Field Jet Erosion Tests of Treated Clay Levee Embankments

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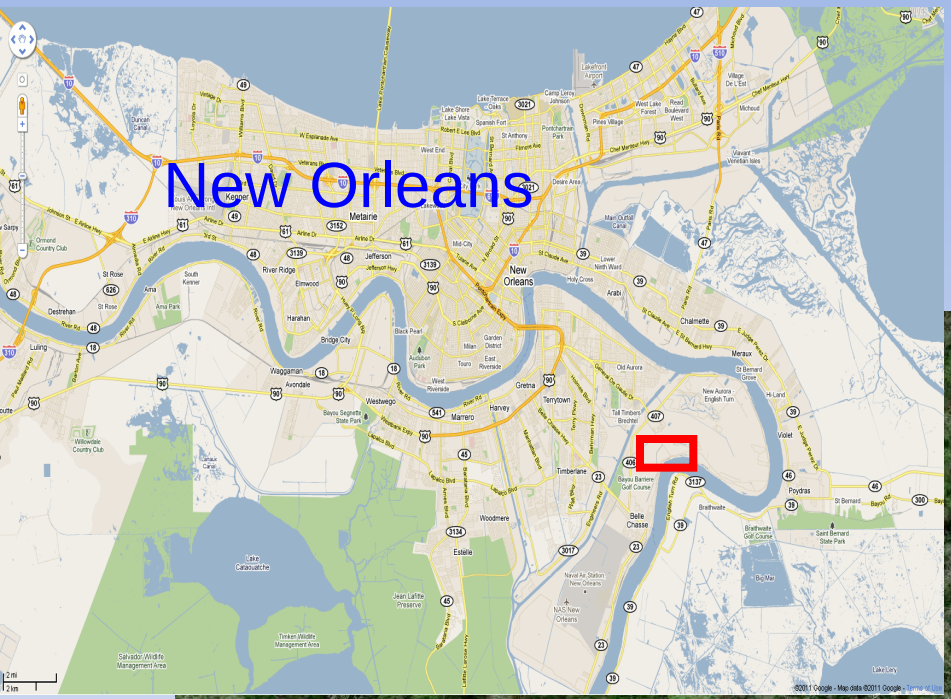
Objective

Discuss the results of field Jet Erosion Tests (JET) of lime and fly-ash treated clay

Project Location



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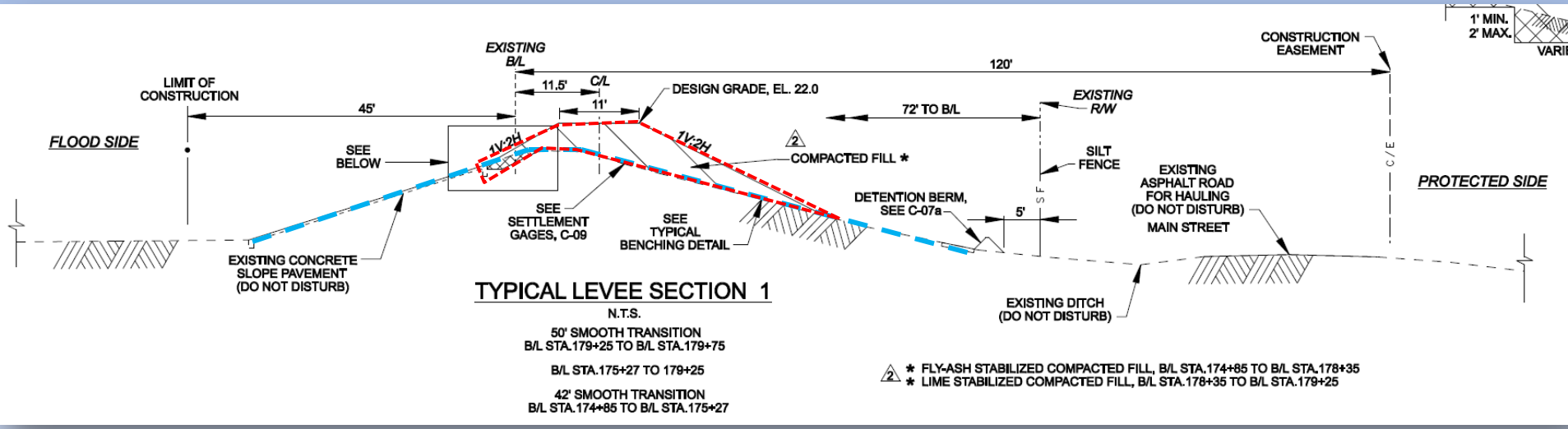
Demonstration Levee Typical Section



- Fly ash and lime treatment alternatives
  - Provide more resilient section
  - No additional foot print

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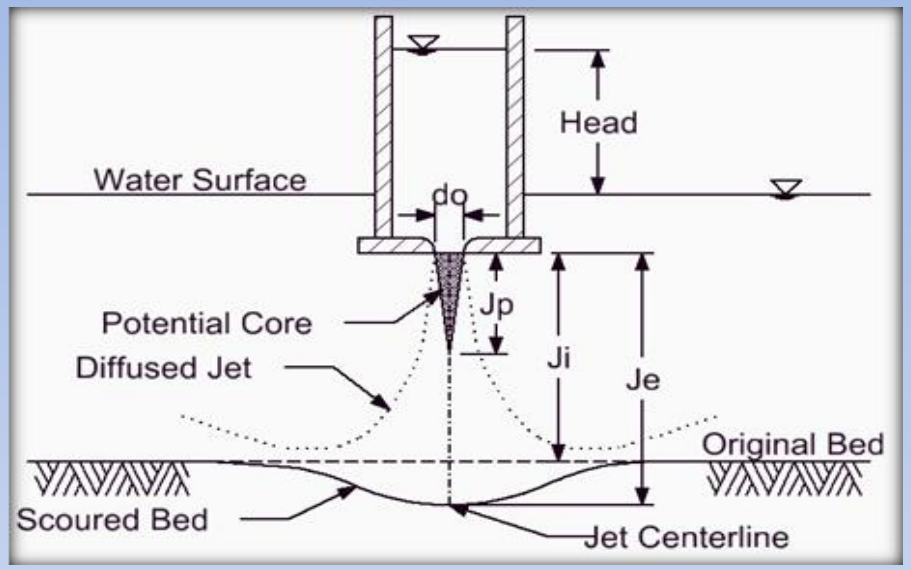
Demonstration Levee Material and JET Locations

Levee Section	Material	Jet Erosion Test Number	Number of Passes
Original Clay Levee	High Plasticity Clay	Test 1-4	
Fly-Ash Treated Clay (120 M)	Bonne Carre Clay, 5% Fly-Ash, 5% Bed-Ash	Test 5-8 and 13-16	2
Lime Treated Clay (120 M)	Bonnet Carre Clay, 8% Lime	Test 9-12	6

Schematic of Jet Erosion Process



Hanson & Cook, 1997

$$\varepsilon = k_d \left(\tau_e - \tau_c \right)$$

$$\tau_c = \tau_0 \left(\frac{J_p}{J_e} \right)^2$$

$$J_p = C_d \, d_0$$

$$\tau_0 = C_f \, \rho U_0^{\,2}$$

$$U_0 = \sqrt{2gh}$$

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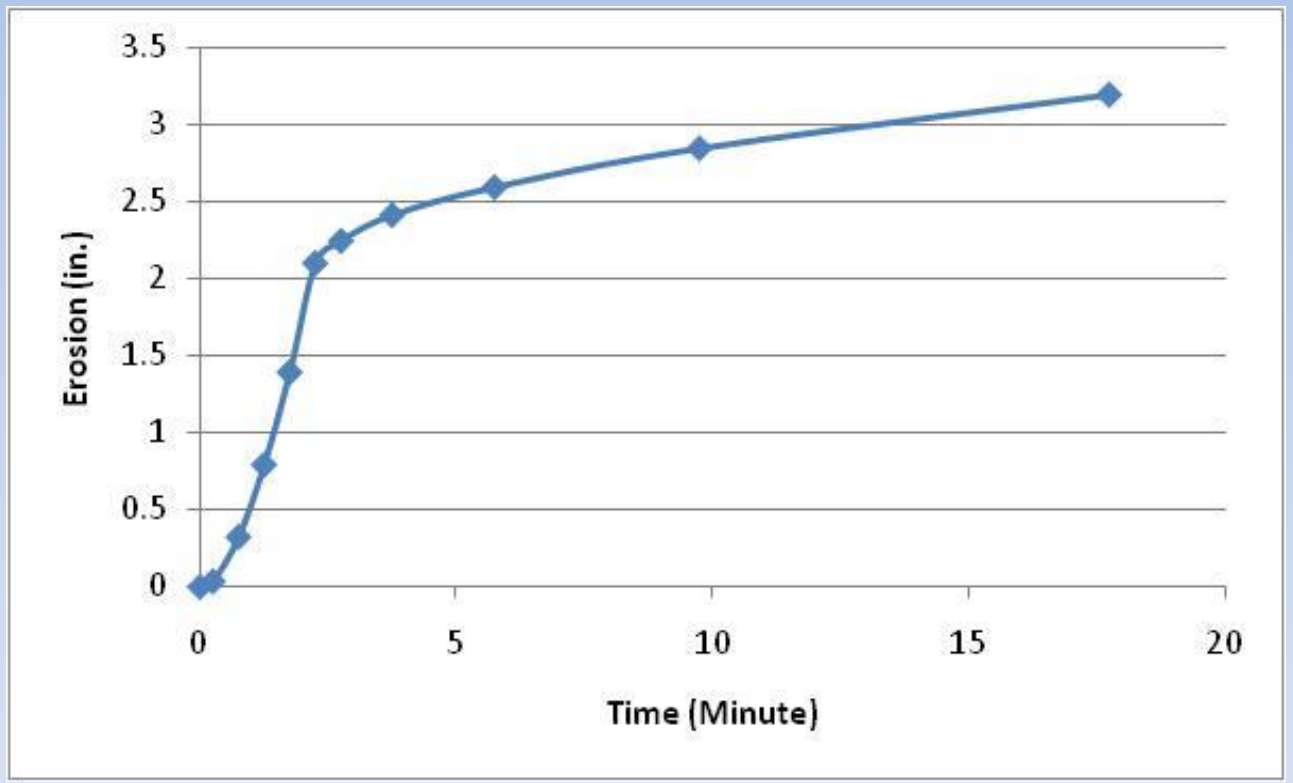
Jet Test Apparatus

Jet Erosion Test Data



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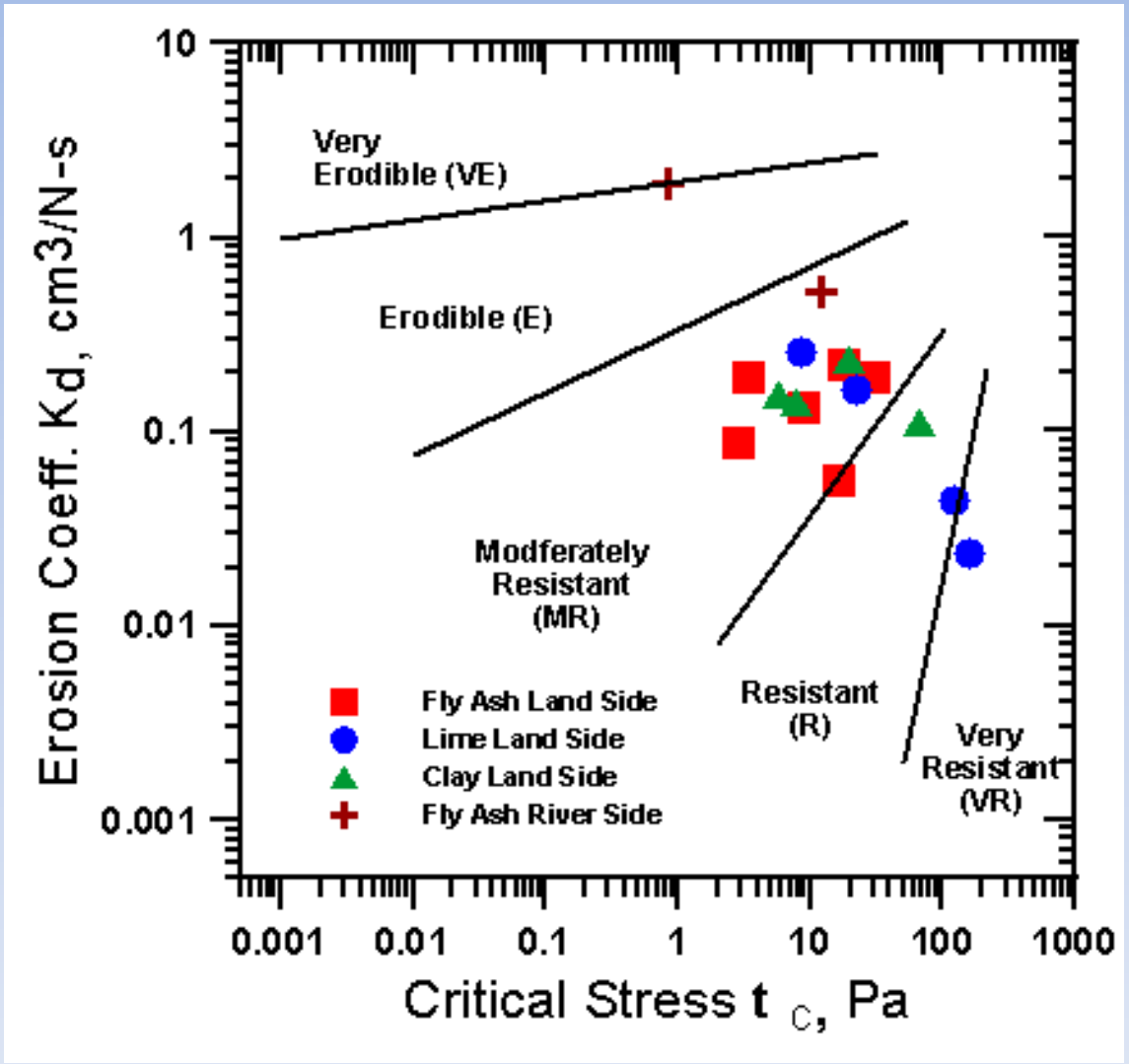
Summary of Field JET Results



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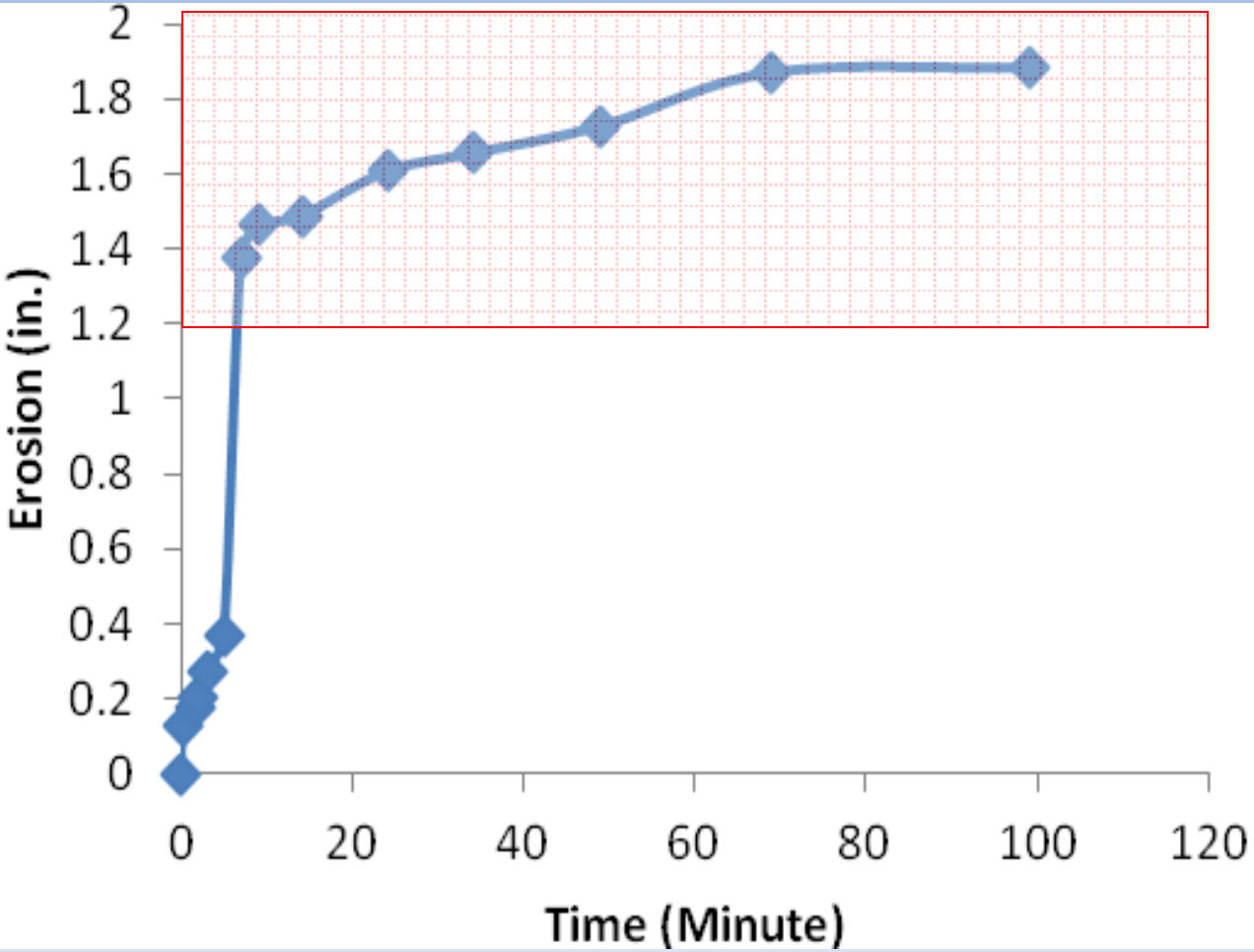
TTI Erosion Function Apparatus Results

Material	EROSION PARAMETERS	MEASURED VALUES						ERODI-BILITY
Bonnet Carrie (BC) Clay	Shear Stress (Pa)	0.92	1.09	4.02	6.39	14.0	22.6	Medium
	Erosion Rate (mm/hr)	0.00	0.00	1.02	3.72	15.1	29.2	
10% Fly Ash Treated BC Clay	Shear Stress (Pa)	26.0	42.0	58.2	86.7	110.1	129.2	Very Low
	Erosion Rate (mm/hr)	0.00	0.00	0.00	0.00	0.00	<0.1	
6% Lime Treated BC Clay	Shear Stress (Pa)	3.31	9.21	21.7	49.2	76.3	90.2	Very Low
	Erosion Rate (mm/hr)	0.00	0.00	0.00	0.00	<0.5	<0.2	

Heterogeneous Layers

(fly ash treated clay)



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Construction

Fly ash treated clay

- After mixing clay with 5 % fly ash and 5 % bed ash, material sit for about two – three week
- Two bulldozer passes

Lime treated clay

- After mixing clay with 8 % lime, material sit for about two – three week
- Six bulldozer passes

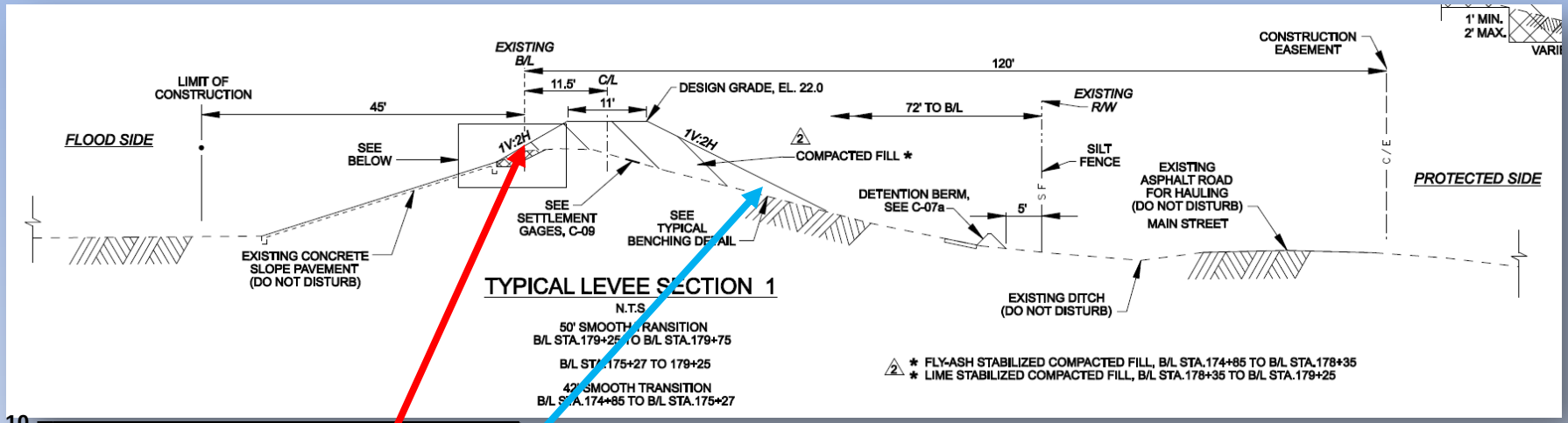
Field JET Tests

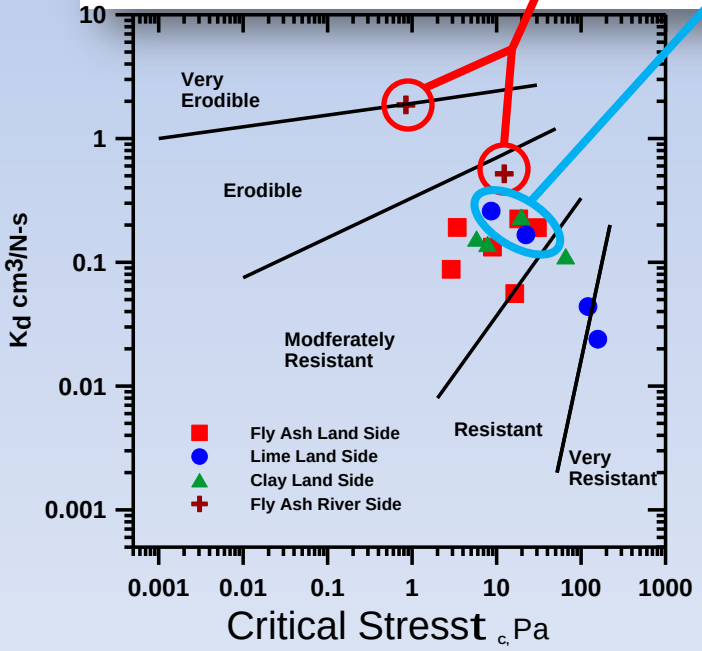
- Twelve weeks after construction

Laboratory Test by Texas Transportation Institute

- Compaction right away after mixing

Analysis of Variation





Geometry makes the embankment toe harder to compact properly!!

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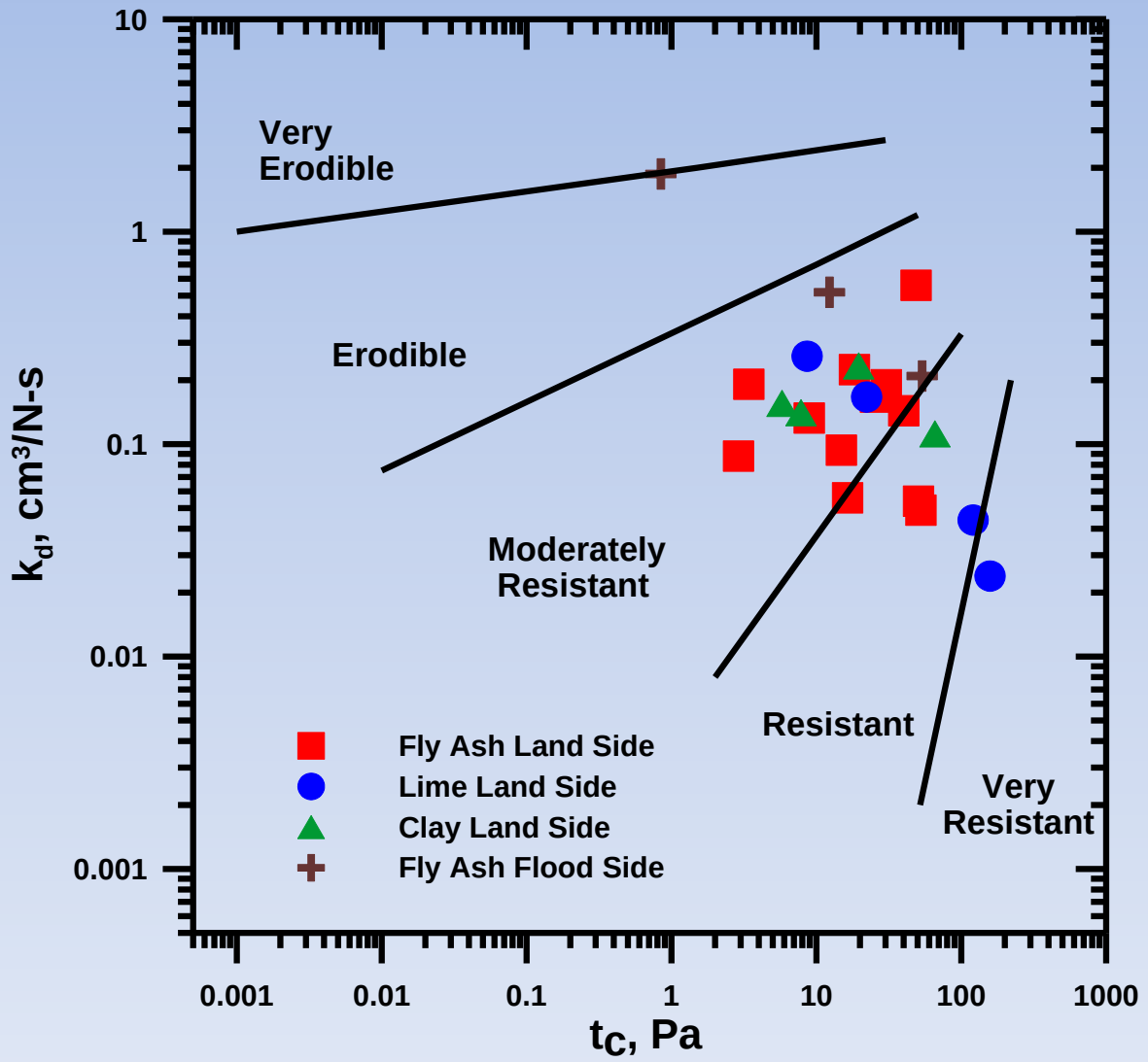
TEST 15 .
CLAY FLYASH
LEVEE TOE
Lufkin

Jet Tests Erosion Tests

		Erosion Parameters			Secondary Parameters		
Test #	Location	k_d *(cm³/N-s)*	τ_c *(Pa)*	Category	k_d *(cm³/N-s)*	τ_c *(Pa)*	Category
1	Clay Levee, LS	0.156	5.762	MR			
2	Clay Levee, LS	0.141	7.796	MR			
3	Clay Levee, LS	0.112	65.536	R			
4	Clay Levee, LS	0.234	19.503	MR			
5	Clay w/Fly ash, LS	0.088	2.899	MR			
6	Clay w/Fly ash, LS	0.056	16.371	R	0.054	50.433	R
7	Clay w/Fly ash, LS	0.225	18.229	MR	0.167	25.46	MR-R
8	Clay w/Fly ash, LS	0.191	30.225	MR	0.144	39.878	R
9	Clay w/Lime, LS	0.167	22.247	MR			
10	Clay w/Lime, LS	0.260	8.592	MR			
11	Clay w/Lime, LS	0.024	157.251	VR			
12	Clay w/Lime, LS	0.094	120.201	VR			
13	Clay w/Fly ash, RS	1.875	0.841	E			
14	Clay w/Fly ash, RS	0.52	12.272	MR	0.21	53.483	R
15	Clay w/Fly ash, LS	0.133	8.899	MR	0.049	52.48	R
16	Clay w/Fly ash, LS	0.192	3.048	MR	0.094	14.797	MR

Summary of Erodibility Test Results



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Conclusions

- Field Jet Erosion tests were conducted to asses the erodibility of lime and fly-ash treated soil and untreated soil
- Both treatment improve the erosion resistance
- Improper construction procedures can reduce erosion resistance
- Reduction resistance was illustrated by significantly higher detachment coefficient measure in the field than in the laboratory

Questions?

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