

MoDOT's Experience with Electronic Acquisition and Management of Geotechnical Field Data

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Midwest Geotechnical Conference



MoDOT – In the Past!

- Handwritten Field Logs
- Typed Final Logs

MoDOT – Geotechnical Section
Log of Sampling & Drilling Operations

Project No.: 34P1138B District: 4 County: Johnson Route: 13
 Bridge No.: A7609 MSE Wall Driller's Hole No.: L-07-47 Date: 12-6-07
 Station: 655+50 Offset: 51.33' RT Surface Elevation: 763.3'
 Coord. Location: 900940.72E 960411.12N Coord. Zone:
 Coord. Datum: U.S. Survey Feet Coord. Proj. Factor:
 General Location: West of Intersection of Rte 13 + ERL + WBL 06+50
 Logged By: Clayton Weather: Cold, Mid 30's, Breezy, some + fog
 Operator: Matthews Drill Equipment: Falling 1500 Drill No.: G-7889
 Height of Fill: Water Table Depth: Moisture Can No.:

Depth From - Length Recovery	P.P., fcf	T _v , fcf	Tare	Sample #	Test	DESCRIPTION	Type Sampler	Std. Pen. Blows/6"
0.0 - 1.5'	1.25	0.85	391	518	ASTM	0.0-5.0' Brown lean clay, stiff, moist.	3"	
1.5 - 2.5'				519	QU	5.0-7.5' Brown mottled lean clay, hard, moist.	3"	
2.5 - 5.0'	4.0	0.9	175	520	ASTM	7.5-12.5' Brown lean clay, stiff		
5.0 - 7.5'	3.50	0.9	383	522	ASTM	10.5-12.5' Brown mottled lean clay, very stiff, moist.		
7.5 - 10.0'	1.75	0.60	166	523	ASTM	12.5-15.0' Dark Gray thinly laminated shale, moderate hard.	3"	
10.0 - 12.5'	3.00	0.80	485	525	ASTM	15.0-16.2' Tanish-brown thinly laminated limy shale, moderate hard.	3"	
12.5 - 15.0'	4.5'	0.9'	455	527	ASTM		3"	
				528	QU			

From TO Run REC Loss
 15.0' 200 5.0' 5.0' 0
 25.0' 300 5.0' 5.0' 0
 22.0' 25.0'

7MSDO 529 @ 19.4' shale QU
 7MSDO 530 @ 30.0' shale QU

MISSOURI DEPARTMENT OF TRANSPORTATION
Construction and Materials

BORING DATA (CORE & SPT)

Job No.: 34P1138B Route: 13 Sheet 3 of 3
 County: Johnson Design: A7609
 Over: Retaining Wall Skew: Right Angles
 Logged by: Clayton Operator: Matthews
 Equipment: Falling 1500 Driller's Hole No.: L-07-47
 Hole Stab. by: Drilling Fluids Date of Work: 12/6/2007
 Automatic Hammer Efficiency: 71% Drill No.: G-7889

Test	Station	Location	Surface Elevation	LOG OF MATERIALS*
	655+50.0	51.33' RT	763.3	0.0-12.5' Brown lean to fat clay, stiff to very stiff, moist.
	303092.72E	960411.12N		12.5-16.2' Dark gray thinly laminated shale, stiff.
				16.2-25.0' Tanish-brown thinly laminated limy shale, soft.

TEST DATA				
Depth, ft.	SPT Blows*	N ₆₀	P.P., fcf	W ₉₀ %
1.0			1.25	0.85
3.0			4.0	0.9+
5.5			3.5	0.9+
8.0			1.75	0.6
11.0			3.0	0.8
13.0			4.5+	0.9

SOIL CLASSIFICATION TEST DATA				
Depth, ft.	LI	PI	ASTM Class.	
5.5	53	37	CH	
11.0	44	28	CL	

UNCONFINED COMPRESSIVE STRENGTH				
Depth, ft.	TEST DATA		P.P., fcf	
	Q _u , psi	Q _u , ksf	Q _u , psi	Q _u , ksf
8.0	1.2	1.75	19.4	19.8
23.3	32.0	9.0+		

CORING LOG (NY Double Tube Barrel)						
From	To	Reac	Rec	Loss	% RQD	Notes
15.0	20.0	5.0	5.0	0.0		Shale
20.0	25.0	5.0	5.0	0.0		Shale

WATER TABLE OBSERVATIONS				
Date	Time Change	Depth Hole Open	Depth To Water	

Coordinate System: Modified U.S. State Plane 1983 Coordinate Zone: Missouri West 2403
 Coordinate Datum: NAD 83 (CONUS) Coordinate Units: U.S. Survey Feet Coordinate Projection Factor: 1.00004101



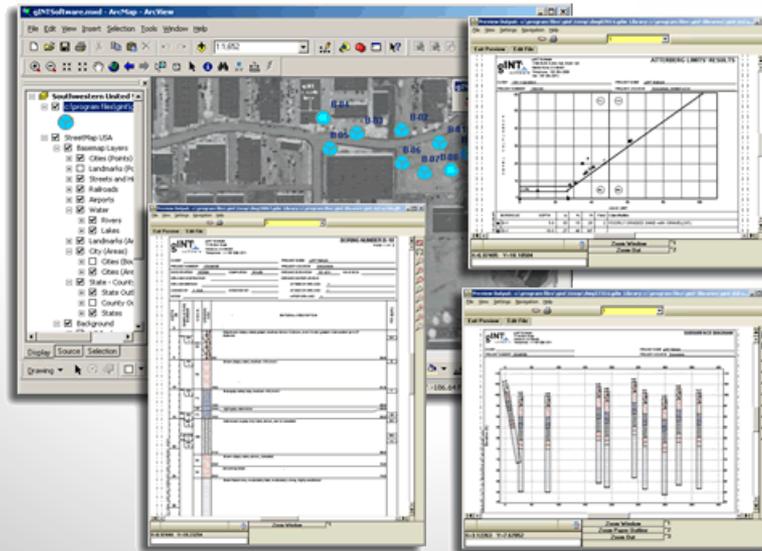
MoDOT – Now!

- *Electronic Data Acquisition (Field)*
 - Software – PLog
 - Hardware – Tablet



MoDOT – Now!

- *Electronic Data Management and Reporting (Office)*
 - Software – gINT
 - Hardware - PC



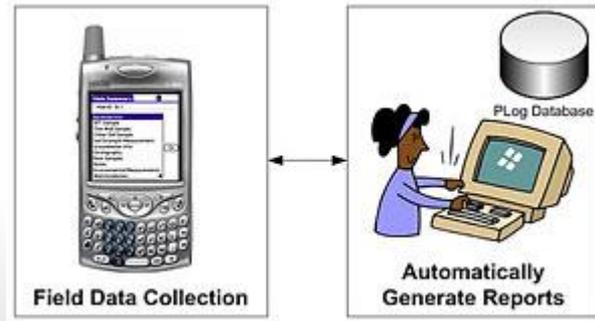
Why the Change?



Why the Change?

Save Time

- ✓ Data is entered only once in the field and then edited/supplemented as necessary in the office



Why the Change?

Avoid errors associated with re-entering data from field to office

- ✓ Typos
- ✓ Transposition
- ✓ Illegible handwriting
- ✓ Smudges/Stains – mud, grease, coffee



Why the Change?

Form T-101 (RMO) Rev. 12/07
 1 = 67-58

MISSOURI DEPARTMENT OF TRANSPORTATION
 Division of Materials

BORING DATA (CORE & SPT) Sheet of

Job No. J2S2158 Design A7931
 County Wain Route WW Skew 10° L.A.
 Over Clark Branch Operator Murray
 Logged by Davis Drillers Hole No. F-17-54
 Equipment CME 45 Date of Work 7/22-7/24/2012
 Hole Stab. by hollow-stem augers Drill No. G7963
 Automatic Hammer Efficiency %

Beat	Station	Location	Surface Elevation	LOG OF MATERIALS*	
2	68+42	16' AT	793.8	Inaccessible due to slope, bridge and	
off	68+36.3	8.5' AT	795.0	0-5.6' Gray lean clay, med. stiff, med. um	
TEST DATA					
Depth, ft.	SPT Blows/6"	N ₆₀	Pocket Pen., tsf		
1.0	2-2	0	0.8	5.6-9.3' Gray sandy lean clay, trace gravel, med. stiff	
0.6	12-1	0	0.75	9.3-21.8' Gray, lean clay, moist, stiff, moist	
1.5	0-0	0	0.6	21.8-28.9' Gray clayey sand, scattered gravel	
1.5	0-22	1	1.25	loose, var.	
1.5	0-01	1	0.65	29.5-32.4' Brown gravelly sand with lean clay	
0.6	16-22	4	—	32.4' clay lens, saturated	
0.9	17-35.5	5	7.2	32.4-37.8' Gray clay shale, soft, cut with rock bit	
0.4	27.5	5	6.5	37.8-59.2' Gray, thinly laminated to thickly laminated silt shale, unweathered, soft	
0.4	35.3	5	—	59.2-61.1' Light gray fine-grained thin- to medium bedded limestone, hard	
CORING LOG (NX Double Tube Barrel)				61.1-66.0' Dark gray, thickly laminated organic shale to coal, hard	
From	To	Rec	Loss	% ROD	Notes
37.8'	42.8'	5.0'	4.0'	1.0	shale
42.8'	47.8'	5.0'	5.0'	0	shale
47.8'	52.8'	5.0'	5.0'	0	"
52.8'	57.8'	5.0'	5.0'	0	"
57.8'	62.8'	5.0'	5.0'	0	38% shale
62.8'	67.8'	5.0'	5.0'	0	66.0-67.8' Green, thinly laminated clay shale, soft

WATER TABLE OBSERVATIONS			
Date	Time Change	Depth Hole Open	Depth To Water
7/25/2012	23 hrs	23.2'	8'8"

N₆₀ - Corrected N value for standard 60% SPT efficiency.
 T₆₀ - Measured transfer efficiency in percent.
 N₆₀ (Emp/60)N₆₀ - Observed N-value.

* Persons using this information are cautioned that the materials shown are determined by the equipment noted and accuracy of the "log of materials" is limited thereby and by judgment of the operator. THIS INFORMATION IS FOR DESIGN PURPOSES ONLY.

MoDOT - Geotechnical Section
 Log of Sampling & Drilling Operations

Project No.: J610985 District: SL County: ST. LOUIS CITY Route: I-64
 Bridge No.: Drillers Hole No.: T-12-09 Date: 01/31/2012
 Station: Offset: Surface Elevation: 459.3
 Coord. Location: Coord. Zone:
 Coord. Datum: Coord. Units: U.S. Survey Feet Coord. Proj. Factor:
 General Location:
 Logged By: THOMAS Weather:
 Operator: MURRAY Drill Equipment: CME-45 Drill No.: G9577
 Height of Fill: Water Table Depth: Moisture Can No.: 124E1T029

Depth From	Length Recovery	R.P., tsf	T _v , tsf	Tare	Sample #	Test	DESCRIPTION	Type Sampler	Std. Pen. Blows/6"
5.0	1.5	1.50	0.40	264	0301 ASTM		0.0' - 0.3' - Pec	3"	
6.6					0310		0.3' - 3.4		
9	1.0	1.50					Dk. brown lean clay w/ gravel, moist, stiff.	S	4
6.6							3.4' - 16.5'	P	3 10
10.0							Dk. tan lean clay (cc-me), trace gravel, moist, stiff.	T	4
12.5							Sample fall in the hole while retrieving.	3"	
12.5	1.4	1.25	0.50	280.6	032 ASTM			3"	
15.0					220.8	033			
15.0	2.0	0.50	0.30	411	024 ASTM		16.5' - 20.0'	3"	
17.5		0.75		236	026		16.5' - 20.0'	S	2 7
9	1.0	1.50		118.2	032		16.5' - 20.0'	P	2 7
7.5							16.5' - 20.0'	T	3
20.0	1.5	1.0	0.45	251	038		20.0' - 32.2'	3"	
2.5				12.5	029		Lt tan lean clay, moist, med. stiff - soft		
10	1.0	0.25						S	1 6
2.5								T	2
= 9.15.									



Why the Change?

Promote completeness and consistency

- ✓ Standard formatting
- ✓ Standard terms
- ✓ Standard menu choices



Why the Change?

Data captured permanently into electronic database

- ✓ Readily accessed, searched and queried
- ✓ Readily output in standardized formats
- ✓ Available for current or future applications



Learning Curve



With any significant process change there is a significant learning curve

- ✓ New software
- ✓ New hardware



Learning Curve

With any significant process change, there is a significant learning curve

- ✓ General Acceptance – must overcome individual/organizational inertia or resistance to change



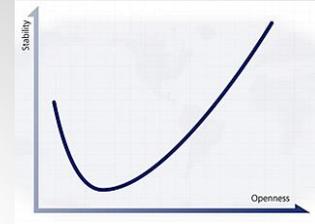
Learning Curve

With any significant process change, there is a significant learning curve

- ✓ Repetition – must use repeatedly and regularly to learn and retain – capability and functionality



Learning Curve



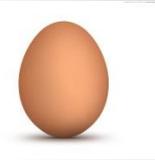
With any significant process change, there is a significant learning curve

- ✓ Familiarity with Desired Function – targeted (direct) access vs. searching (trial and error) access



Where to Start?

MoDOT initially did not use either PLog or gINT and had to learn both



- ✓ Chicken or Egg? PLog or gINT?
- ✓ Input to Output (PLog to gINT)
- ✓ Output to Input (gINT to PLog)



Where to Start?

MoDOT initially sought to learn PLog and then gINT

- ✓ Initially not very satisfying as we could not produce output without gINT
- ✓ In hindsight should have learned gINT fundamentals to produce output first
- ✓ In reality, without knowing either you learn both incrementally back and forth



Less Efficient?

A new process (electronic field logging) is initially less efficient

- ✓ Initial duplication of effort to ensure data is not lost – paper logs and electronic logs
- ✓ Initial lack of proficiency slows logging independent of duplication



MoDOT Implementation

Progress with electronic logging from most simple to most complex boring logs

- ✓ Simple - Auger Logs
 - Location/equipment/personnel data
 - Simple stratigraphy/ water level



MoDOT Implementation

Progress with electronic logging from most simple to most complex boring logs

- ✓ Intermediate - SPT/Core Logs – SPT on 5 ft. intervals/5 ft. rock cores
 - Location/equipment/personnel data
 - Intermediate stratigraphy/water level
 - SPT rec., PP, N_{60} , soil lab specimens (moisture content, AL, gradation), core rec./RQD, rock lab specimens (rock Q_u)



MoDOT Implementation

Progress with electronic logging from most simple to most complex boring logs

- ✓ Complex – Shelby tube/SPT/core logs - Shelby tube & SPT combination on 5 ft. intervals/5 ft. rock cores
 - Location/equipment/personnel data
 - SPT rec., rec., PP, N_{60} , SPT (disturbed) soil lab specimens (moisture content, Atterberg limits, gradation), core rec./RQD, rock lab specimens (rock Q_u)
 - Complex stratigraphy/water level, Shelby tube rec., T_v , Shelby tube (relatively undisturbed) soil lab specimens (extrude and preserve – soil Q_u , direct shear, triaxial, consolidation, etc.)



With Repetition & Experience

- Simple and intermediate logs
 - ✓ Experienced logger is not challenged to keep up - Electronic logs only in field (no paper logs)
- Complex logs
 - ✓ Experienced logger is challenged to keep up - Paper logs initially in field (electronic logs as time permits or after completion)



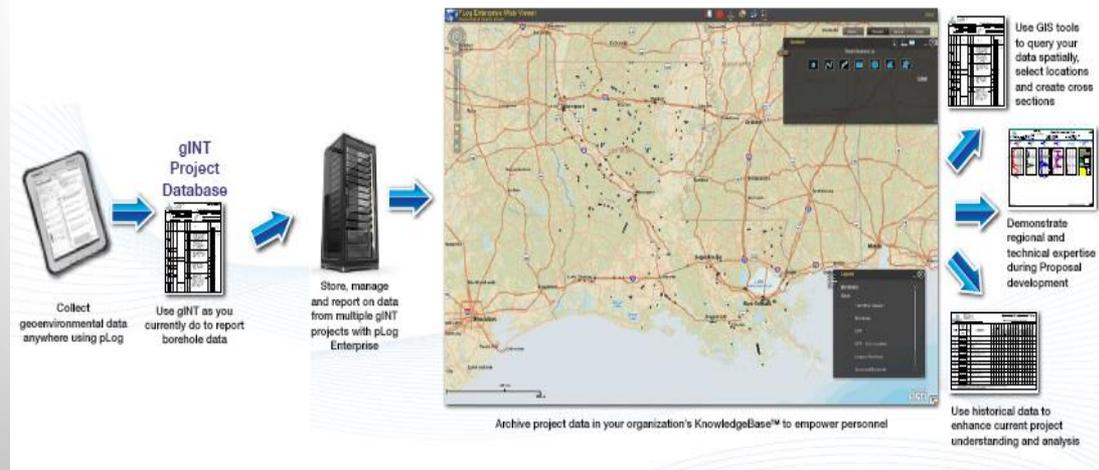
With Repetition & Experience

- Paper Logs
 - ✓ All data is visible at a glance
 - ✓ Can readily detect incomplete data
- Electronic Logs
 - ✓ All data is not visible at a glance
 - ✓ Cannot readily detect incomplete data



MoDOT Improvements

- Cloud – Data Transfer
- KeyLAB – Laboratory Management System (LMS)
- PLog Enterprise – Database (Repository)



- Questions?

