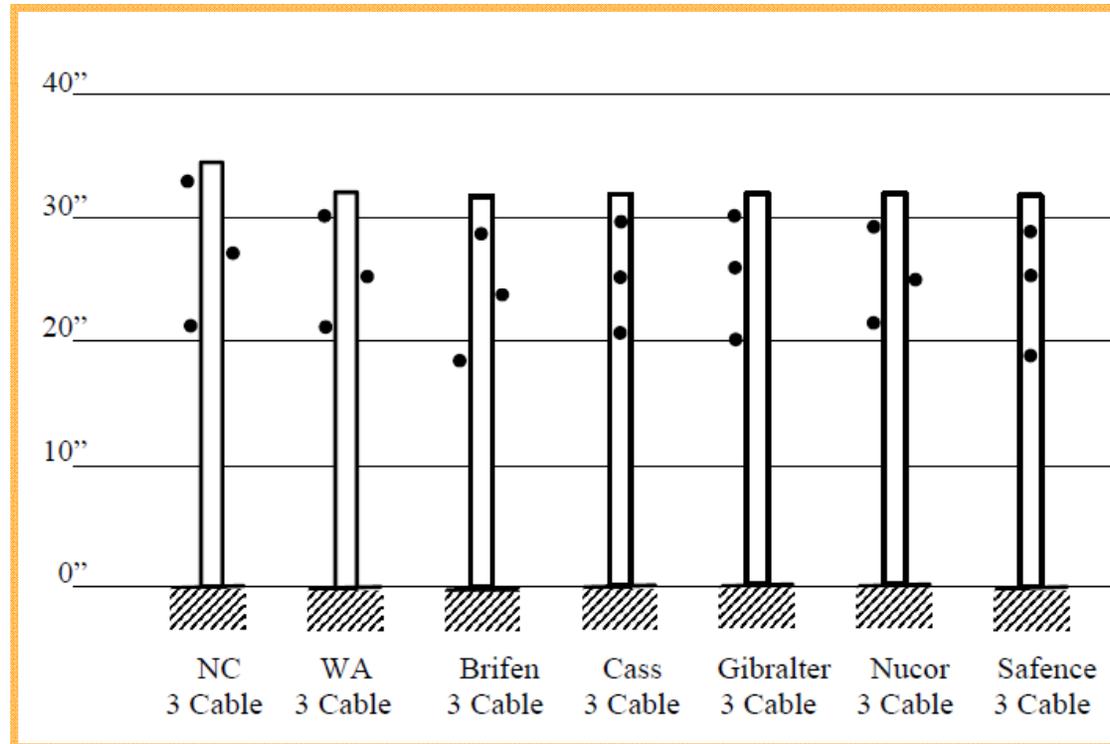
Placement 8'

On Either Side



# Cable Barrier – Heights

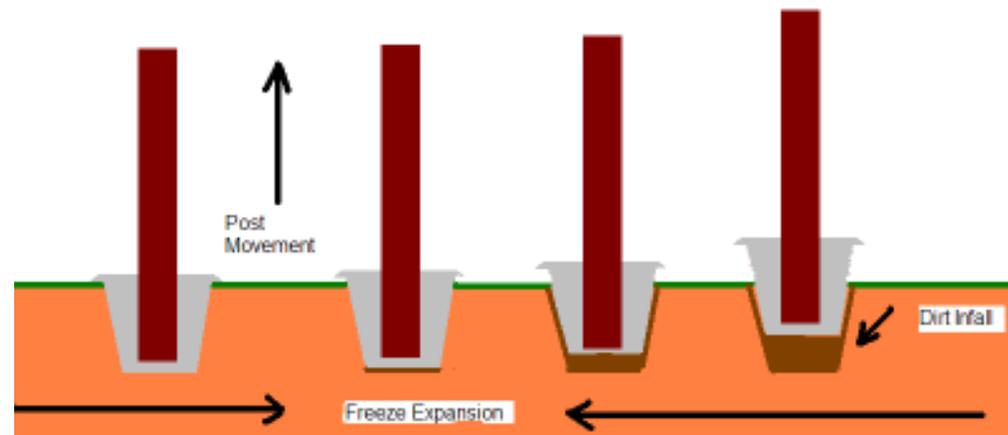
Average Height of “3 Wire Rope” for TL-3 Cable Barrier Systems:  
Top = 30” Plus 1” Tolerance & Bottom = 20” Minus 1” Tolerance



# Lateral Dynamic Deflection

**Lateral Dynamic Deflection of 3 Wire Rope Depends on:**

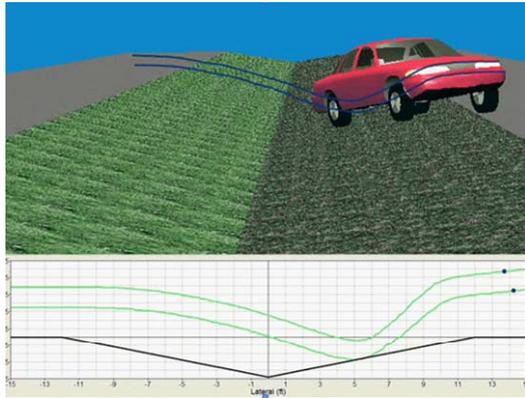
- End Anchor Spacing (Length of Run),
- Post to Post Spacing,
- Cable Tensioning.



# Cable Barrier – Lateral Placement

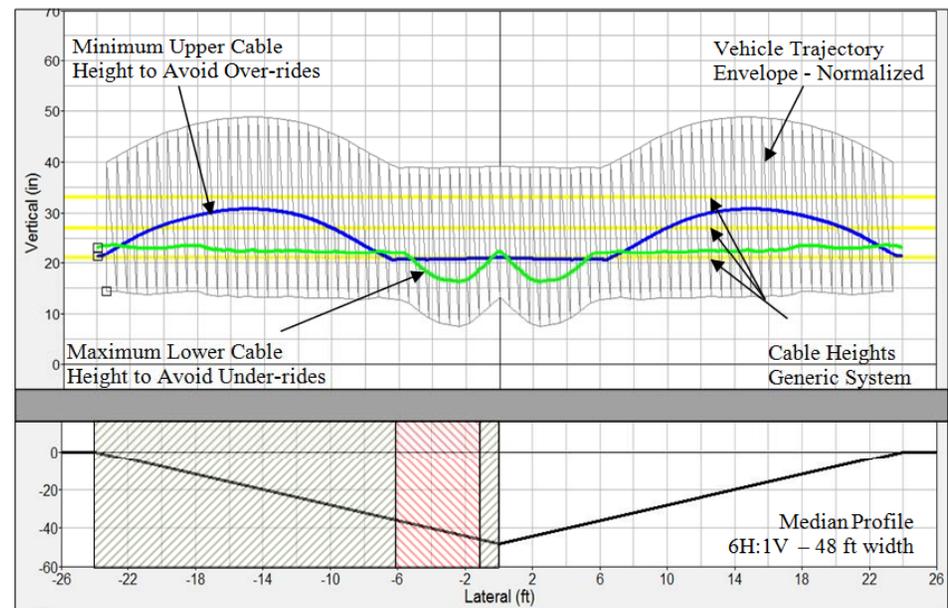
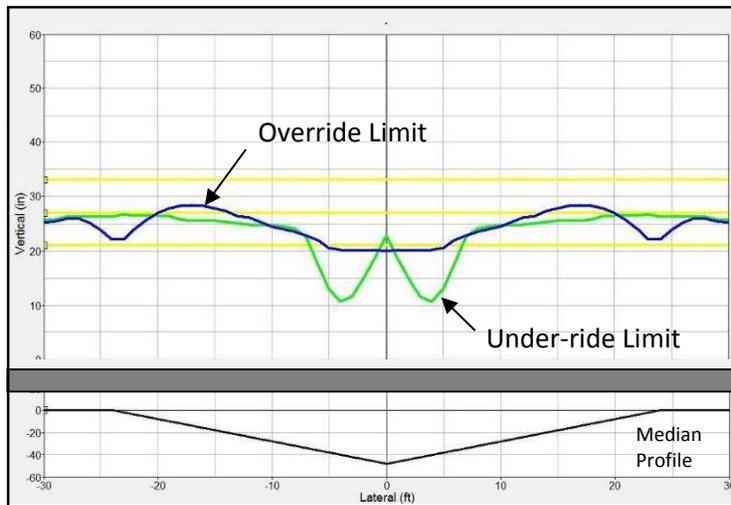
Computer Crash Simulations Calibrated with

Crash Test Results:



# Cable Barrier – Critical Interface

## Sample Over-Ride and Under-Ride Limit Plots

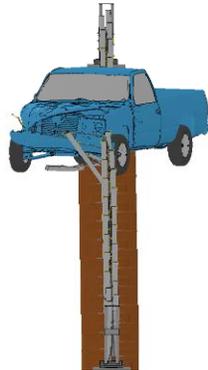
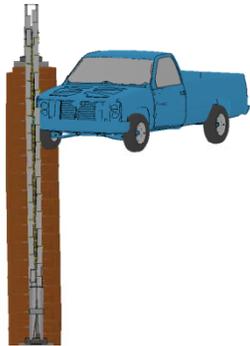


**Yellow = 3 Wire Rope**  
**Red = Bad Placement**  
**(Exclusion Zone)**

-  Lateral placement where barrier is likely to capture vehicles
-  Lateral placement where barrier may miss some cases

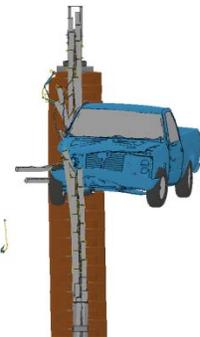
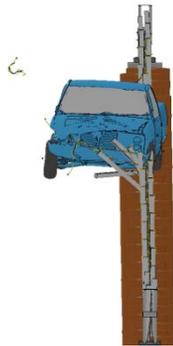
# Cable Barrier – Sequential Plots

Compare Crash Simulation Sequential Plots to Crash Test Video



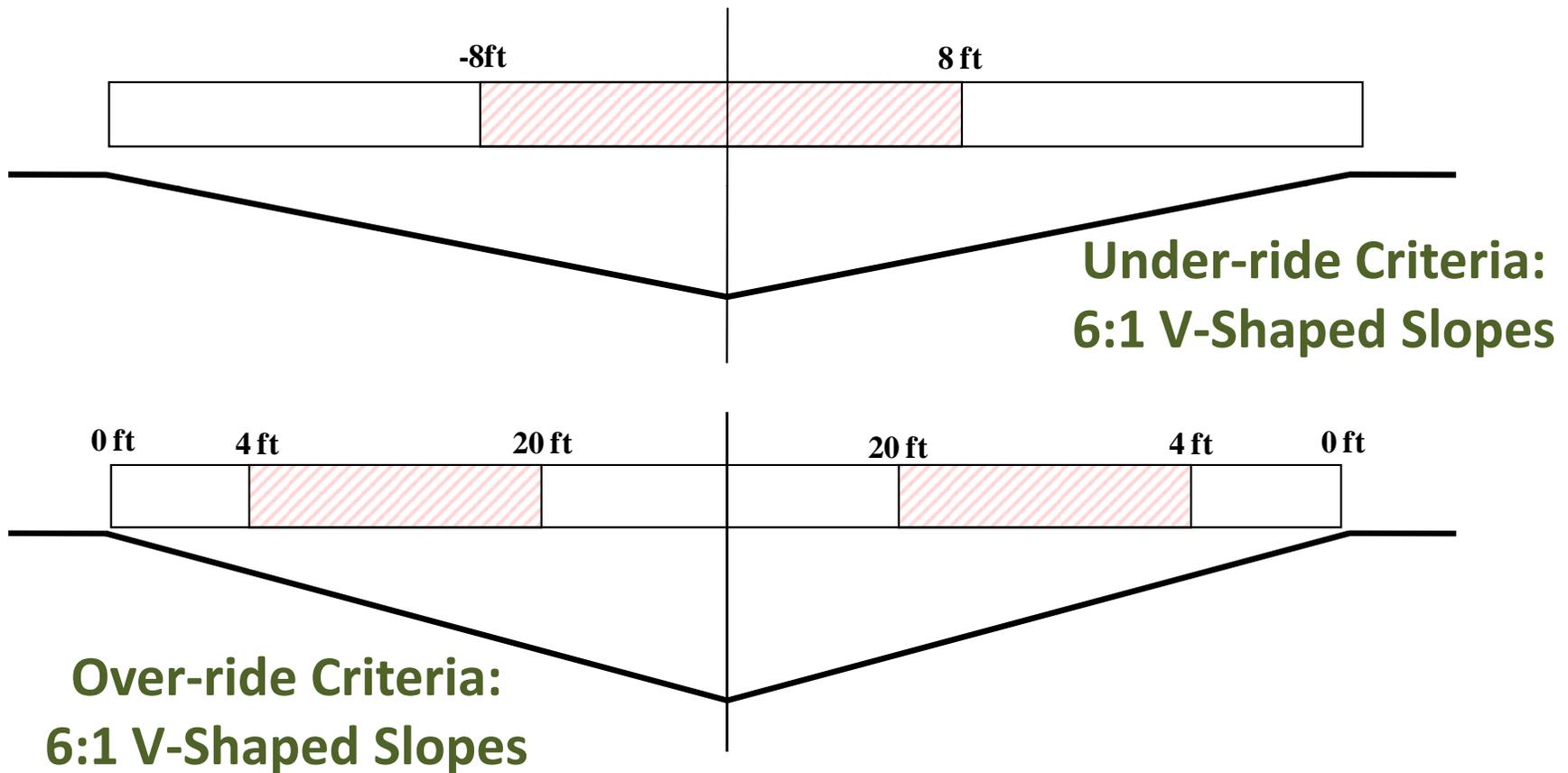
# Cable Barrier – Sequential Plots

Compare Crash Simulation Sequential Plots to Crash Test Video



# Cable Barrier – Research Findings

Based on Vehicle Dynamics Analysis (VDA):



# Cable Barrier – Layout & Design



## Layout and Design:

1. High Tension Cable Barrier Systems
2. Implementation Guidance
3. Anticipated Design Standards



# Cable Barrier – Layout & Design

## 1. High Tension Cable Barrier Systems

- Design Coordination Process
- Guide Line Issues
- Plans Production



# Design Coordination Process

## Coordination Steps to Process Cable Barrier Designs:

1. Cable Barrier Maintenance Program Must be in Place
2. Contact District Specifications Office and Obtain
  - **Developmental Specification, SECTION 540, HIGH TENSION CABLE BARRIER SYSTEM**
3. Contact the State Roadway Design Engineer, to Evaluate Your Conceptual Design and to Obtain Project Approval
  - **David C. O'Hagan, P.E.**
  - **(850) 414-4283**

# Design Coordination Process

Design Standard Drawings are **Not** Available, but

Developmental Specification (**Dev 540**), and

Design Bulletin **RDB 07-08**

have been produced to coordinate the design

process.



# Design Coordination Process

## Developmental Specification 540

Office Level Navigation  
[Home](#)  
(Scroll down for full list.)

- [Implemented Specifications](#)
  - [2010 Standard Specifications](#)
  - [Implemented Modifications](#)
    - [January 2011 Workbook](#)
      - [Mandatory - January](#)
    - [July 2010 Workbook](#)
      - [Mandatory - July](#)
  - [Design/Build Division 1](#)
  - [Web Links in the Specs](#)
  - [Spec Book Archives](#)
    - [2010 Spec Book](#)
    - [2007 Spec Book](#)
    - [2004 Spec Book](#)
    - [2000 Spec Book](#)
  - [Other Specifications](#)
    - [Local Agency Specs](#)
    - [Developmental Specs](#)
    - [Push Button Specs](#)
- [Specification Development](#)
  - [Industry Review](#)
  - [Track Proposed Revisions](#)



Click here to go to the Specs

Then Click here to go to the Dev Specs

- Scroll Down to Dev540.pdf
- Obtain Design Bulletin Instructions from the Design Standards Website



**Design Bulletins and Update Memos**  
Archives - 1998 to 2010

# Design Coordination Process

For details or questions, please call (850) 414-4318. The files listed below are in Adobe Acrobat Portable Document Format (PDF). You must have the free [Adobe Acrobat Reader](#) to view and/or print these files.

[Lump Sum Project Guidelines](#) - (Scroll down to the bottom of the page)

### Manual Abbreviations

BE = Basis of Estimate P1 = Plans Preparation (Volume 1) P2 = Plans Preparation (Volume 2)  
DM = Drainage Manual DB = Design Bulletins MM = Misc. Memos DS = Roadway & Traffic Design Standards  
Naming Convention - Manual, Year, Month, Day

File Name	Description	File Date
<a href="#">RDB10-11.pdf</a>	Roadway Design Bulletin 10-11 Electronic Display Signs	10/11/10
<a href="#">RDB09-10.pdf</a>	Roadway Design Bulletin 09-10 Use of Flare Burn Lights on Temporary Traffic Control Devices	10/11/10
<a href="#">RDB07-09.pdf</a>	Roadway Design Bulletin 07-09 Pipe Culverts - Pay Item, Plans and Specification Changes - Effective with the July 2008 Letting	12/18/07
<a href="#">RDB07-08.pdf</a>	Roadway Design Bulletin 07-08 High Tension Cable Barriers	10/25/07
<a href="#">RDB07-07.pdf</a>	Roadway Design Bulletin 07-07/Estimates Bulletin 07-02 Object Markers and Delineators	8/27/07
<a href="#">RDB07-06.pdf</a>	Roadway Design Bulletin 07-06/Structures Design Bulletin 07-07 2007 Design Standards - Implementation	7/25/07

<http://www.dot.state.fl.us/rddesign/updates/files/updatearchives.shtm>



# GUIDELINE ISSUES

- **FHWA Approved Proprietary High Tension Cable Barriers**

- **Cable Barrier Systems, include:**

- 3 cable systems = TL-3
- 4 cable systems = TL-3 or TL-4



- **Deflection Distances Depend on Post Spacing and Product**

- Tables can be obtained from specific product manufacturers

- **Federal Oversight Projects Require FHWA Approval**

# FHWA Approved Proprietary High Tension Cable Barriers



**CASS**



**Gibraltar**



**Marion**

# FHWA Approved Proprietary High Tension Cable Barriers



**Safence**



**Brifen**

# Cable Barrier Systems



➤ Test Level 3 (TL-3)

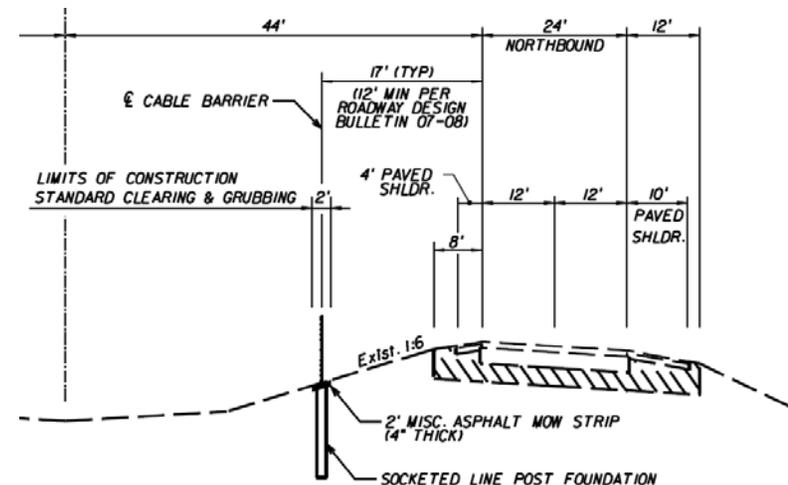


➤ Test Level 4 (TL-4)

# Plans Production

## Plans Production:

- Plans Preparation Criteria
- Plan Set Components
- Design Documentation



# Plans Preparation Criteria

## Placement:

- **Min. 12' Offset from Edge of Travel Way**
- **10:1 Slopes are Preferred**
- **Can be placed on shoulders or on slopes  
“up to” 6:1**
- **Slopes Steeper Than 6:1 Require State  
Roadway Design Engineer Approval**



# Plans Preparation Criteria

- Median Placement, cable barrier Shall ***NOT*** be in the region 8' either side of the center 'V'
- Minimum System Length is 1000'
- Approach and Trailing End Terminals should be designed in the same manner as guardrail

– See Index 400



# Plan Set Components

- **Provide Typical Sections for Cable Installations**
- **Locate Cable Barrier Systems on Plan Sheets**
  - Label Begin and End Stations with Offset
  - Include any Necessary Alignment Data for Construction (such as Offsets, PC's, PT's, PI's, Alignment Transitions, Radii, etc.)
- **Generate Special Details Sheets**
- **Tabulate Quantities**



# Plan Set Components

- Summarize Cable Barrier Quantities on the Summary of Quantities Sheet by Station and Location
- Tabulate all Segment Lengths and Show the Total Plan Quantity of Cable Barrier Required for the Project (to include End Terminals)



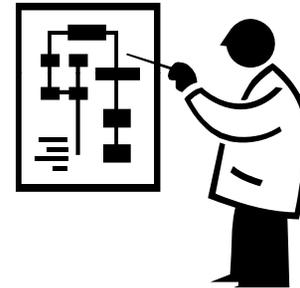
# Summary of High Tension Cable Barrier Systems

<i>SUMMARY OF HIGH TENSION CABLE BARRIER SYSTEM</i>								
<i>LOCATION</i>		<i>CABLE BARRIER (LF)</i>				<i>REMARKS</i>	<i>FIELD BOOK REFERENCE</i>	
<i>STATION</i>	<i>SIDE</i>	<i>ROADWAY</i>		<i>END TERMINAL (EA)</i>				<i>CONCRETE APRON (SY)</i>
		<i>P</i>	<i>F</i>	<i>P</i>	<i>F</i>			
<i>FROM</i>								
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# Design Documentation

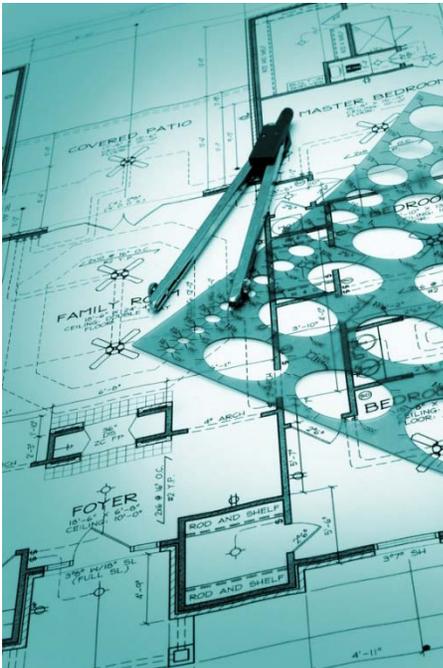
## Document Critical Design Issues:

- **Typical Section Packages**
- **Summary of Quantities**
- **Engineers Construction Cost Estimate**



# Cable Barrier – Layout & Design

## ➤ Implementation Guidance:



- Developmental Specification, Section 540
- Valid Pay Item Use
- Deliverable Requirements



# Implementation Guidance

## Developmental Specification, Section 540



- Description
- Materials
- Train Installation Work Crew  
On-Site Supervisor
- Construction Requirements
- Method of Measurement
- Basis of Payment

# Implementation Guidance



## Valid Pay Item Use:

- 904-540-2**     **Socketed Post System, LF**
- 904-540-4**     **End Terminal, EA**
- 904-540-5**     **Reset Existing System, LF**
- 904-540-6**     **Reset Existing End Terminal, EA**
- 904-540-10**    **Relocate, LF**

# Implementation Guidance

## Deliverable Requirements:

- Follow Developmental Specification 540
- Ensure Proper Pay Item Use
- Require a Soils Specific Design for End Terminals
- Request Shop Drawings for Product Specific Installations
- Request Approvals for Federal Oversight Projects from FHWA and add to Statewide Work Plan
- Provide Final Plans to Central Office, Roadway Design



# Cable Barrier - Layout & Design

## ➤ Anticipated Design Standards

- Cable Barrier Critical Issues
- Implementation of Research Findings
- In-service Performance Evaluations
- Proposed Design Criteria and Design Standards



# Anticipated Design Standards

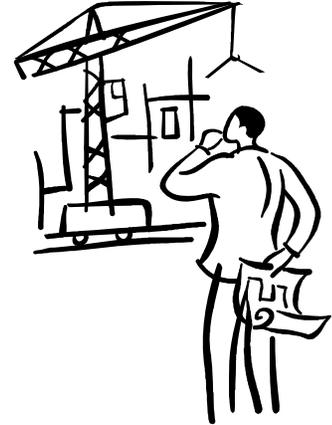
## ➤ Cable Barrier Critical Issues:

- Cable Barrier Lateral Placement
- Cable Barrier Deflection Criteria
- End Terminal and Post Anchoring Systems
- Interconnection with Other Barrier Systems

# Cable Barrier Critical Issues

## ➤ Cable Barrier Critical Issues (Continued):

- Construction Tolerances;
  - Top Height Requirements ( + 1")
  - Bottom Height Requirements ( - 1")
- Horizontal Curve Placement Guidance
- Installation vs. Maintenance Costs



# Implementation of Research Findings

- **MASH Cable Barrier Test Requirements**

- “Assessment of Vehicle Dynamics on Sloped Medians  
for New MASH Cable Barrier Test Criteria”



- **NCHRP Project 22 – 25**

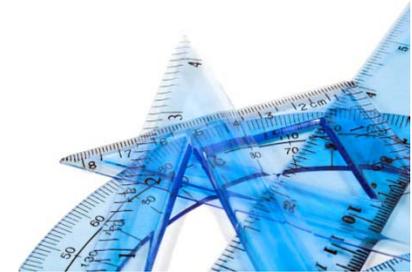
- “Development of Guidance for the Selection, Use, and Maintenance of  
Cable Barrier Systems”

- **FDOT Research Contract No. BDK 80 977-19**

- “In-Service Performance Evaluation of Median Cable Barrier in Florida”

# In-service Performance Evaluations

- **Evaluate and Monitor In-service Performance**
  - “In-Service Performance Evaluation of Median Cable Barrier in Florida”
- **Based on Installation Costs (Cost/Mile)**
- **Based on Maintenance Costs (Average Cost/Repair)**



# Proposed Design Criteria

- Derive Permanent Specifications –
- Compile Foundation Design Parameters (Soils) –
- Establish Permanent Pay Items –
- Plans Preparation Manual Update –
  - Update Chapter 4, PPM Vol. I
- Establish Guidelines for Cable Barrier Design
- Update Exhibits with Examples of Cable Barrier Systems



# Proposed Design Standards

- Develop Proposed Standard Indexes
- Draft Generic High Tension Cable System Drawings
- Organize Drawings within the Index 400 Series (Guardrail)
- Reference Specifications, Estimates, and Design Guidelines (AASHTO, MASH, RDG, HSM, etc.)
- Update Roadside Barrier Training - Based on New Criteria and Standards



# Design Standards Team

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# Only You Can Prevent Cross Median Crashes

