



Case Studies: Long Term Performance of Highway Slopes Stabilized with Recycled Plastic Pin

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Fact About Plastic Bottles!

- 50 Billion Water Bottle end up in US Landfill Each Year
- It takes 700 year to decompose plastic bottles
- Ecosystems and wildlife are negatively impacted by plastic debris.





Recycled Plastic Pin (RPP)

- **Recycled Plastic Pin (RPP)**
 - Mainly Polymeric Materials
 - Fabricated from Recycled Plastics

- **Advantages**
 - Commercially Available
 - Use of RPP Reduces Waste Volume
 - Resistant to Biological Exposure

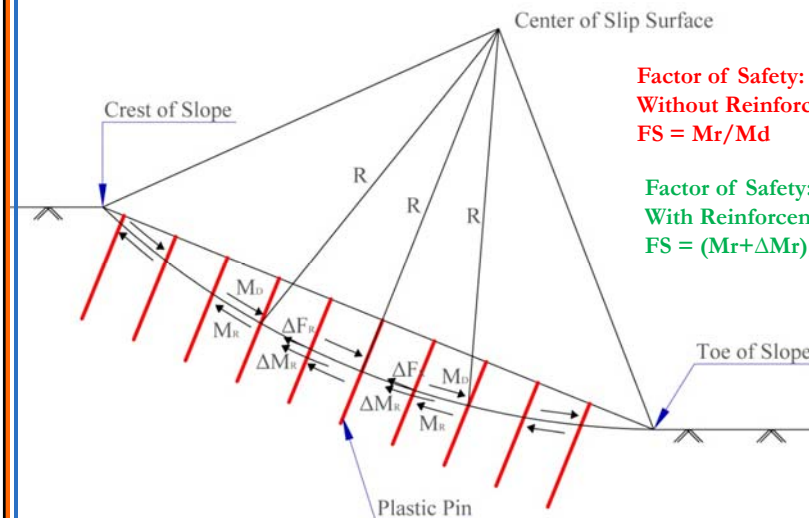
- **Typical Composition**
 - HDPE : 55-90%
 - LDPE : 5-10%
 - PP, PET, PS : 1% - 10%
 - Misc. : 0 – 5%



A 10' long RPP can replace 500 Soda Bottles



Slope Stabilization

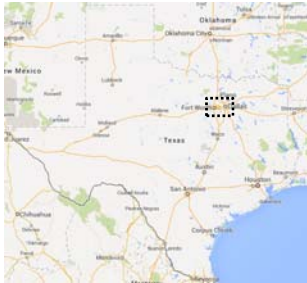


**Factor of Safety:
Without Reinforcement**
 $FS = M_r / M_d$

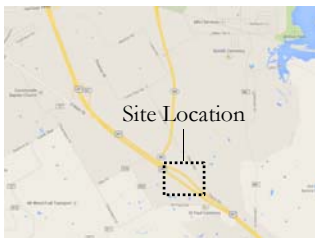
**Factor of Safety:
With Reinforcement**
 $FS = (M_r + \Delta M_r) / M_d$

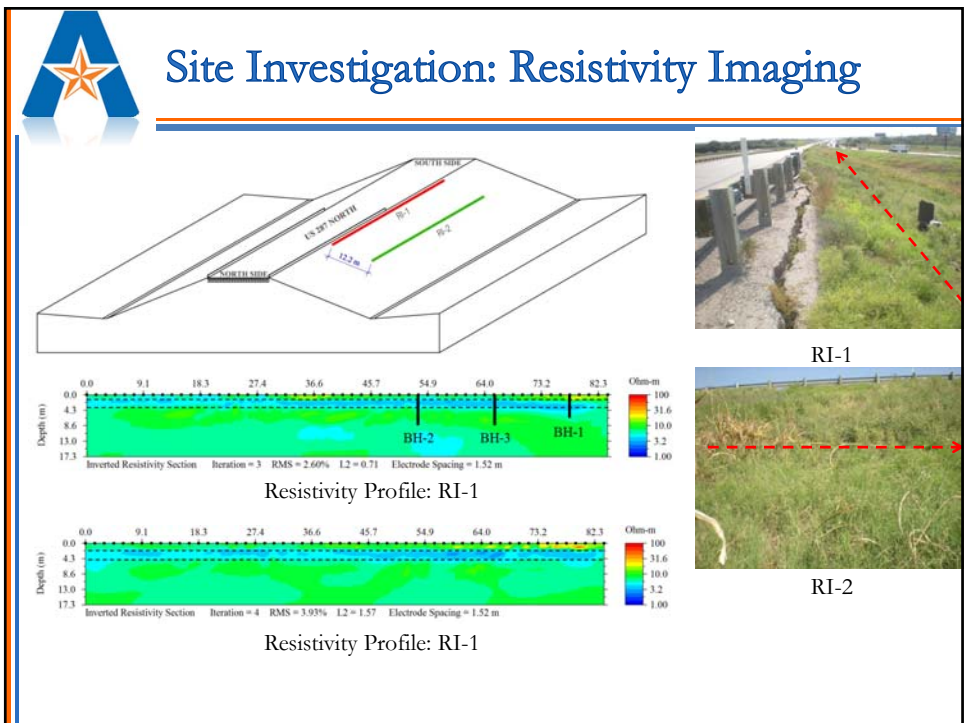
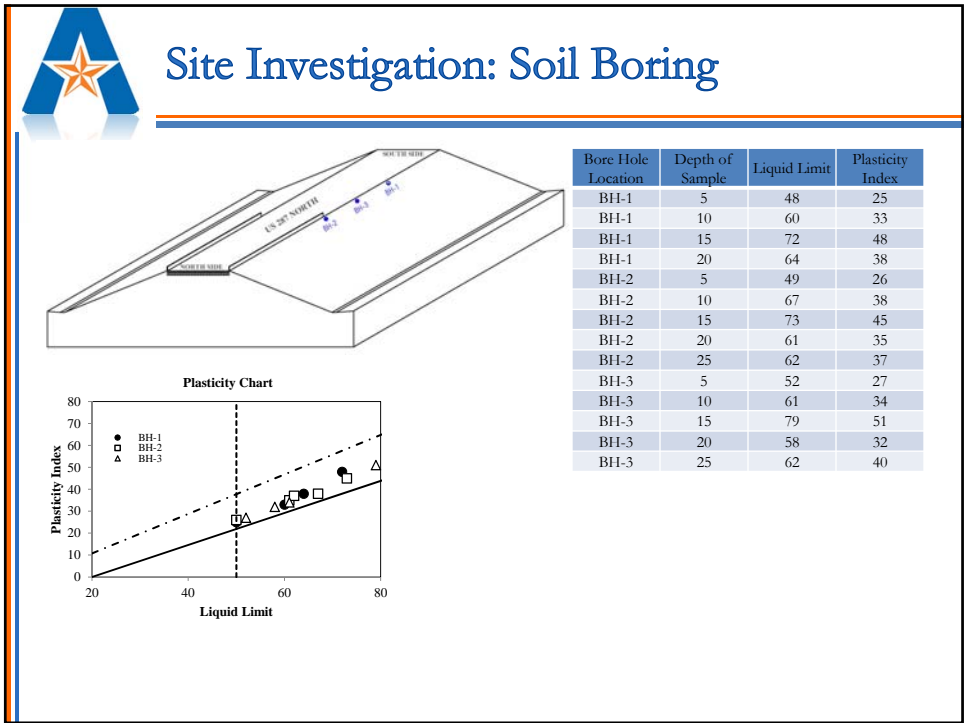


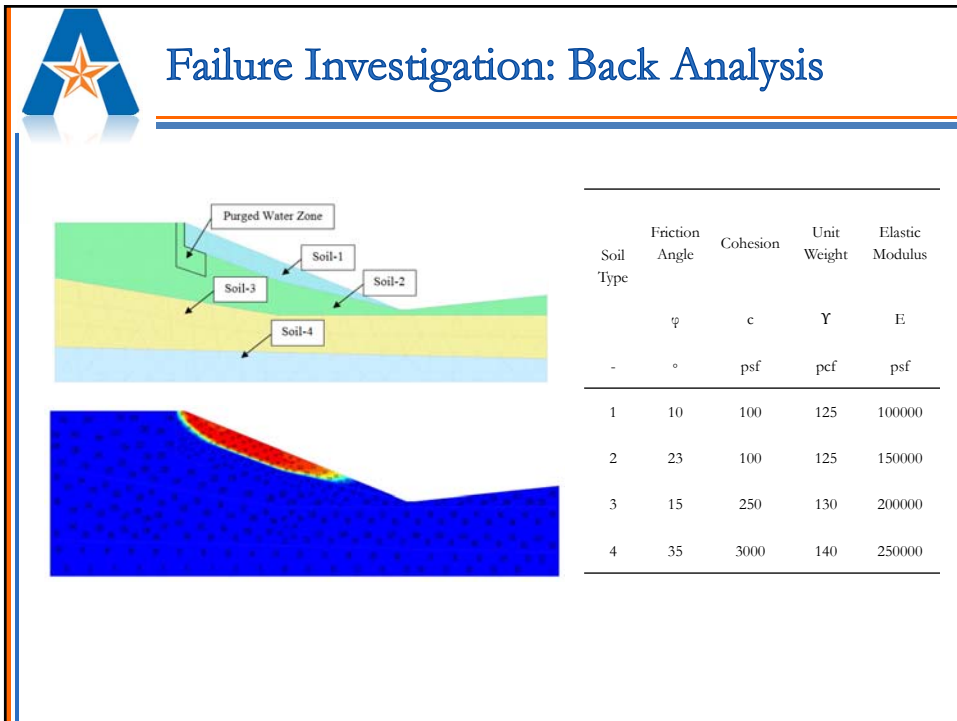
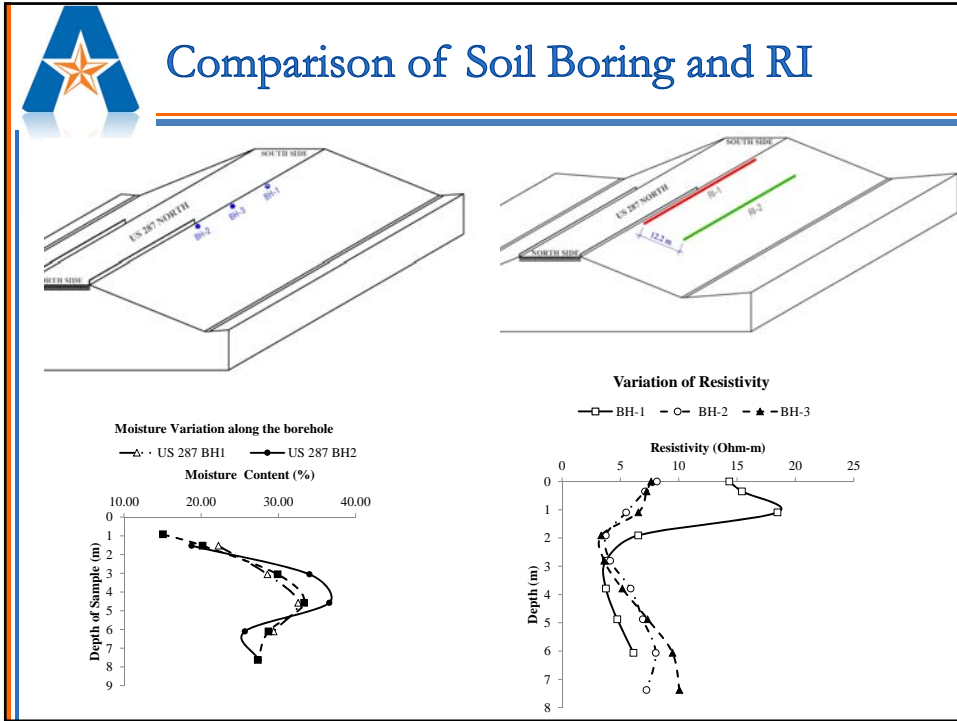
Site Selection

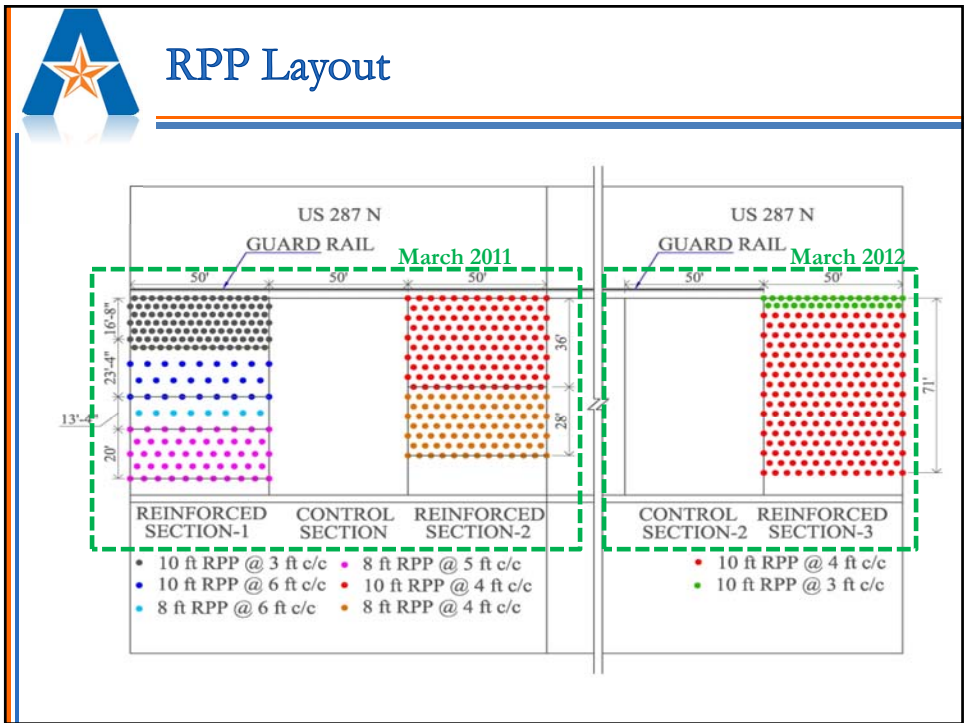
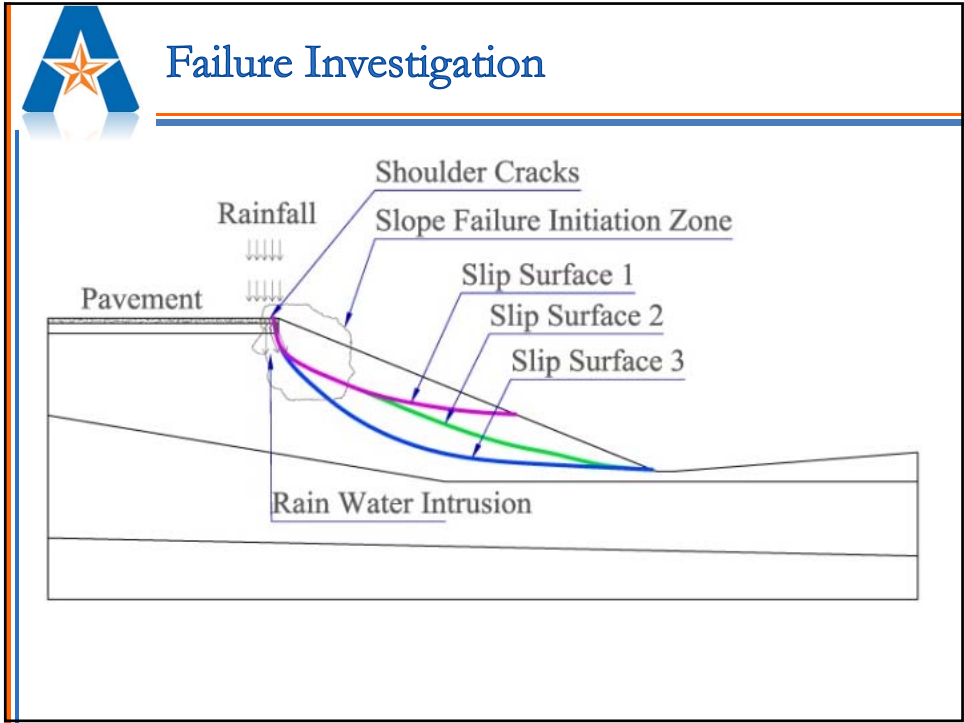


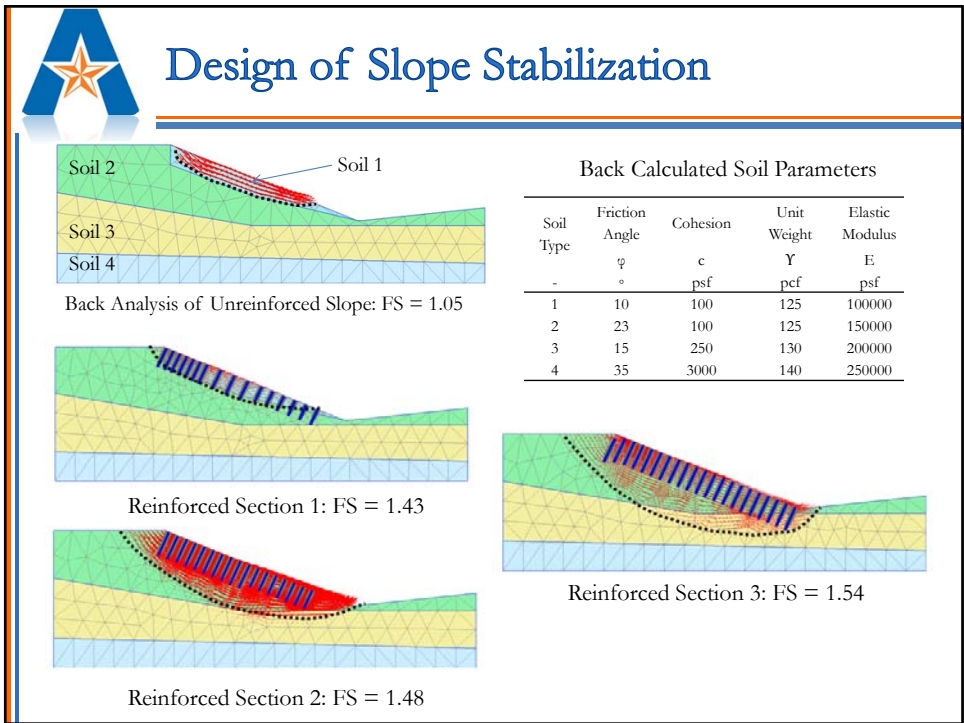
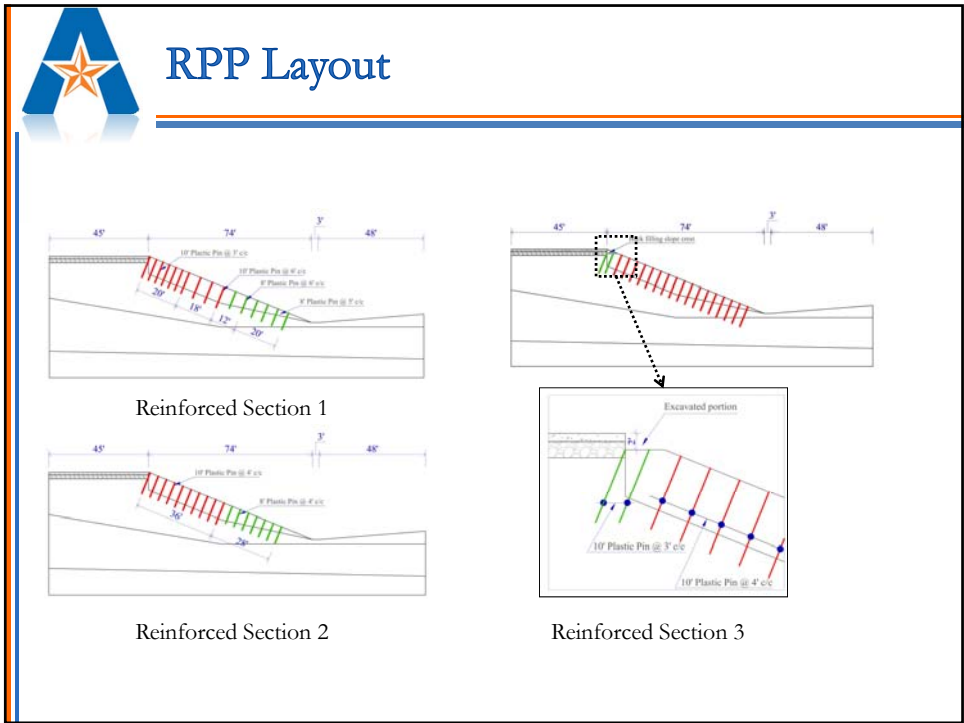
Site Investigation: US 287 Slope





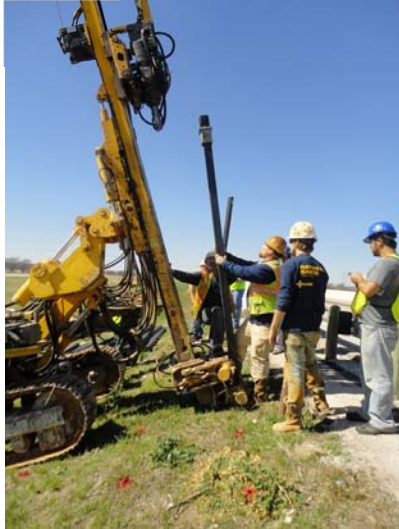








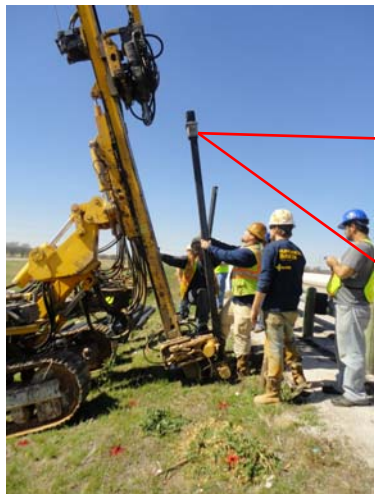
Installation of RPP: Reinforced Section 1 and Reinforced Section 2



- Equipment: Klemm 802 Drill Rig
- Hammer Type: KD 1101



Installation of RPP: Reinforced Section 1 and Reinforced Section 2






Installation of RPP: Reinforced Section 3







Installation Details

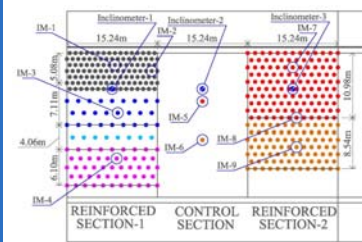
Section	No. of RPP	Installation Time(Day)	Start Date	Finished Date
Reinforced Section 1	192	2	March 01, 2011	March 03, 2011
Reinforced Section 2	225	2	March 04, 2011	March 05, 2011
Reinforced Section 3	238	3	Feb 29, 2012	March 6, 2012

Total RPP 655, Replaced 330000 Plastic Bottles from Landfill

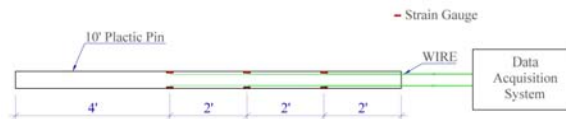


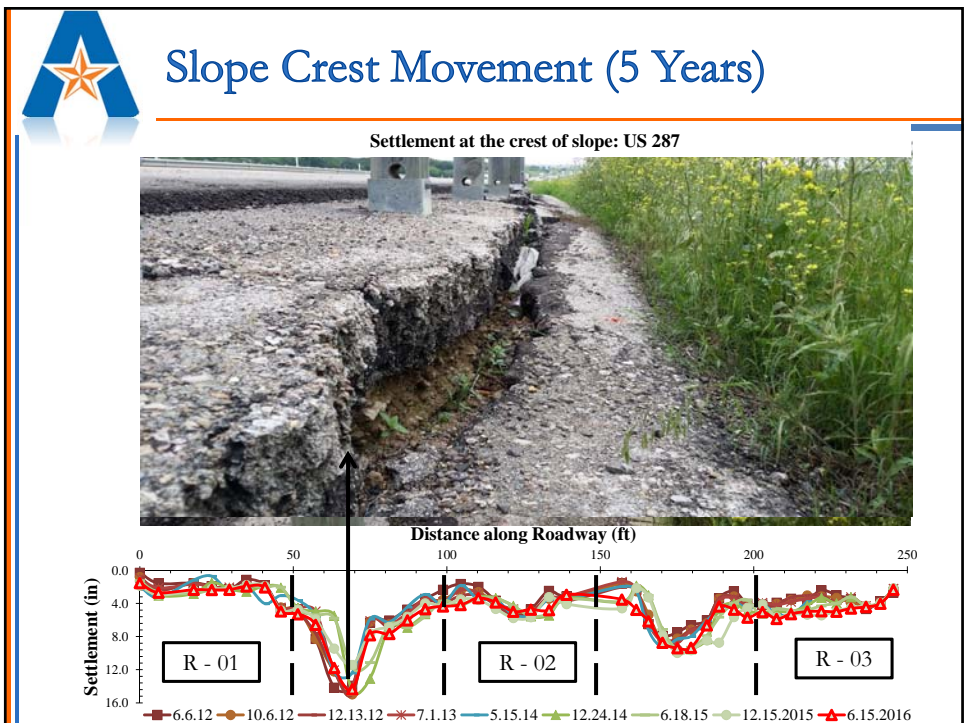
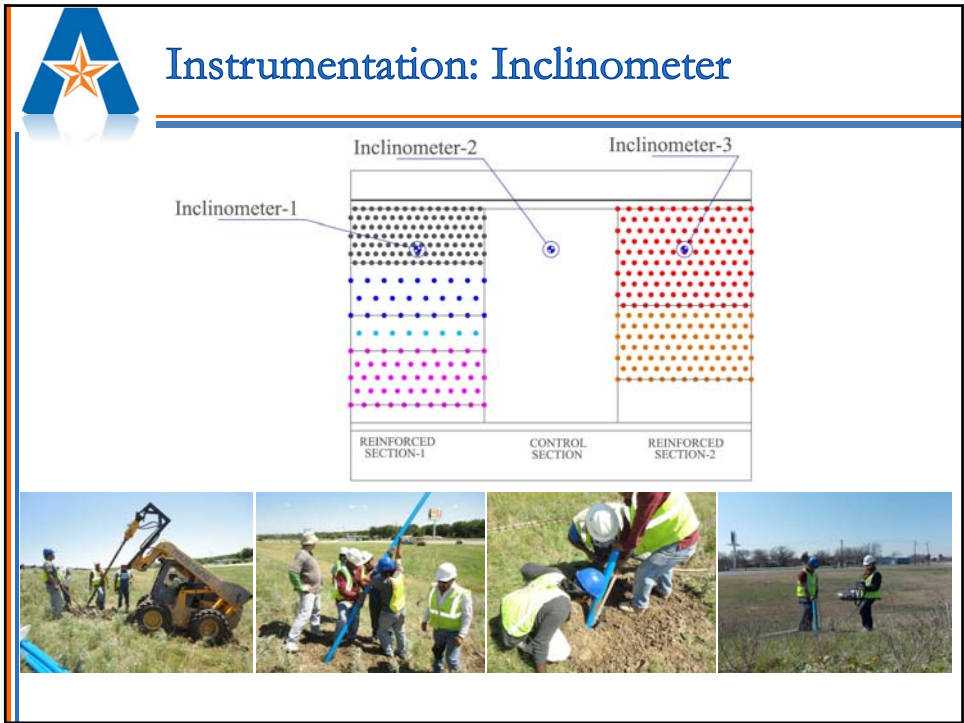
Instrumentation

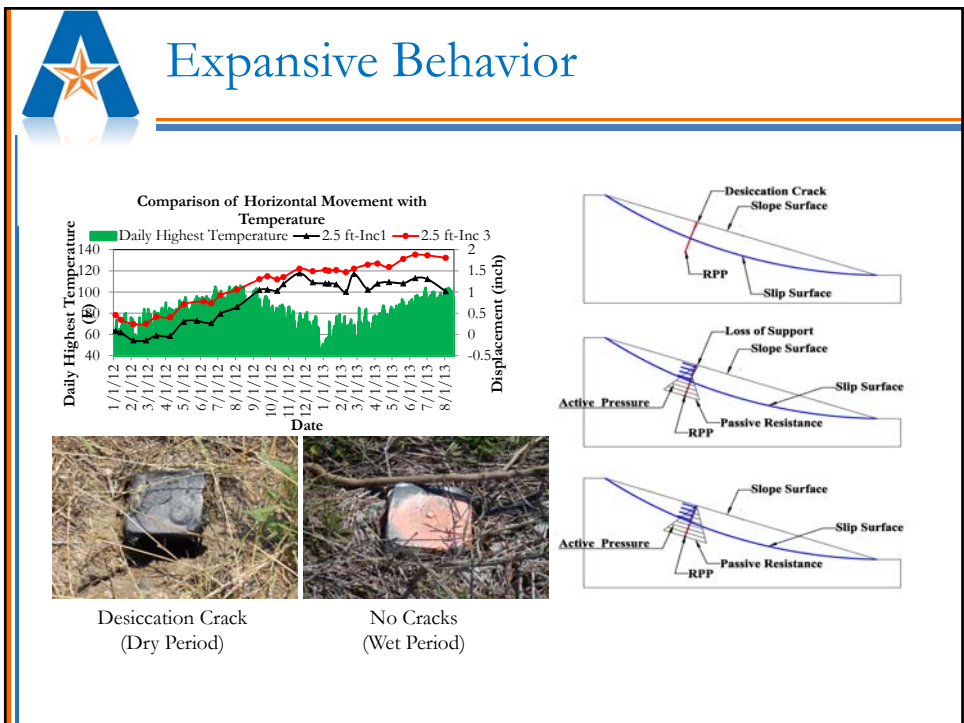
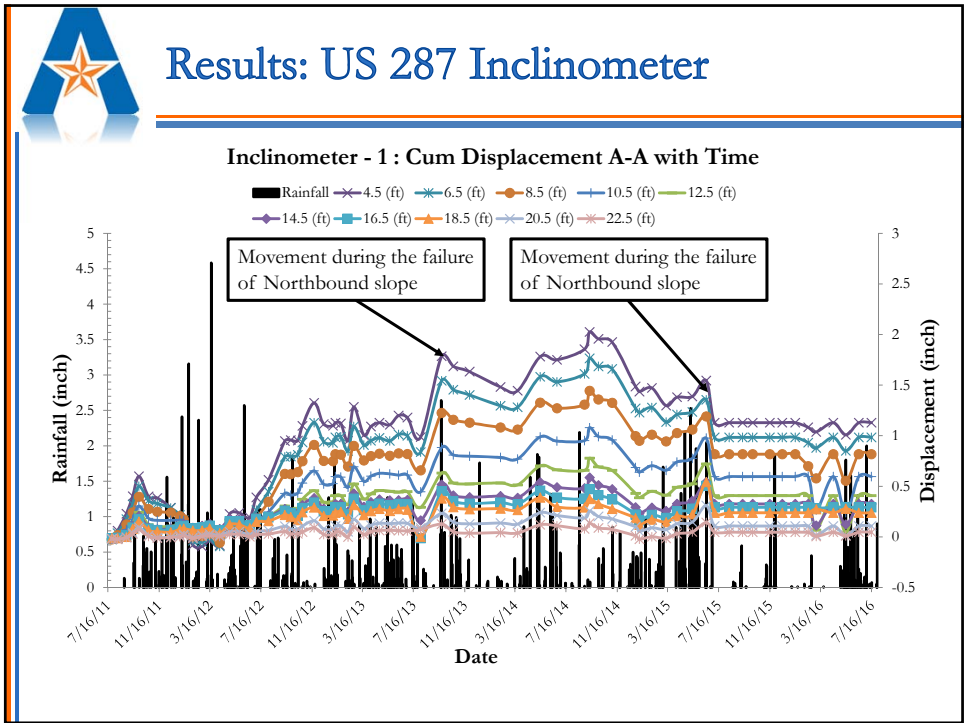
- Rain Gauge
- Instrumented RPP
- Surveying
- Inclinometer
- Moisture Sensor
- Water Potential Probe

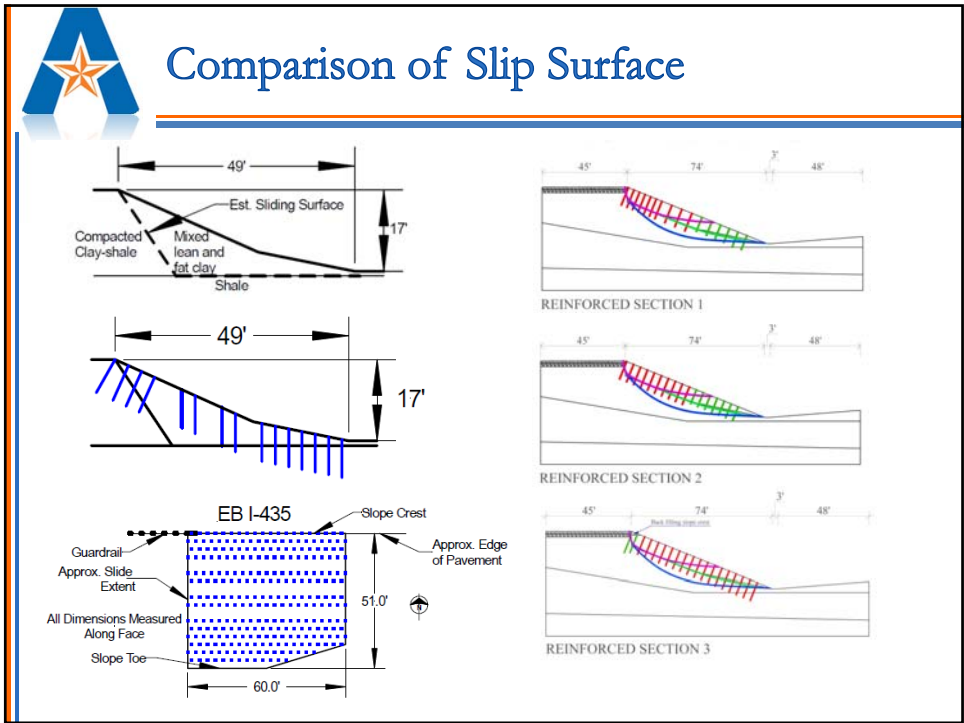


Instrumentation: Instrumented RPP









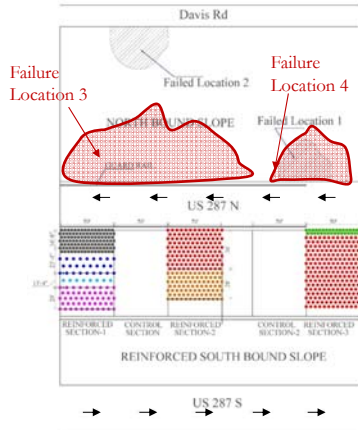


News and Media



Comparison of Performance Northbound and Southbound (Reinforced) Slope

Failure Location	Time
Failure Location-1	October 2013
Failure Location -2	October 2013
Failure Location-3	June 2015
Failure Location-4	June 2015



Reconstruction of Northbound Slope

September 2015

Soil Nailed Wall

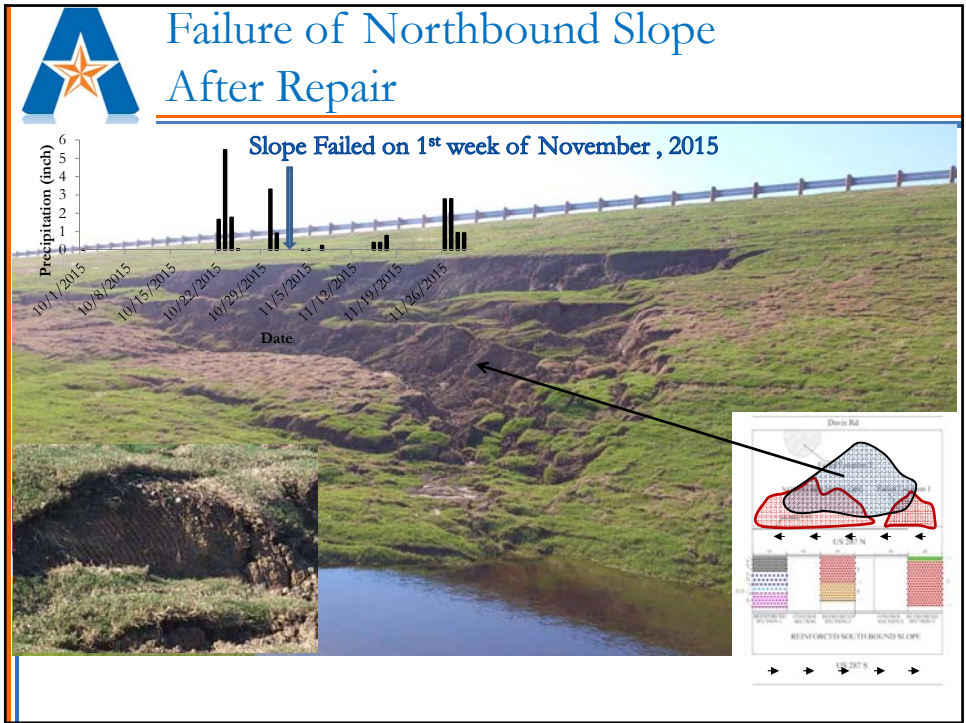
North Side

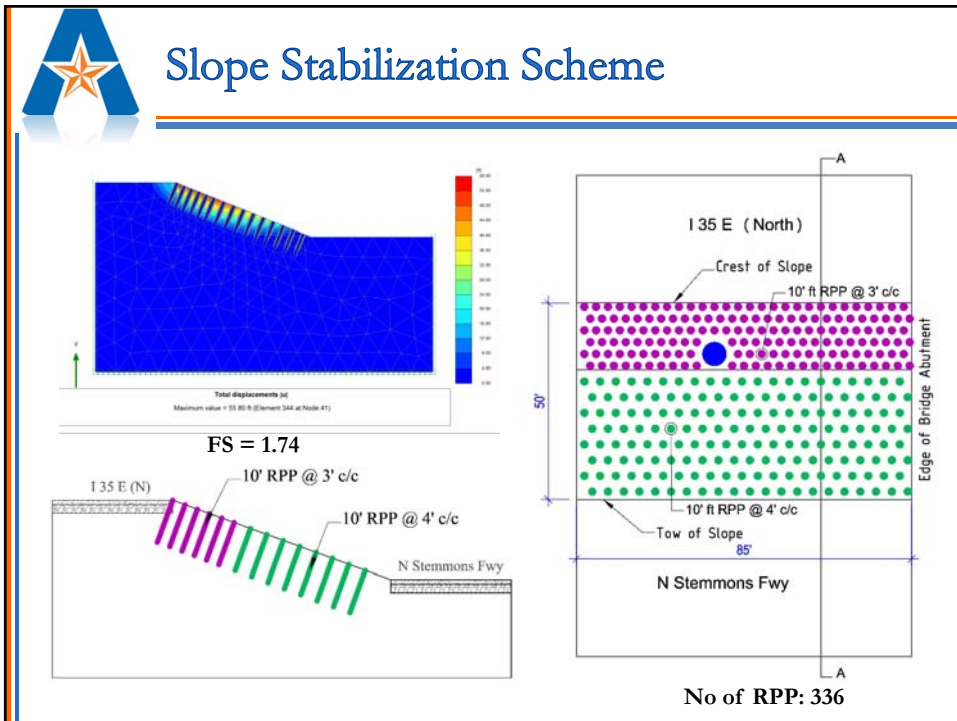
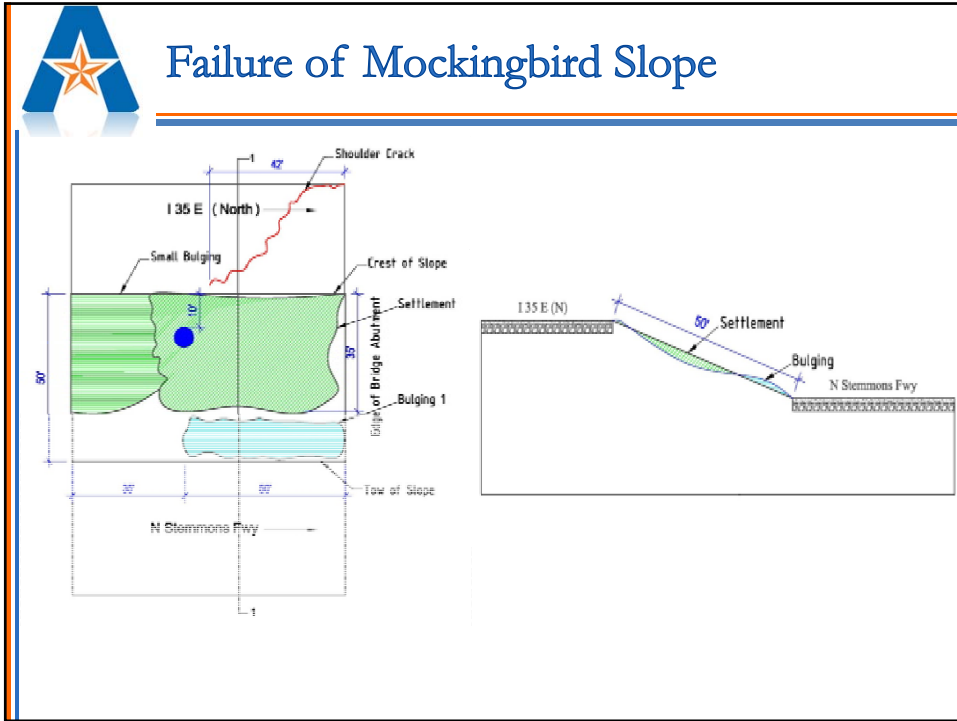
October 2015

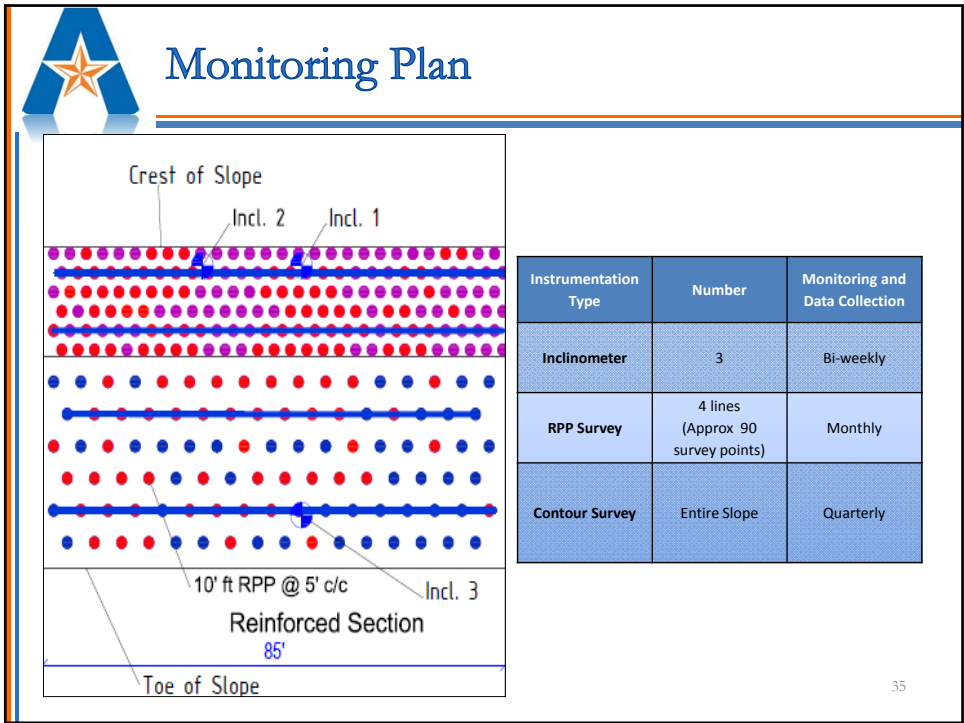
Comparison between RPP Stabilized Slope and Reconstructed Control Slope

Northbound slope
(after construction of soil nail wall)

Southbound slope (RPP stabilized)

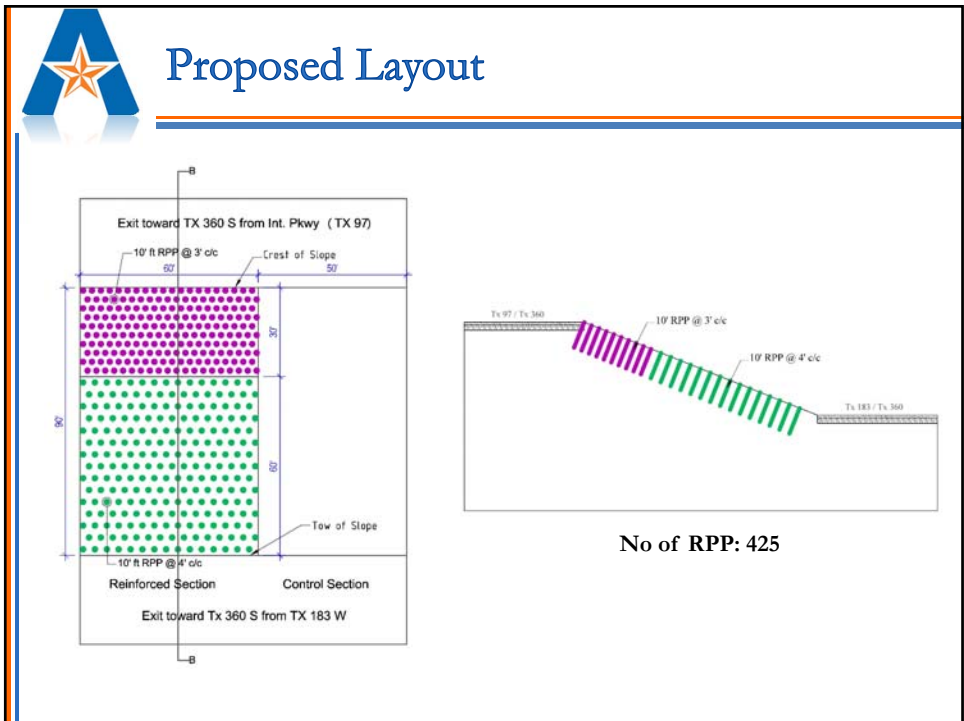
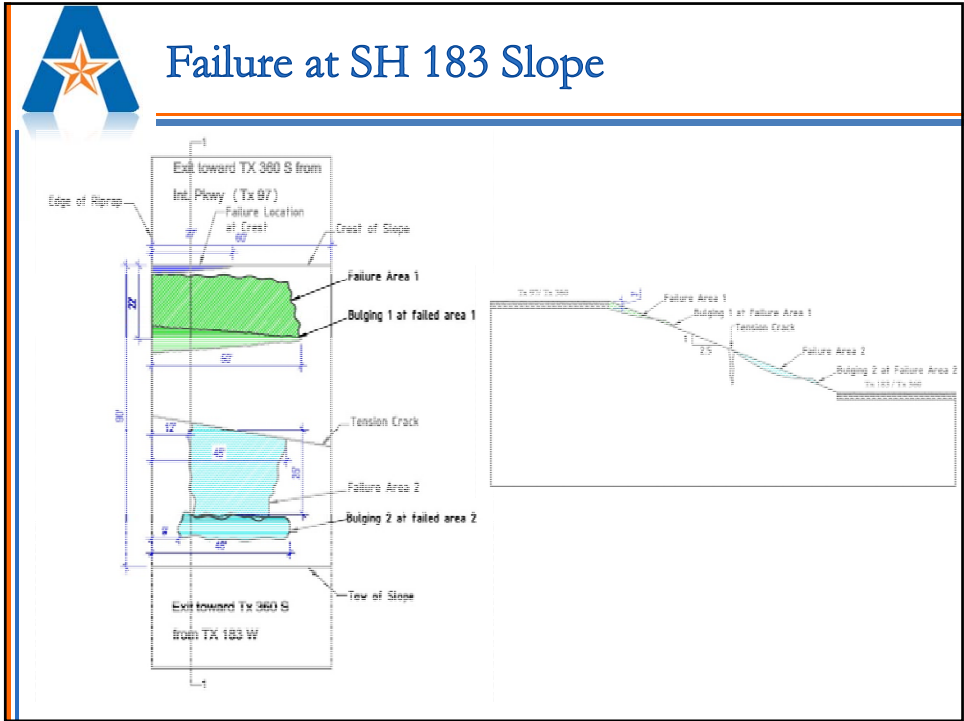






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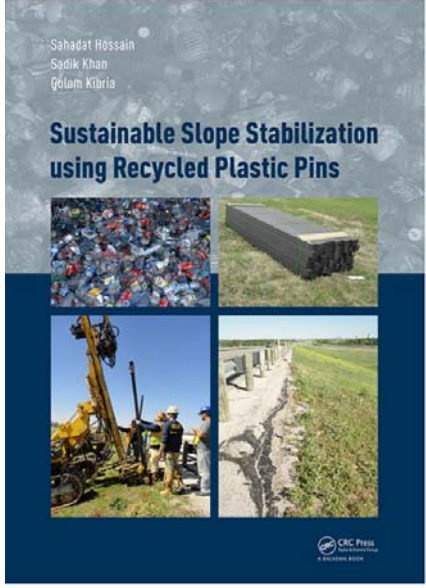


A Summary and Conclusion

- **RPP provided resistance against shallow slope failure**
- A Crawler-Mounted Rig, Equipped with a Mast-Mounted Pseudo Vibratory Hammer, Worked Effectively to Install RPPs
- On Average, a RPP Can be Installed within 4 Minutes, and a Total of 100 to 120 RPPs can be Installed in a Single Day.
- Settlement at Control Section is 15 inch
- Settlement at Reinforced Section 1 is 2.5 inch.
- Closer RPP Spacing at Crest Provided Higher Resistance against Slope Deformation
- RPP can save the stabilization cost up to 60% - 80% of conventional technique, and have potential to be a **effective sustainable alternative** to stabilize shallow slope failure.



Upcoming Book



Sustainable Slope Stabilization using Recycled Plastic Pins

Sahadat Hossain, Sadik Khan, Golam Kibria

May 5, 2017 **Forthcoming** by CRC Press

Reference - 238 Pages

ISBN 9781138636101 - CAT# K32128

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Thank You

