


Stabilization of Shallow Slope failure on Expansive Clay using Recycled Plastic Pin

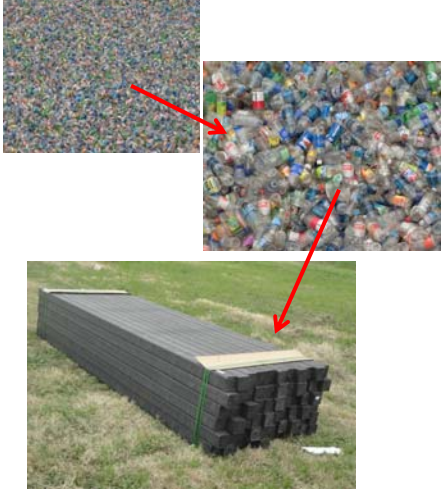
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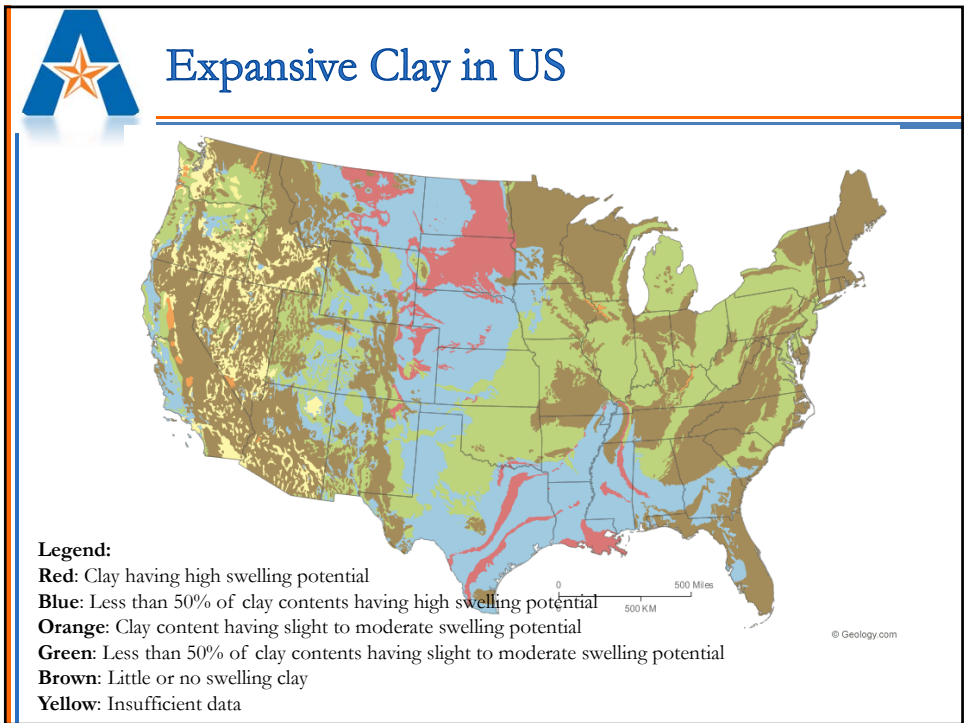
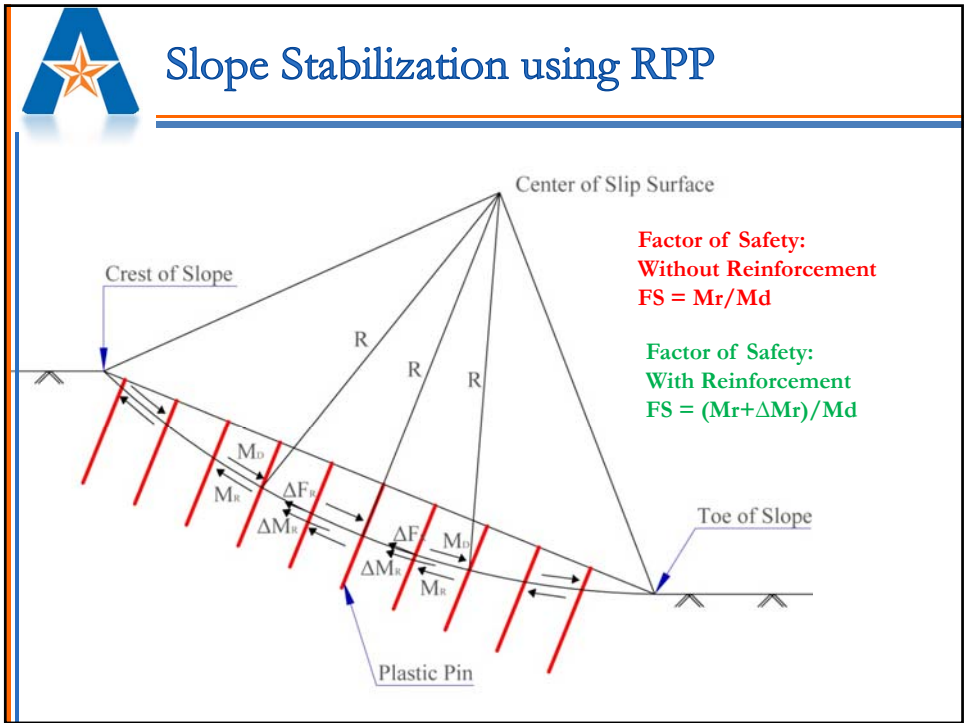


What is Recycled Plastic Pin?

- **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%

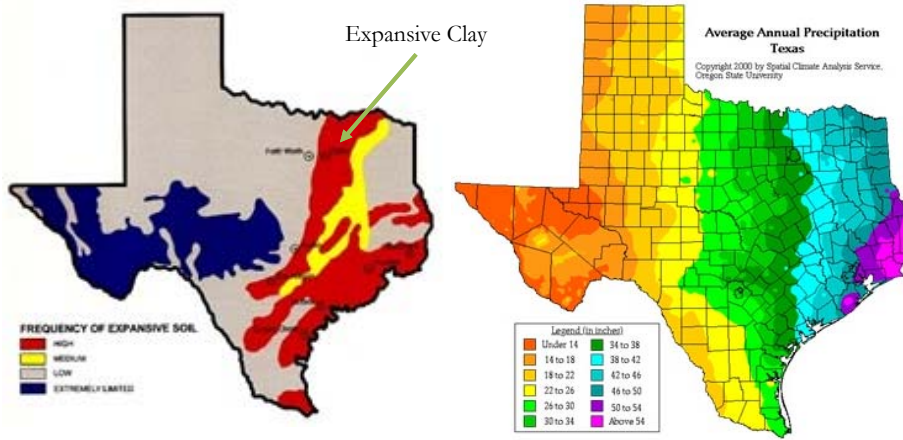


A 10' long RPP can replace 500 Soda Bottles





Major Slope Failures in North Texas



Most Slope Failure in Texas takes place due to the Shrink Swell behavior of Expansive Clay and Formation of Perched Water Zone due to Rainfall



Site Selection






Site Investigation: US 287 Slope

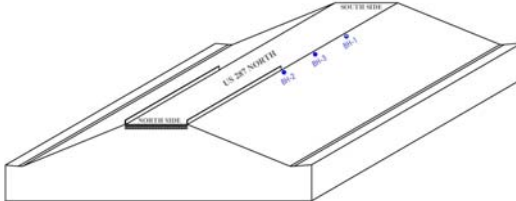


Site Location



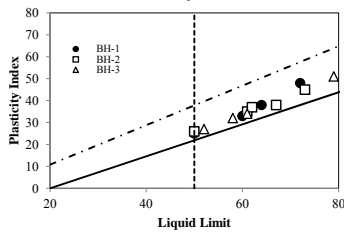


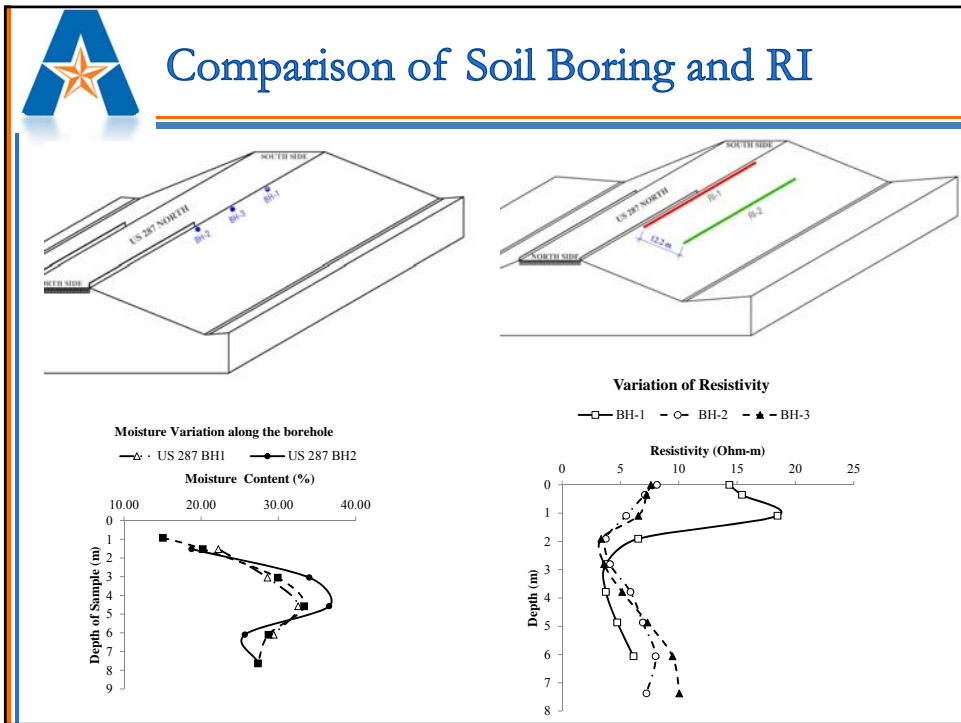
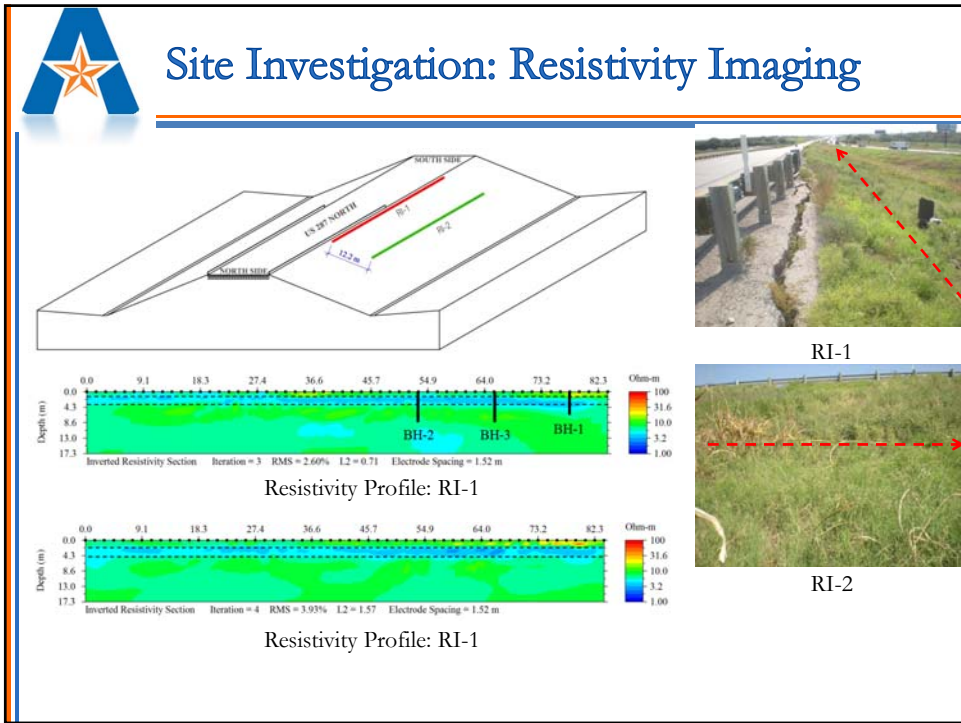
Site Investigation: Soil Boring

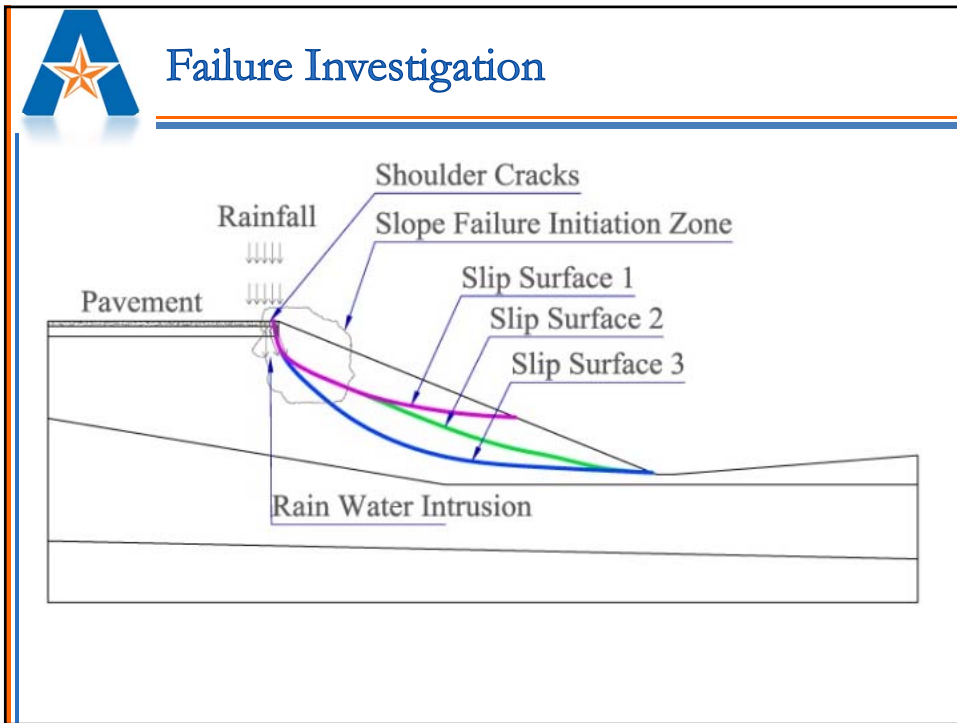
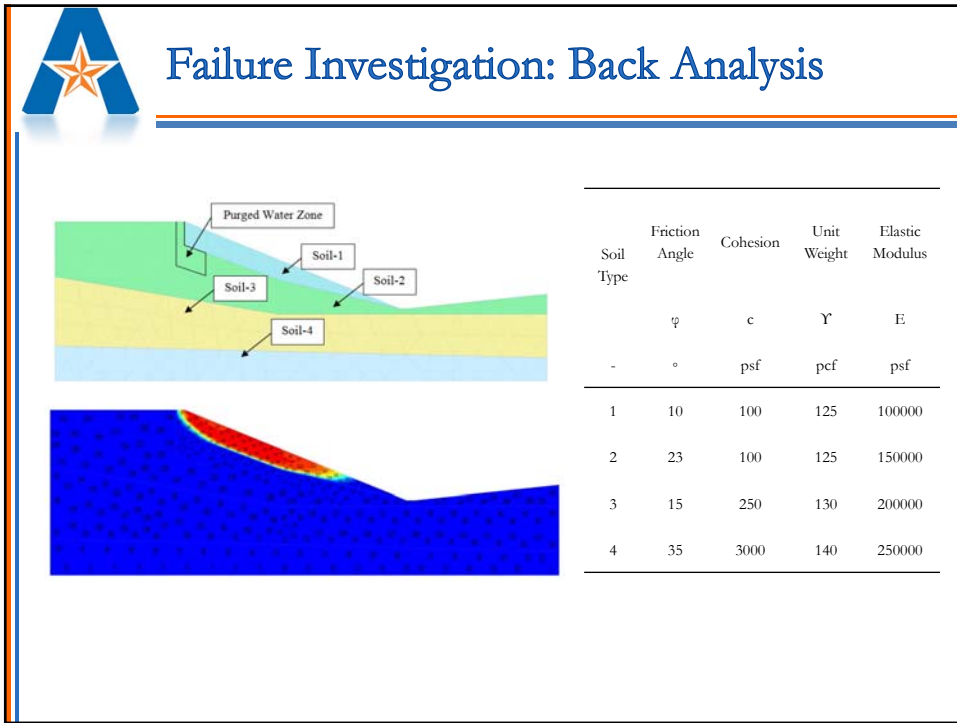


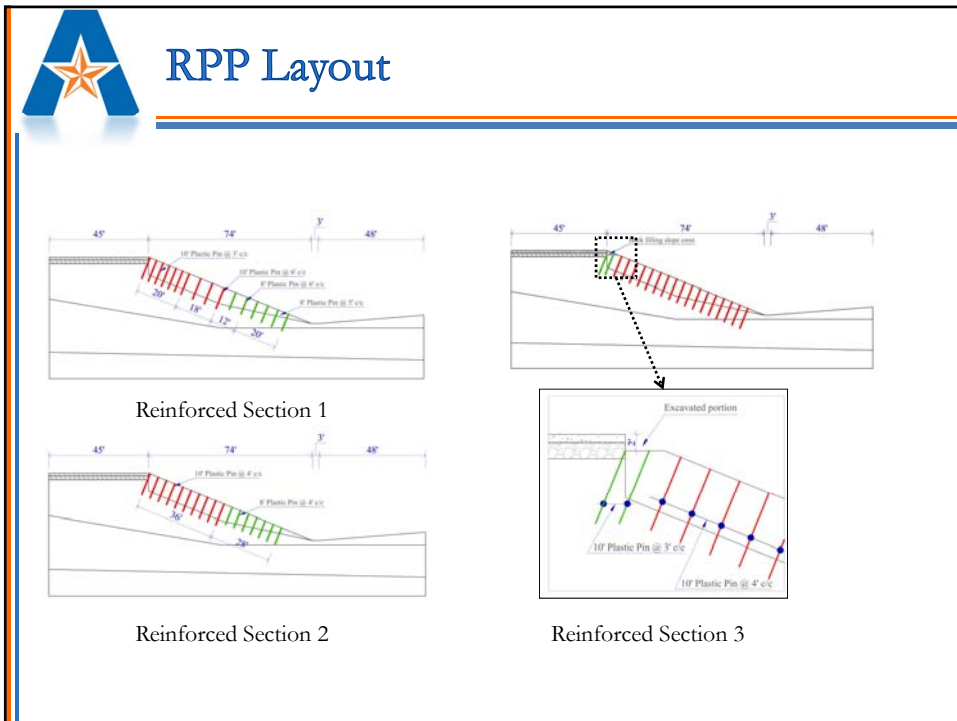
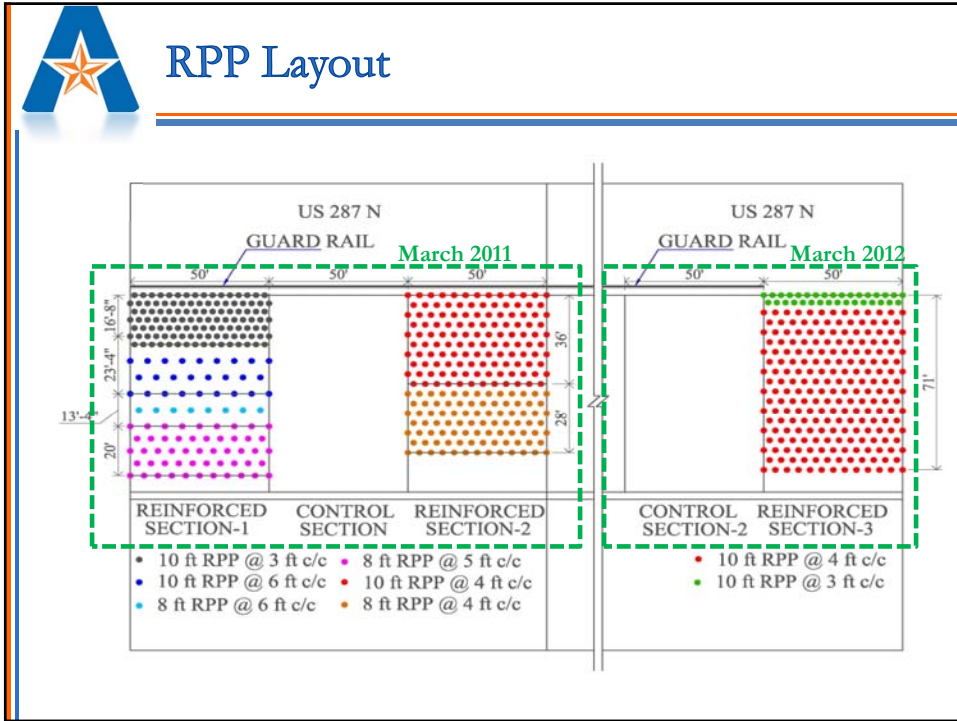
Bore Hole Location	Depth of Sample	Liquid Limit	Plasticity Index
BH-1	5	48	25
BH-1	10	60	33
BH-1	15	72	48
BH-1	20	64	38
BH-2	5	49	26
BH-2	10	67	38
BH-2	15	73	45
BH-2	20	61	35
BH-2	25	62	37
BH-3	5	52	27
BH-3	10	61	34
BH-3	15	79	51
BH-3	20	58	32
BH-3	25	62	40

Plasticity Chart



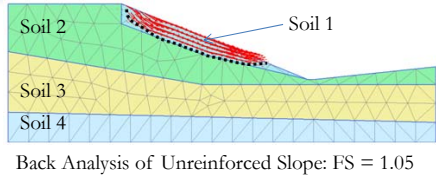






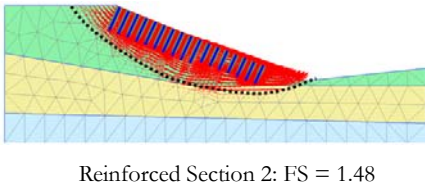
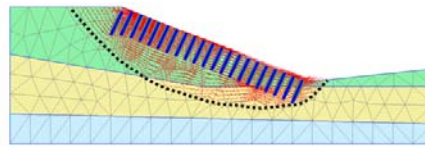
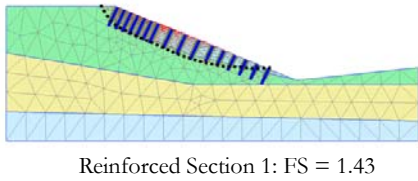


Design of Slope Stabilization

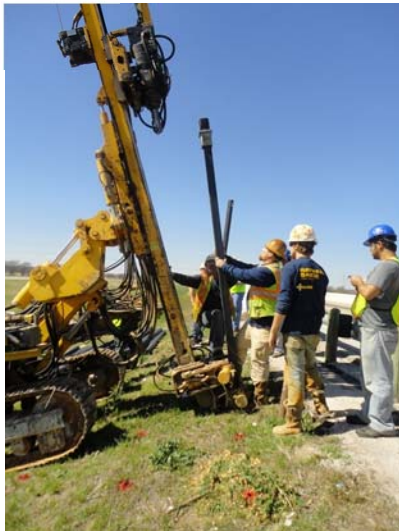


Back Calculated Soil Parameters

Soil Type	Friction Angle φ °	Cohesion c psf	Unit Weight γ pcf	Elastic Modulus E psf
1	10	100	125	100000
2	23	100	125	150000
3	15	250	130	200000
4	35	3000	140	250000



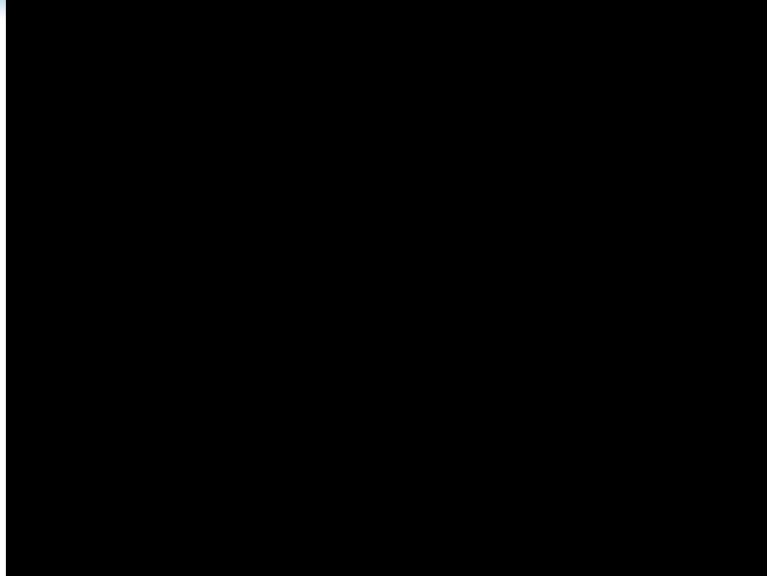
Installation of RPP: Reinforced Section 1 and Reinforced Section 2



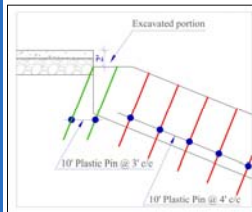
- Equipment: Klemm 802 Drill Rig
- Hammer Type: KD 1101



Installation of RPP:



Installation of RPP: Reinforced Section 3





Installation Details

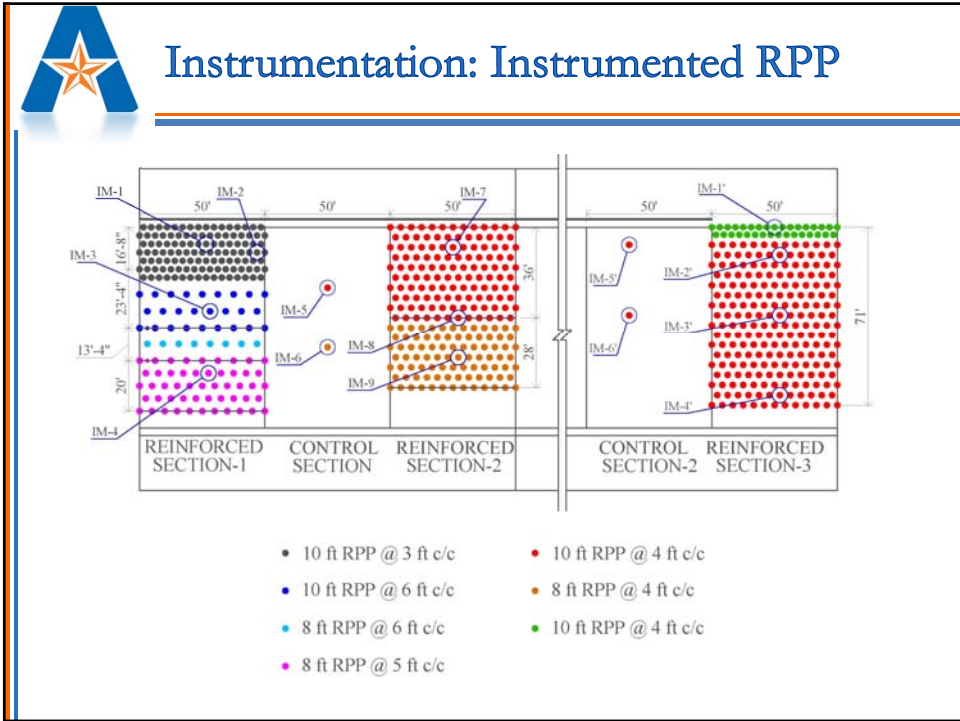
Section	No. of RPP	Installation Time(Day)	Start Date	Finished Date
Reinforced Section 1	192	2	March 01, 2011	March 03, 2011
Reinforced Section 2	225	2	March 04, 2011	March 05, 2011
Reinforced Section 3	238	3	Feb 29, 2012	March 6, 2012



Instrumentation

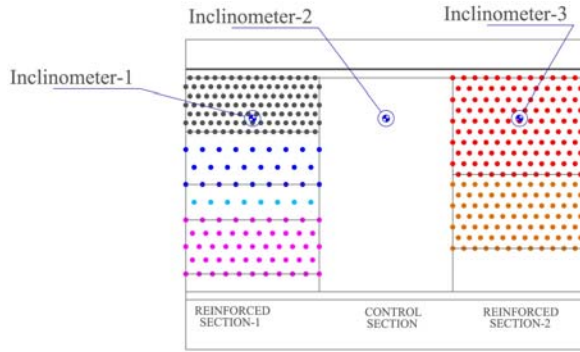
- Rain Gauge
- Instrumented RPP
- Surveying
- Inclinator
- Moisture Sensor
- Water Potential Probe



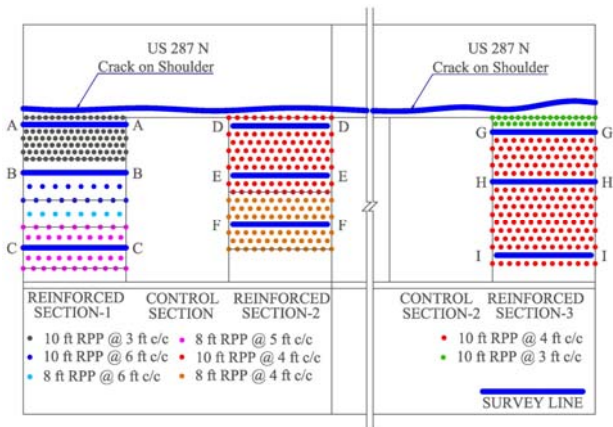


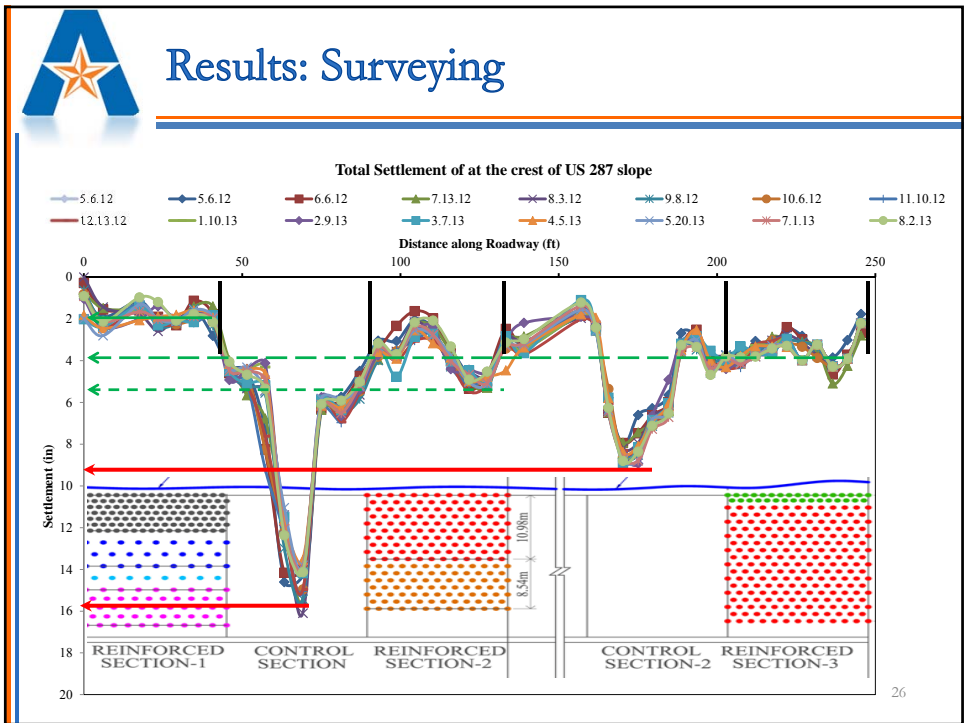
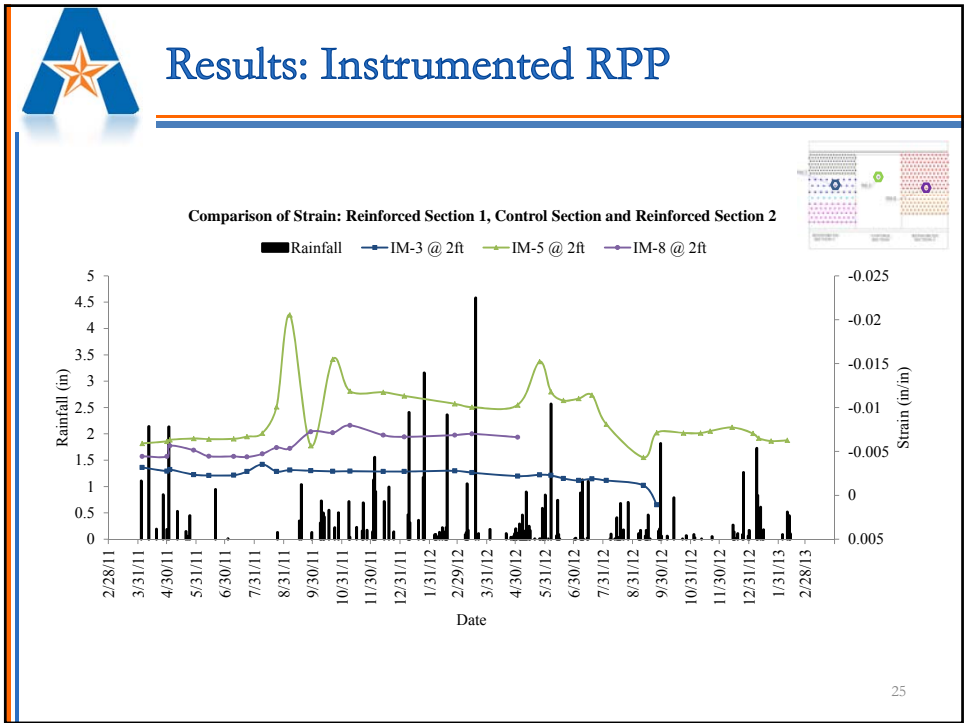


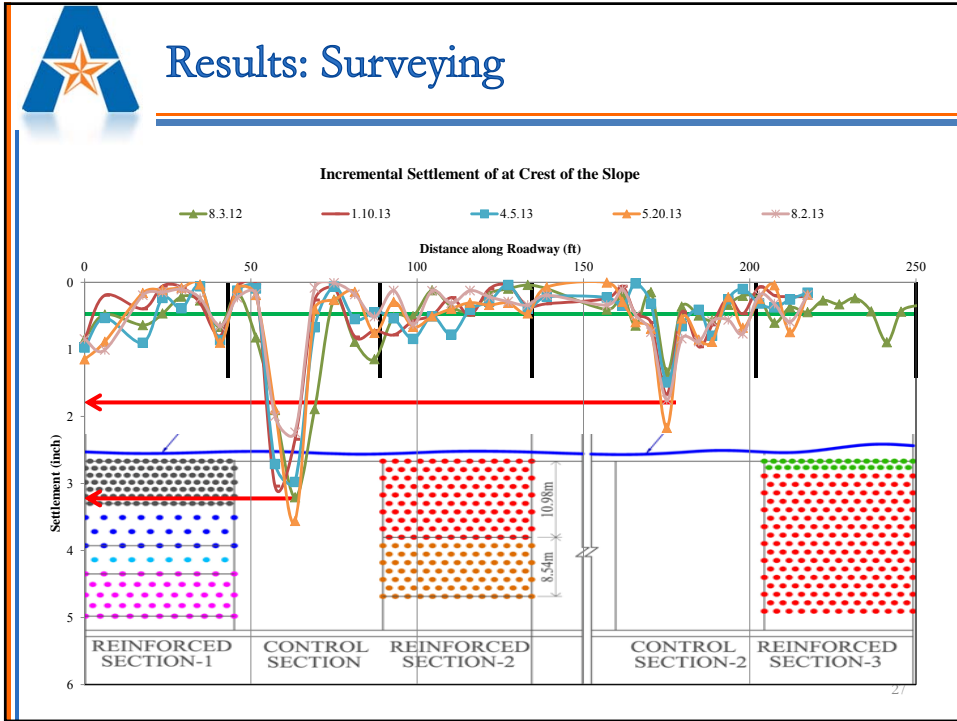
Instrumentation: Inclinator

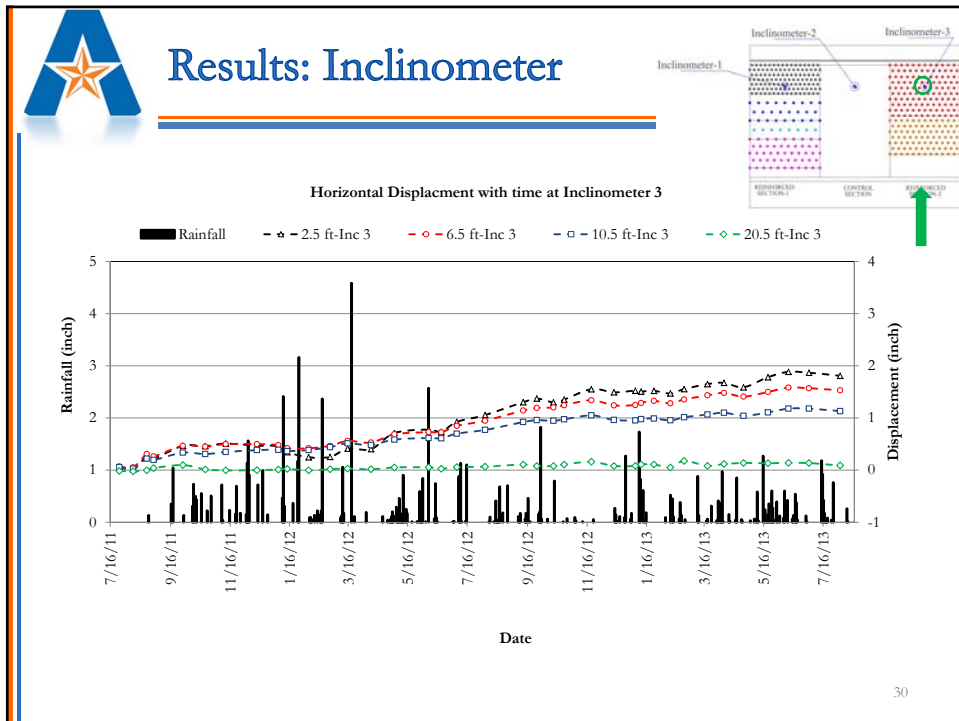
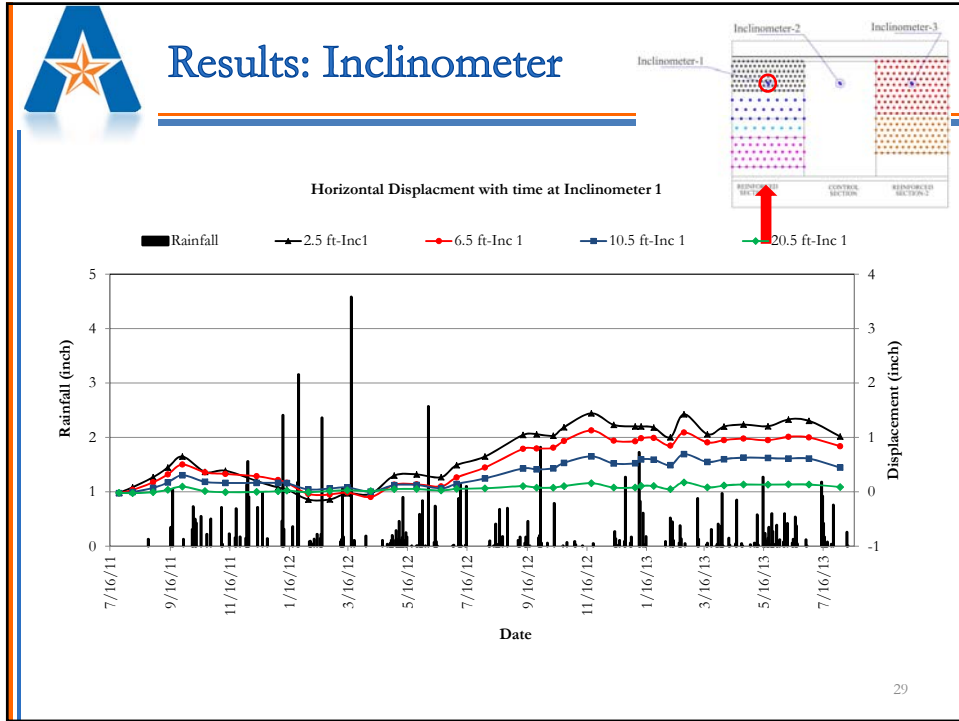


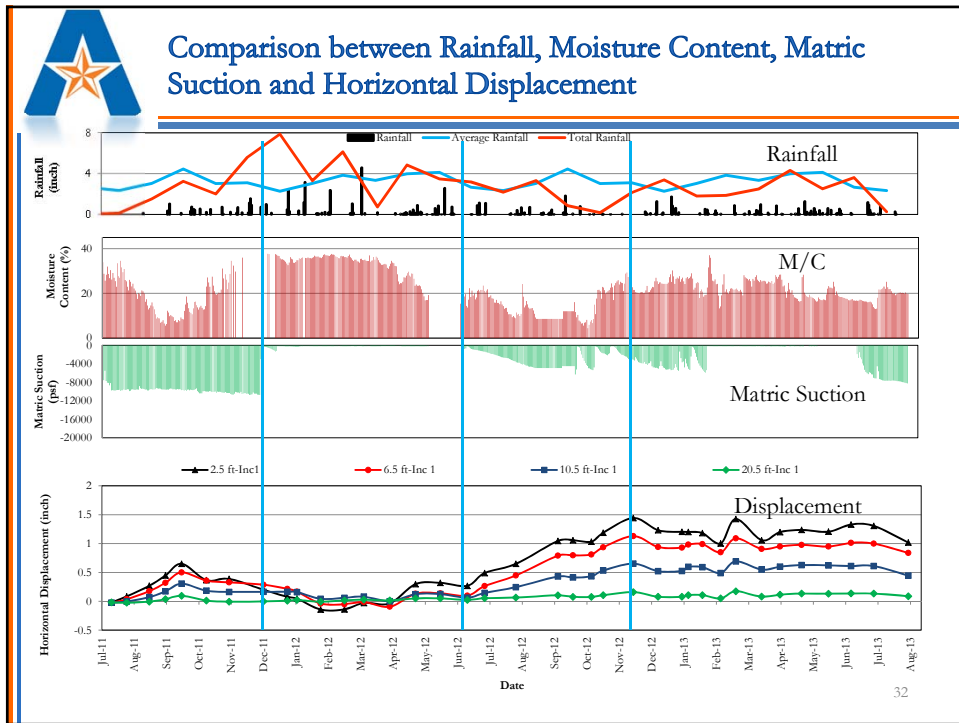
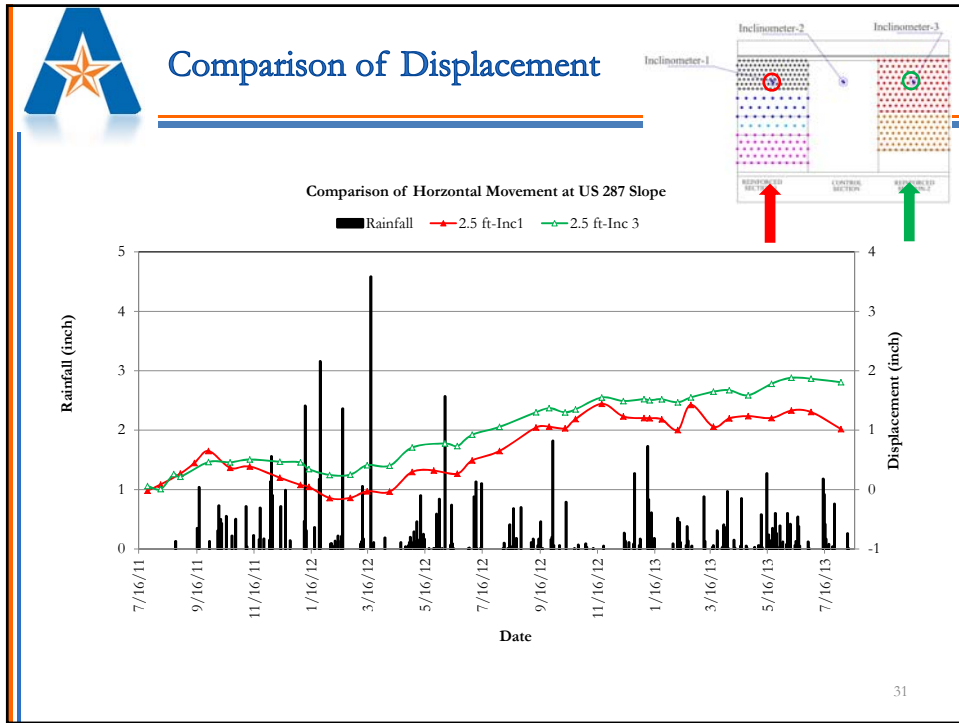
Instrumentation: Surveying

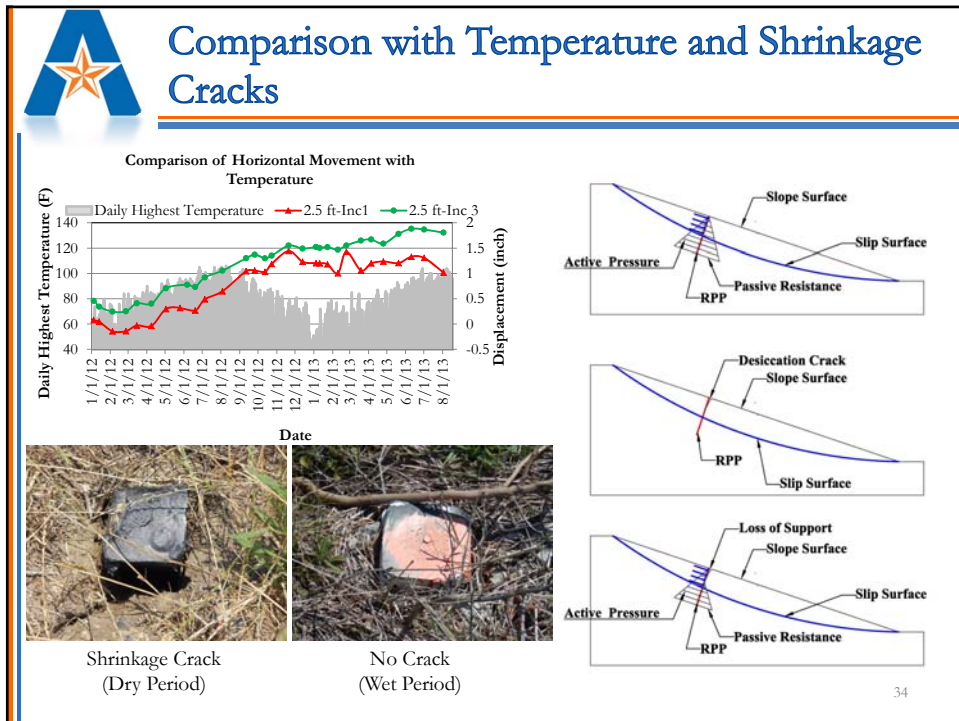
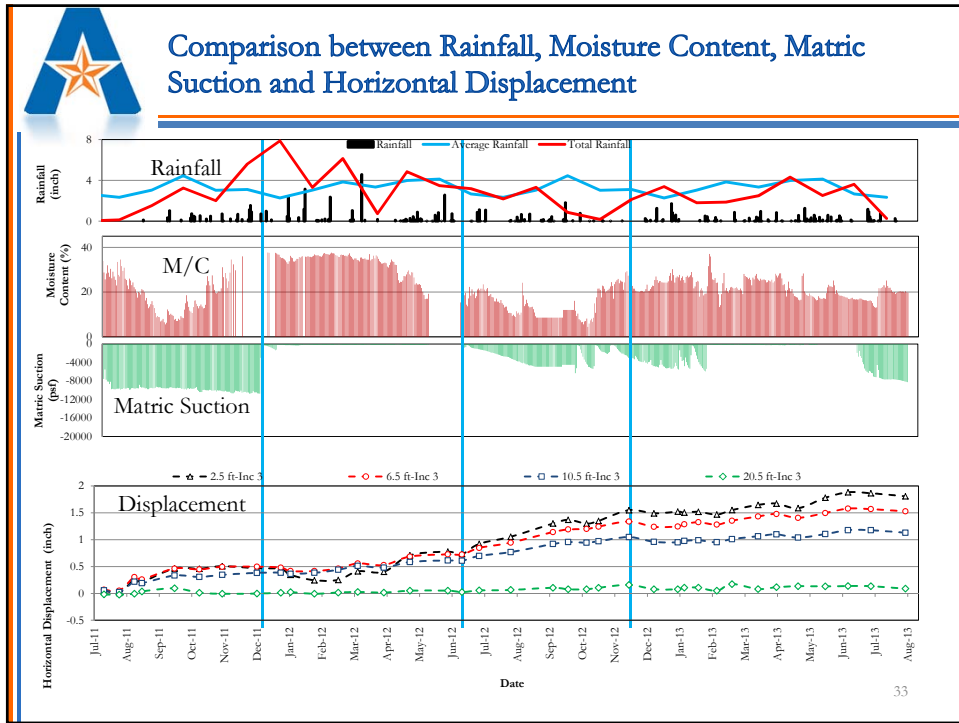


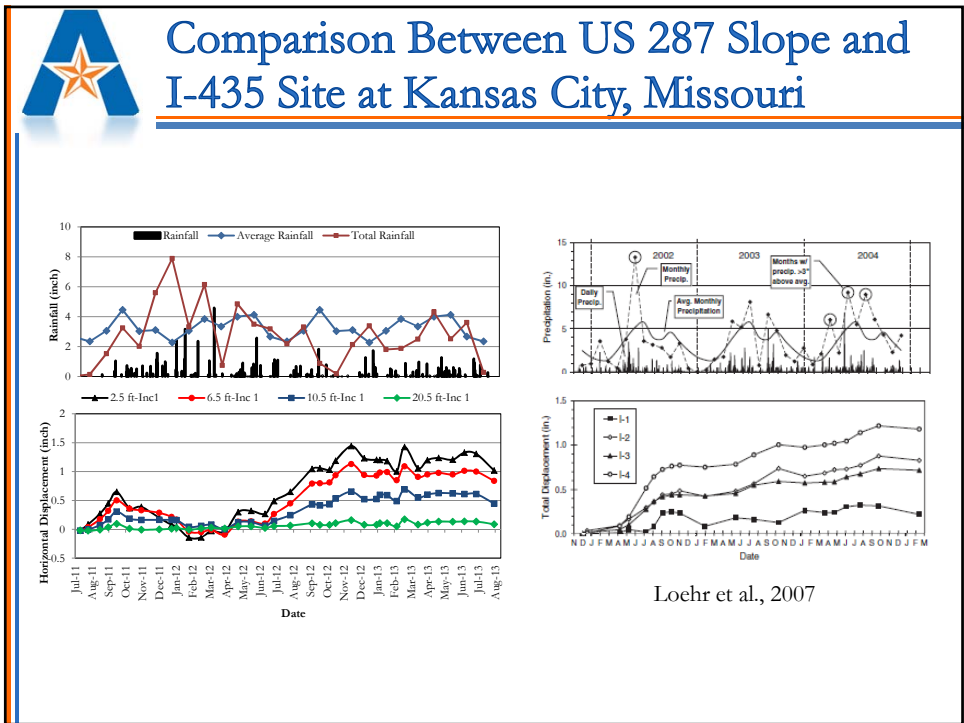
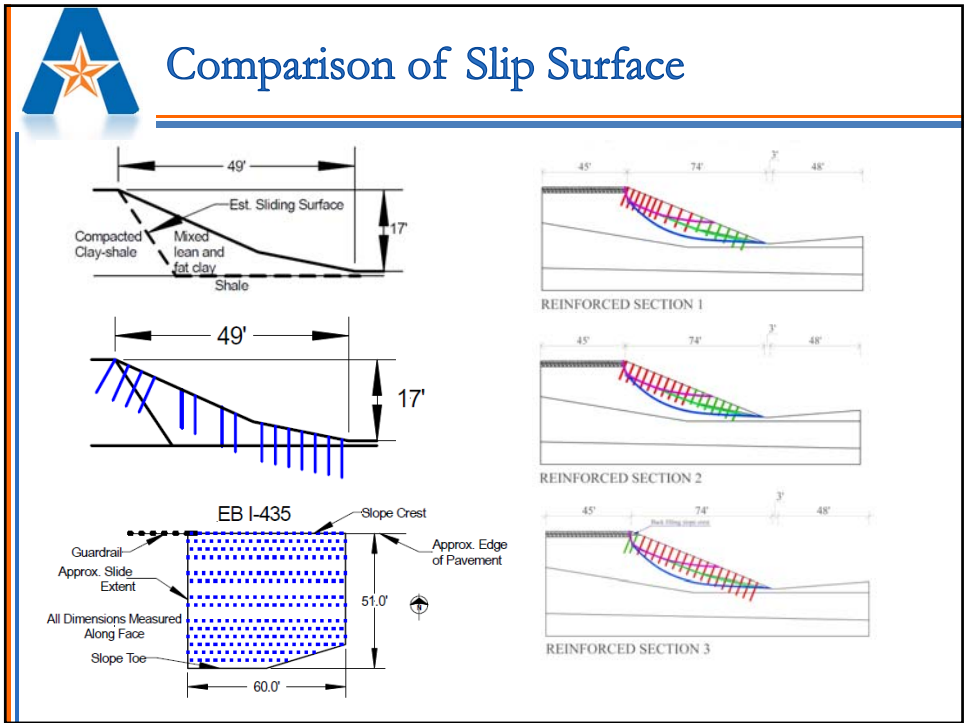


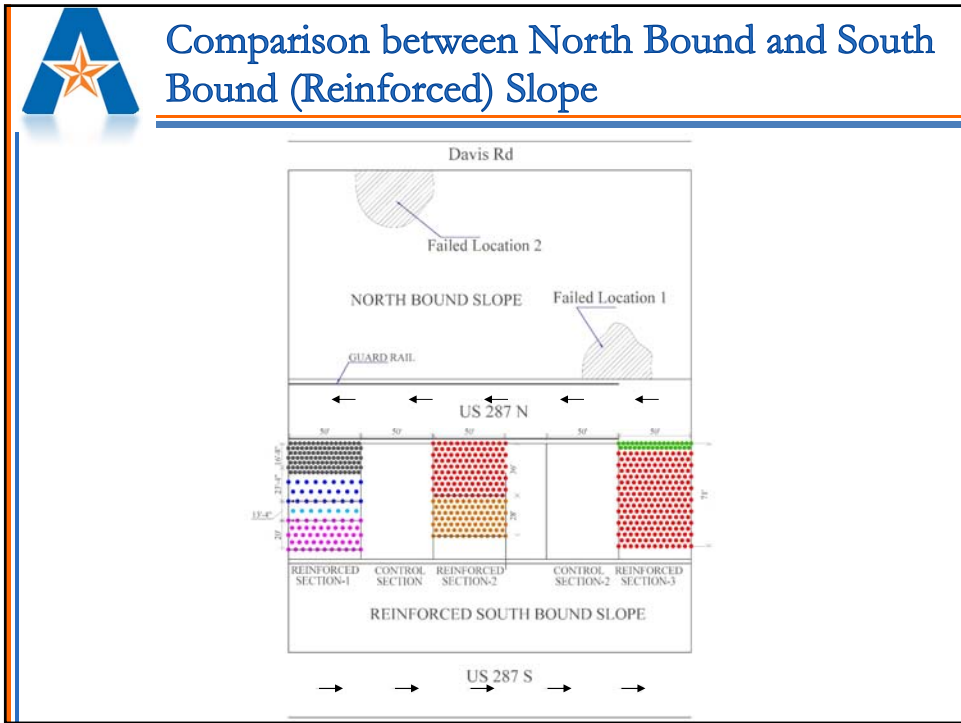


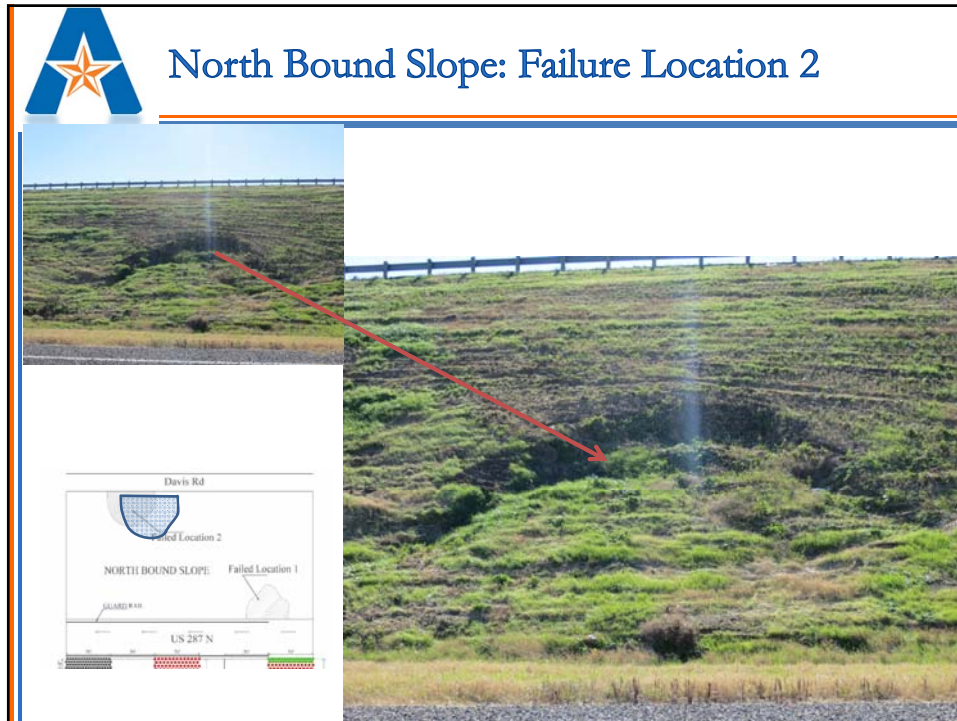












Summary and Conclusion

- **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
- Only 15% to 16% of the Total Capacity of RPP is Currently Mobilized
- 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.

