U.S. Department of Transportation
Federal Highway Administration

SafetyEDGE
Your Angle for Reducing Roadway Departure Crashes


# *SAFETY EDGE*

## Module 2: Equipment and Construction of Safety Edge

Level of Audience: Engineers, Project Managers and Municipal Authorities

Instructor: Eng. Freddie Salado

Duration: 1 Hour

# Acronyms

| | |
|---|---|
| AAA | American Automobile Association |
| AASHTO | American Association of State Highways and Transportation Officials |
| DTOP | Department of Transportation and Public Works |
| DUI | Driving Under Influence |
| EDC | Every Day Counts |
| EIS | Environmental Impact Statements |
| FAQ's | Frequently Asked Questions |
| FARS | Fatality Analysis Reporting System |
| FHWA | Federal Highway Administration |
| NHTSA | National Highway  Traffic Safety Administration |
| OGFC | Open Graded Friction Course |
| PCC | Portland Cement Concrete |
| PRHTA | Puerto Rico Highway and Transportation Authority |
| PRLTAP | Puerto Rico Local Technical Assistance Program |
| RAP | Reclaimed Asphalt Pavement |
| RC | Ramp Champ |
| RDG | Roadside Design Guide |
| ROR | Run Off the Road |
| SE | Safety Edge |
| SWM | Shoulder Wedge Maker |
| TRB | Transportation Research Board |
| WMA | Warm Mix Asphalt |

# Learning Outcomes

1. Define conventional paving process
2. Define paving with the Safety Edge
3. Compare each paving process
4. Introduce the Safety Edge equipment
5. Discuss the Installation of each Safety Edge Shoe
6. Discussion of Safety Edge in Puerto Rico

# Conventional Paving Process: Vertical Drop-off

- Compaction
  - 80% by screed
  - Series of Rollers
- Edge of Pavement
  - Not well compacted
  - 45° angle
  - Typically breaks off

# Conventional Paving Process: Vertical Drop-off

- Shoulder Material
  - Before project is complete
  - After a few months:
    - Settle and edge is exposed
    - Edge is nearly vertical
    - Tire-scrubbing at exposed edge
    - Potential crashes
- Personnel
  - No training is needed

# Paving with Safety Edge: Mountable Drop-off

- Compaction
  - Pavement edge by the Shoe
  - Series of rollers
  - No additional compaction
- Edge of Pavement
  - Well compacted
  - 30° angle
  - May last longer

# Paving with Safety Edge: Mountable Drop-off

- Shoulder Material
  - Before project is complete
  - After a few months:
    - Settle and edge is exposed
    - 30° Pavement edge
    - No tire-scrubbing at exposed edge
    - Drivers likely able to return to lane
- Personnel
  - Requires training

# Comparing Safety Edge to Conventional Paving Process

- Conventional Paving Process
  - Advantages:
    - No training
    - No additional cost
  - Disadvantages:
    - Potential crash
    - Pavement edge breaks off
- Safety Edge
  - Advantages:
    - Safer roadways
    - Low to none cost
    - Pavement may last longer
  - Disadvantages:
    - Requires training
    - Relative  inexpensive piece of equipment

# Hardware
# Advant-Edge: Ramp Champ

- Advant-Edge: Ramp Champ (RC)
  - Reversible hardware (either the left or right side)
  - Self-adjustable during paving process
  - Adjusted slope (5° to 30°)
  - Detachable shoe
  - Weight (approx. 115 lbs.)
  - Initial Cost (approx. $4,600)

# Key Parts
# Advant-Edge: Ramp Champ

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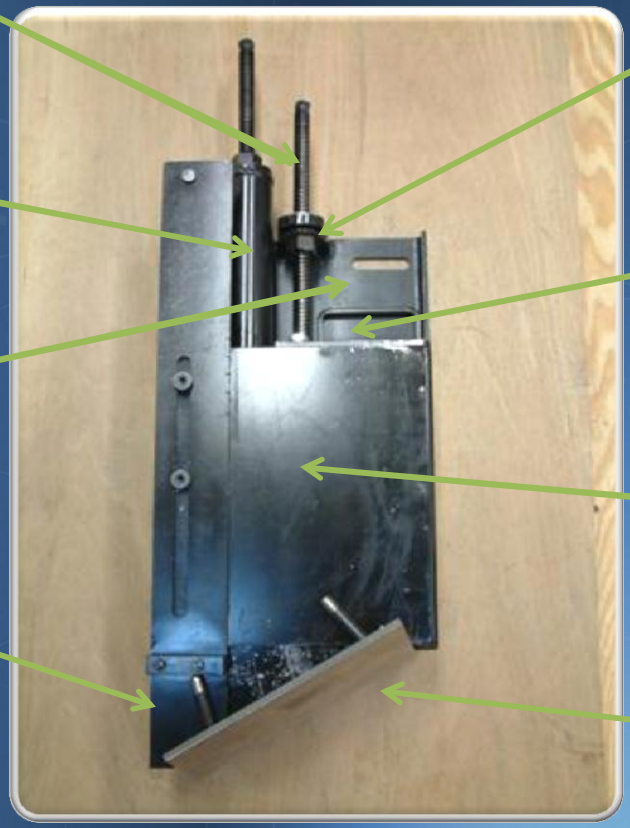
**Height Adjusting Screw**

**Radial Force Cylinder**
Produces downward and inward force on the shoe creating a stronger edge

**Mounting Plate**
Remains fixed and is bolted to the screed

**Wedge**
Designed to form different slope angles and allows it to change with the elevation of the adjacent road shoulder



**Cotter Pin**
Removal of piece is necessary to remove box from plate

**Cover Plate**
Protects inner adjustment elements from dirt and asphalt

**Box**
The box contains a slope set screw where the slope of the angle can be adjusted

**Shoe**
Produces either a tapered safety edge or a longitudinal center lane joint

# Hardware
# TransTech: Shoulder Wedge Maker

- TransTech: Shoulder Wedge Maker (SWM)
  - Tapered shoulder wedge
  - Used in match pair (one for left side and one for right side)
  - Fixed slope angle (30°)
  - Needs adjustment during construction
  - Weight (approx. 50 lbs.)
  - Initial Cost ($4,200)

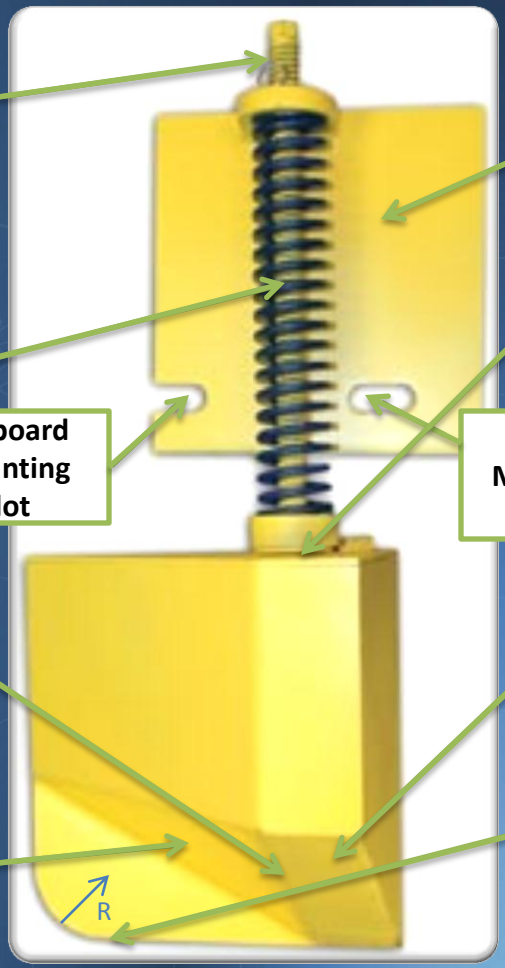
# Key Parts
# TransTech: Shoulder Wedge Maker

**Adjusting Screw**
Sets the height of the SWM and when adjusted, creates a downward force to keep the device in contact with the surface

**Self-adjusting Internal Spring**
Provides a downward force to keep the guide rail in connection with the surface

**½" Radius Leading Edge**
Provides a smooth transition from the asphalt being extruded under the SWM

**45° Compound Angle Surface**
Forces asphalt mix under the device and increases compaction of the wedge fillet




**Mounting Plate**

**Cover Plate**
Protects the inner adjustment elements from any dirt or asphalt that may enter

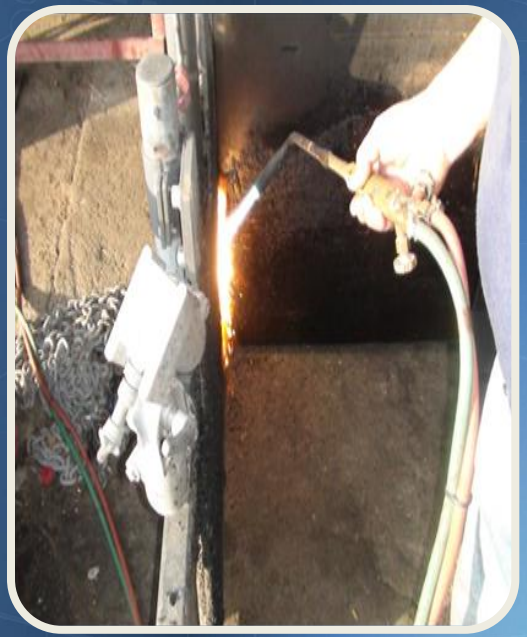
**30° Forming Edge**
Extends below the screed strike-off plate and extrudes the fillet at the given angle

**Guide Rail with a 2"radius**
- Allows the SWM to ride along the surface of the shoulder
- The 2"radius allows for better transitions between obstacles

Figure 2: Description of Principal Components of TransTech Shoulder Wedge Maker

# Field Test: Installation

- TransTech: Shoulder Wedge Maker (SWM)
  - Step #1: Clean Surface
    - Clear any remaining debris on paver



# Field Test: Installation

- TransTech: Shoulder Wedge Maker (SWM)
  - Step #2: Measure and mark
    - 16” (from bottom of the screed unit)
    - 6” (from left side)

# Field Test: Installation

- TransTech: Shoulder Wedge Maker (SWM)
  - Step #3: Mounting holes
    - 1/2” holes (1/8”, 1/4” and 1/2” used)

# Field Test: Installation

- TransTech: Shoulder Wedge Maker (SWM)
  - Step #4: Mounting Plate
    - Remove cotter pin
    - Position plate

# Field Test: Installation

- TransTech: Shoulder Wedge Maker (SWM)
  - Step #5: Bolts and washers
    - Insert into each mounting slot and tighten

# Field Test: Installation

- TransTech: Shoulder Wedge Maker (SWM)
  - Step #6: Adjusting screw and cotter pin
    - Insert through the mounting plate

# Field Test: Installation

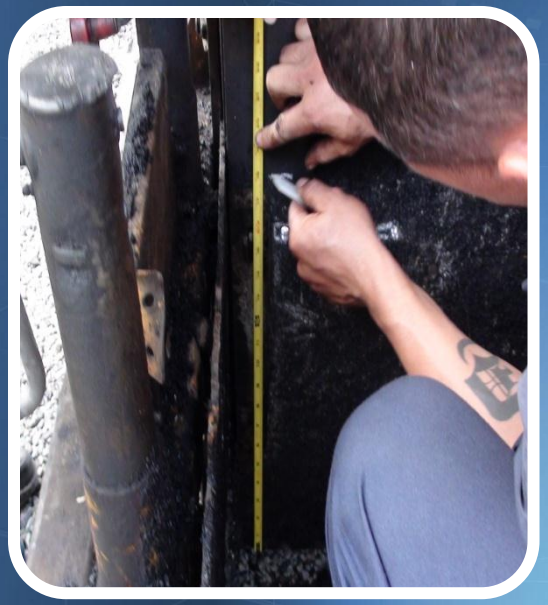
- Advant-Edge: Ramp Champ (RP)
  - Step #1: Clean surface
    - Clean any remaining debris on paver

# Field Test: Installation

- Advant-Edge: Ramp Champ (RP)
  - Step #2: Holes measurement
    - Place a 1” shim at the bottom of the screed unit

# Field Test: Installation

- Advant-Edge: Ramp Champ (RP)
  - Step #3: Cotter pin and holes
    - Remove cotter pin and mark holes

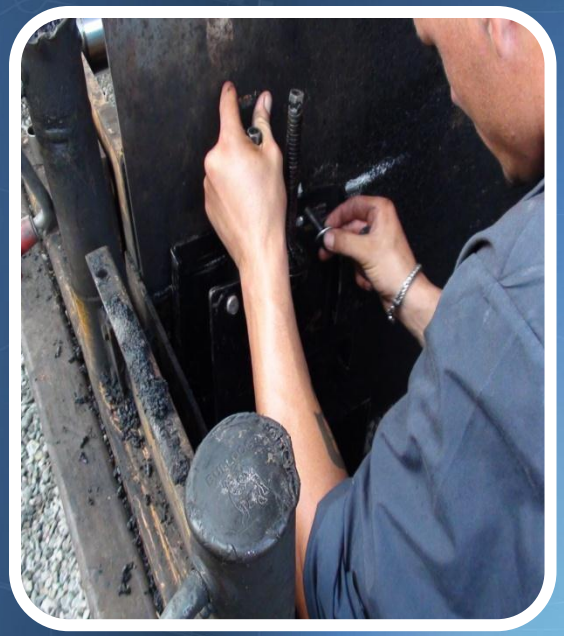


# Field Test: Installation

- Advant-Edge: Ramp Champ (RP)
  - Step #4: Mounting holes
    - 1/2” holes (1/8”, 1/4” and 1/2” used)

# Field Test: Installation

- Advant-Edge: Ramp Champ (RP)
  - Step #5: Bolts and washers
    - Insert into each mounting slot and tighten



# Field Test: Installation

- Advant-Edge: Ramp Champ (RP)
  - Step #6: Box and cotter pin
    - Reattach box and reinsert cotter pin

# Implementation of Safety Edge in Puerto Rico

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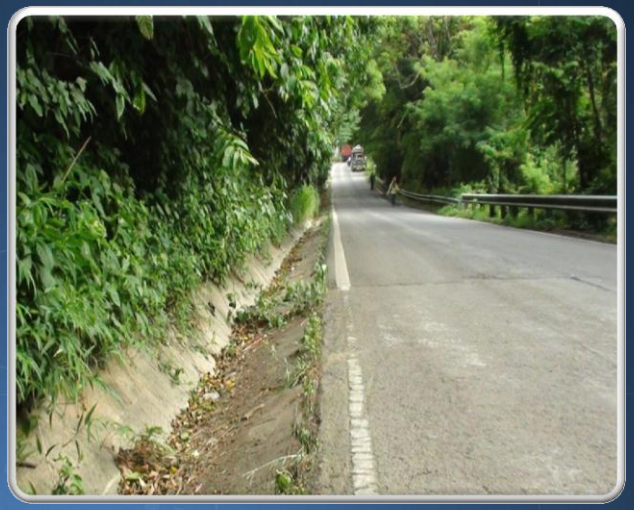
## Job Site Locations

# Implementation of Safety Edge in Puerto Rico

- Location:
  - Yabucoa, PR-182
- Hardware:
  - West bound:
    - Advant-Edge: Ramp Champ
  - East bound:
    - TransTech: Shoulder Wedge Maker
- ADT = 8,922 (ACT)

# Implementation of Safety Edge in Puerto Rico

- Location:
  - Patillas, PR-184
- Hardware:
  - North Bound
    - Advant-Edge: Ramp Champ
  - South Bound
    - TransTech Shoulder: Wedge Maker
- ADT = 12,170 (ACT)



# Implementation of Safety Edge in Puerto Rico

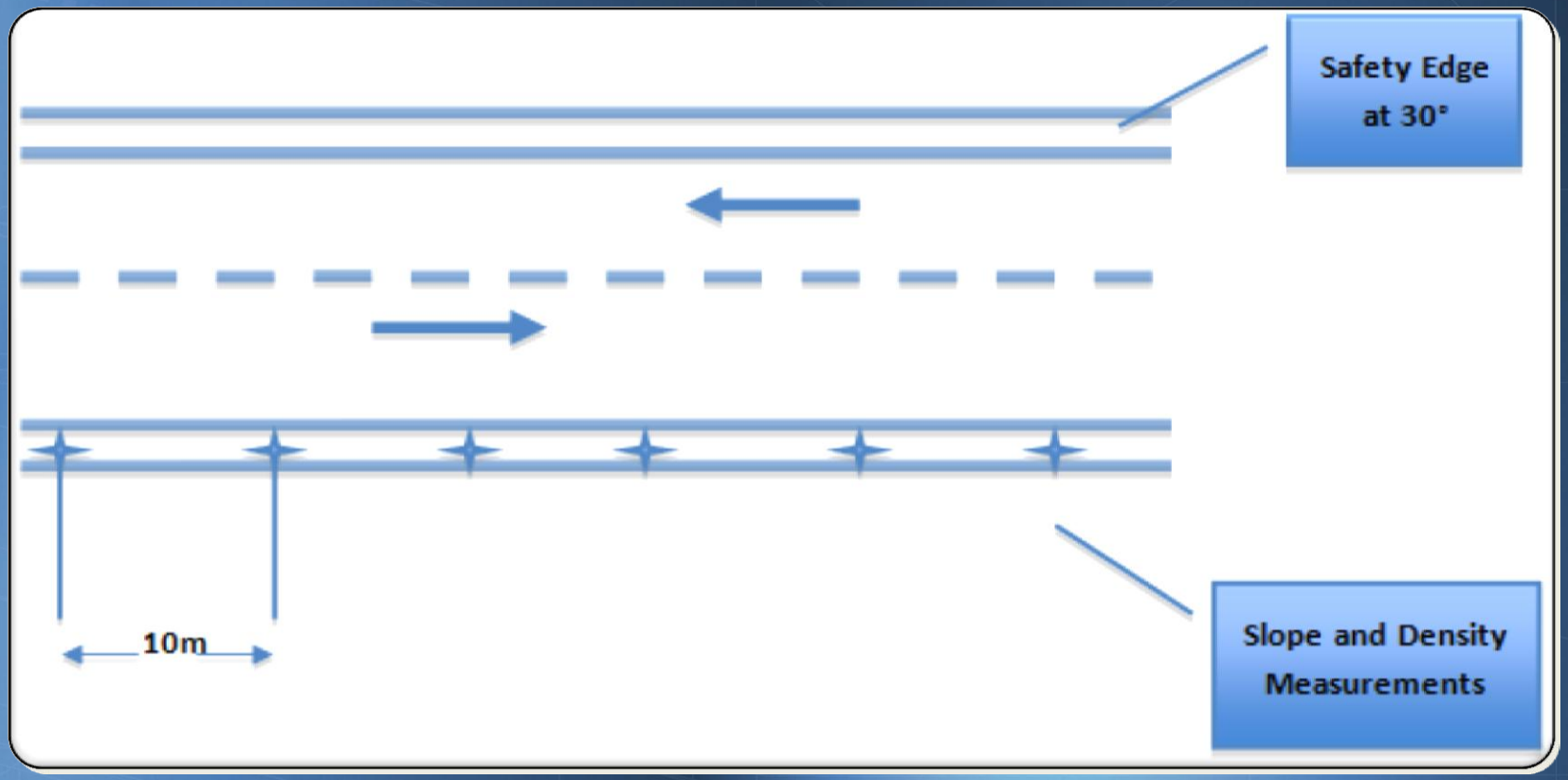
- Asphalt producer:
  - Betteroads Asphalt Corp.
- Experiment facts:
  - Almost 1,400 tons of asphalt
  - 1.5” Pavement thickness
  - 1 Kilometers paved
- Data Analysis Measurements:
  - Density
  - Slope
    - Every 10 mts

# Implementation of Safety Edge in Puerto Rico

- Location:
  - Robles Asphalt Corp. Facilities
  - Ponce, Puerto Rico
- Material:
  - Sand
    - Cold
    - Wash
    - 10% humidity
  - Layer Thickness
    - 4” Pavement Thickness
- Hardware:
  - North Bound
    - Advant-Edge: Ramp Champ
  - South Bound
    - TransTech: Shoulder Wedge Maker

# Implementation of Safety Edge in Puerto Rico

- Betteroads Experiments Layout



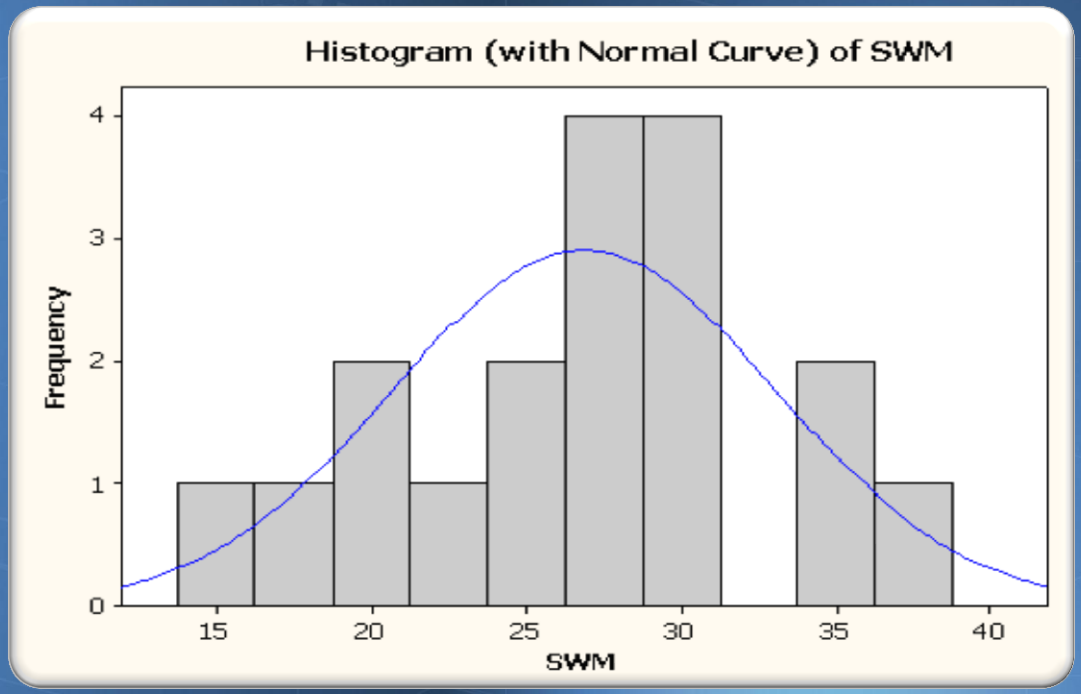
# Descriptive Statistics for Betteroads Experiments

- Descriptive Statistics: Summary Table
  - TransTech: Shoulder Wedge Maker

| Variable | Mean | Std. Dev. | Minimum | Median | Maximum |
|---|---|---|---|---|---|
| % Compaction (%) | 93.49 | 0.98 | 92.3 | 93.3 | 95.1 |
| % Compaction (%)@ 1 ft. | 82.90 | 2.56 | 78.2 | 83.1 | 86.8 |
| Slope (°) | 25.8 | 5.69 | 13.8 | 27.15 | 36.4 |

# Pavement Edge Slope Histogram

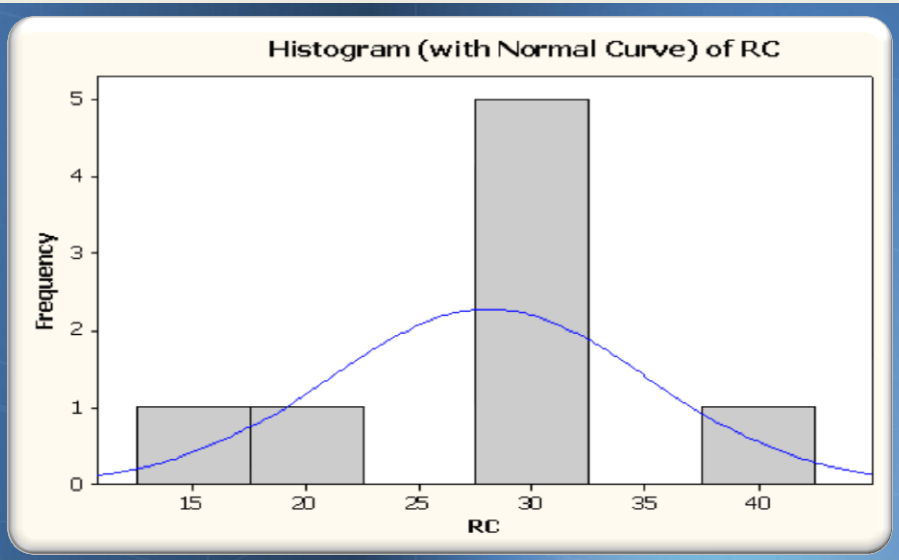
- Histogram of Betteroads Experiments
  - TransTech: Shoulder Wedge Maker



# Descriptive Statistics for Betteroads Experiments

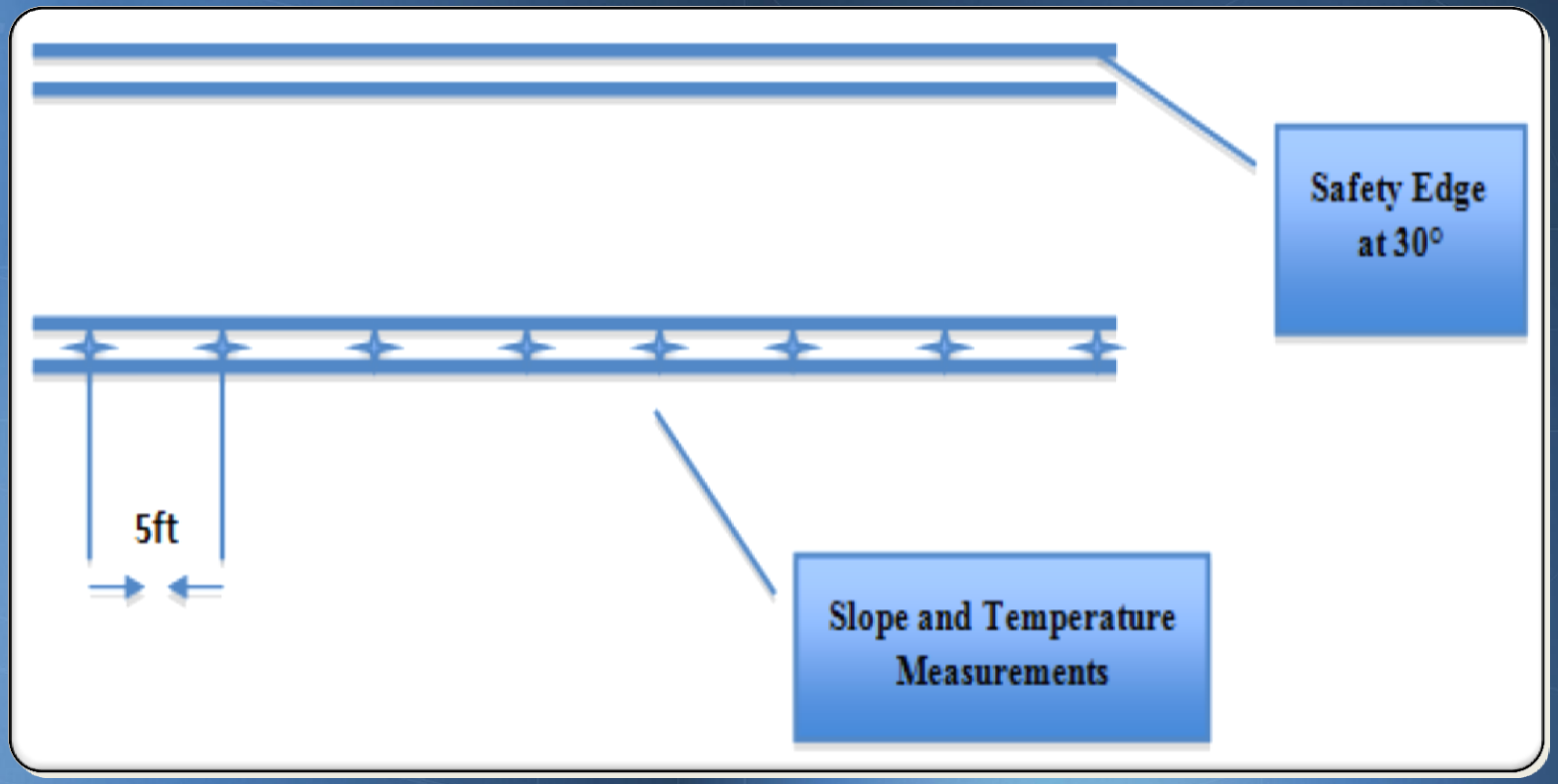
- Descriptive Statistics: Summary Table and Histogram
  - Advant-Edge: Ramp Champ

| Variable | Mean | Std. Dev. | Minimum | Median | Maximum |
|---|---|---|---|---|---|
| % Compaction (%) | 94.31 | 1.29 | 92.60 | 94.10 | 96.0 |
| % Compaction (%)@ 1 ft. | 83.60 | 3.38 | 79.10 | 85.20 | 87.40 |
| Slope (°) | 26.27 | 5.21 | 16.80 | 29.00 | 29.80 |



# Implementation of Safety Edge in Puerto Rico

- Robles Asphalts Experiments Layout



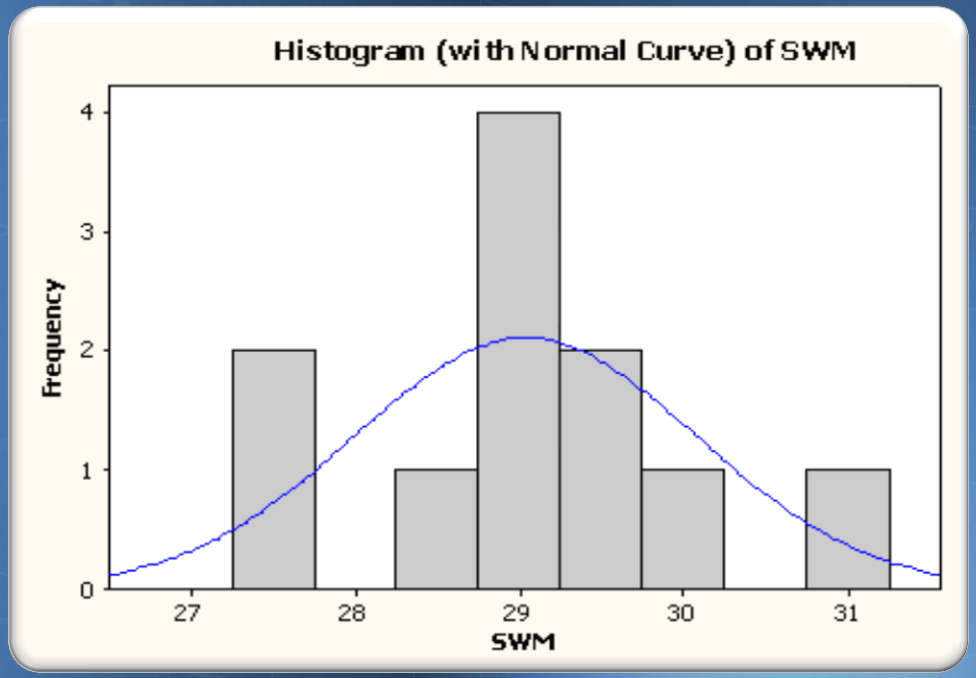
# Descriptive Statistics for Robles Asphalt Experiments

- Descriptive Statistics: Summary Table
  - TransTech: Shoulder Wedge Maker

| Variable | Mean | Std. Dev. | Minimum | Median | Maximum |
|---|---|---|---|---|---|
| **Slope** | 29.04 | 1.04 | 27.40 | 29.10 | 31.20 |
| **Temperature** | 88.96 | 0.86 | 87.00 | 89.00 | 90.00 |

# Pavement Edge Slope Histogram

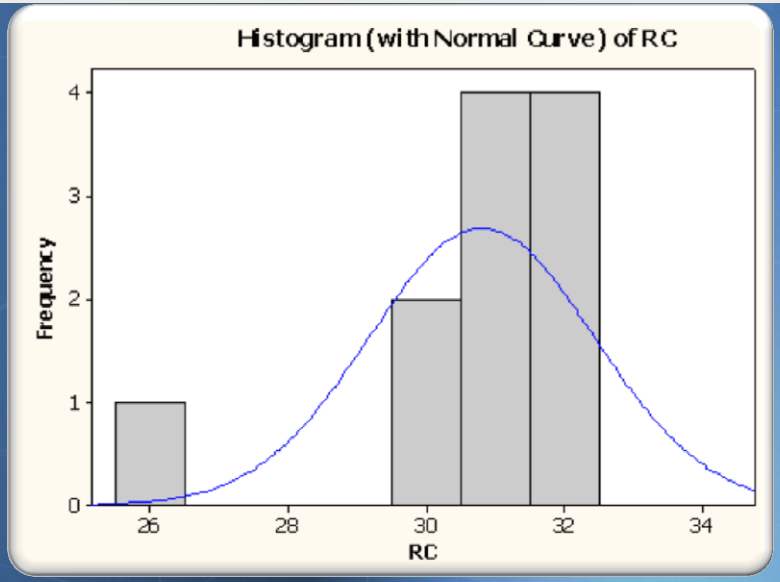
- Histogram of Robles Asphalt Experiments
  - TransTech: Shoulder Wedge Maker



# Descriptive Statistics for Robles Asphalt Experiments

- Descriptive Statistics: Summary Table and Histogram
  - Advant-Edge: Ramp Champ

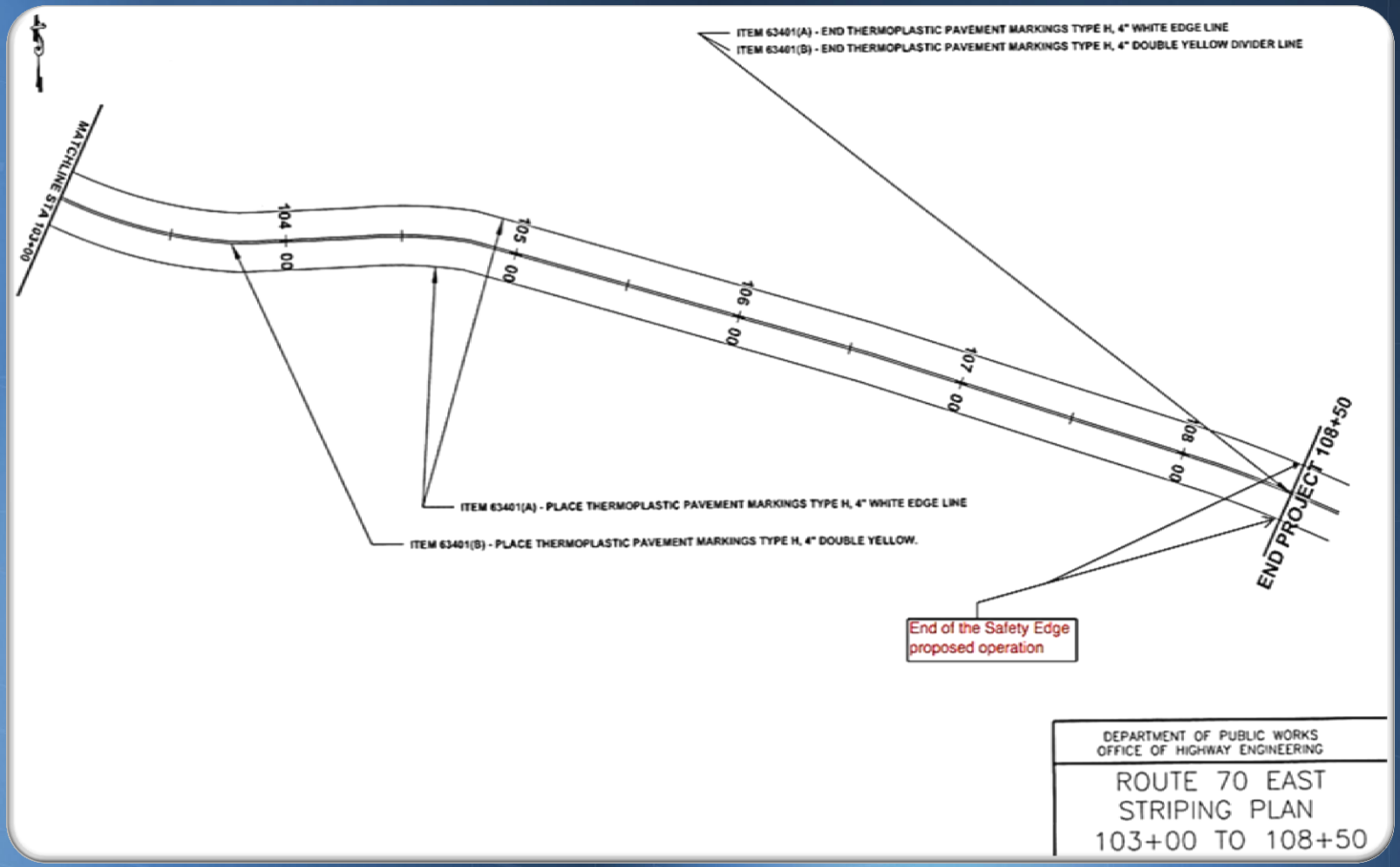
| Variable | Mean | Std. Dev. | Minimum | Median | Maximum |
|---|---|---|---|---|---|
| Slope | 30.80 | 1.63 | 26.40 | 31.10 | 32.40 |
| Temperature | 88.91 | 0.83 | 87.00 | 89.00 | 90.00 |



# Job Site Location of Safety Edge Projects in USVI

# Safety Edge Initiative in St. John USVI, 2011

# Safety Edge Initiative in St. Croix USVI, 2011
## Route 70, Queen Mary Highway



# Safety Edge Initiative in St. Croix USVI, October 21, 2011

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# Safety Edge Initiative in St. Croix USVI, October 21, 2011

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# Safety Edge Equipment and Construction Quiz

True or False:

1. Advant-Edge: Ramp Champ  is the Safety Shoe designated to work with Portland Cement Concrete (PCC), while TransTech: Shoulder Wedge Maker is designated to work on Warm Mix Asphalt (WMA).

Advant-Edge: Ramp Champ

TransTech: Shoulder Wedge Maker

# Safety Edge Equipment and Construction Quiz

2. The acceptable pavement edge slope angle range is:

a) 25°-30°
b) 30°-35°
c) 35°-40°

# Review: Learning Outcomes

1. Define conventional paving process
2. Define paving with the Safety Edge
3. Compare each paving process
4. Introduce the Safety Edge equipment
5. Discuss the Installation of each Safety Edge Shoe
6. Discussion of Safety Edge in Puerto Rico

# References

- How does Safety Edge compare to Conventional Paving Process?
- Puerto Rico Transportation Technology Transfer Center
- Safety Impacts on Pavement Edge Drop-offs
- The Safety Edge: Your Angle for Reducing Roadway Departure Crashes (FHWA DVD)
- 2011 Progress Report: Safety Edge, PR-LTAP
- http://www.fhwa.dot.gov/everydaycounts/projects/
- http://www.fhwa.dot.gov/everydaycounts/technology/

# Acknowledgement

This module was made possible through the collaboration of Eng. Juan C. Rivera, Eng. Ana L. Torres, Eng. Alvin Gutiérrez, Eng. Freddie Salado, Dr. Benjamín Colucci, Ms. Melvies Rodríguez, Mss. Leilany Benejam and Mr. Josué Ortiz.

# End of Module #2:

# Equipment and Construction of Safety Edge

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# AN OVERVIEW OF SAFETY EDGE DEMONSTRATION

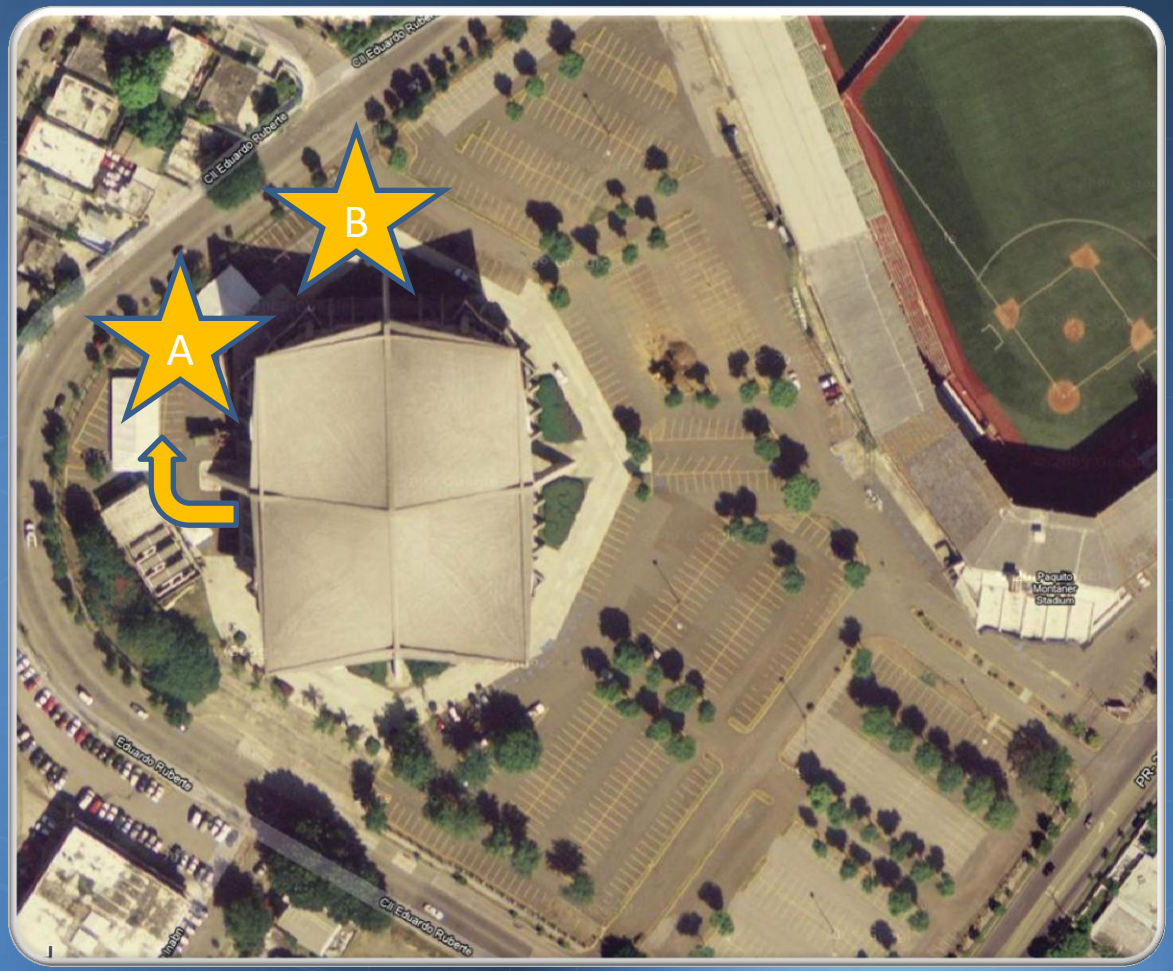
Instructor: Mr. Josué D. Ortiz

# An Overview of Safety Edge Demonstration

- Every Day Counts Safety Edge Agenda:

| Time | Activity |
|---|---|
| | Lunch Break |
| 1:20pm-2:45pm | Safety Edge Demonstration |
| 2:45pm-3:00pm | 15 Minute Break |
| 3:00pm-3:45pm | Safety Edge Panel |
| 3:45pm-4:00pm | Questions & Answers Session |
| 4:00pm | Closure |

# Safety Edge Demonstration




Aerial photo: Juan Pachín Vicens Auditorium, Ponce, PR