

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: 9209427E 960411N 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: Claws Weather: Cold, Mid 30's, Bristle soap + JOC
 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., of	Tv., of	Tare	Sample #	Test	DESCRIPTION	Type Sampler	Std. Pen. Blows/6"
0.0 - 2.5'	1.25	0.85	391	518	ASTM	0.0-5.0' Brown lean clay, stiff, moist.	3"	
2.5 - 5.0'	4.0	0.9	175	520	ASTM	5.0-7.5' Brown mottled lean clay, hard, moist.	3"	
5.0 - 7.5'	3.50	0.9	383	522	ASTM	7.5-12.5' Brown lean clay, stiff, moist.		
7.5 - 10.0'	1.75	0.60	166	523	ASTM	12.5-15.0' Brown mottled lean clay, very stiff, moist.	3"	
10.0 - 11.5'	3.00	0.80	485	525	ASTM	15.0-16.2' Dark Gray thinly laminated shale, moderate hard.	3"	
11.5 - 12.5'	4.5'	0.9	455	526	ASTM	16.2-30.0' Tanish-Brown thinly laminated limy shale, moderate hard.	3"	
12.5 - 15.0'				528	QU			

From TO RW REC Loss
 15.0' 20.0 5.0 5.0 0
 25.0 30.0 5.0 5.0 0
 30.0 35.0
 7MSDO 529 @ 19.4' shale QU
 7MSDO 530 @ 30.0' shale QU
 E3.8

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: Claws 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

Best	Station	Location	Surface Elevation	LOG OF MATERIALS*
	655+50.0	51.3' RT	763.3	0.0-12.5' Brown lean to fat clay, stiff to very stiff, moist.
	303042.7E	96041.1N		12.5-16.2' Dark gray thinly laminated shale, soft.
				16.2-25.0' Tanish-brown thinly laminated limy shale, soft.

Depth, ft.	SPT Blows*	N ₆₀	P.P., of	T _v , of	W ₅₀ %
1.0			1.25	0.85	24.1
3.0			4.0	0.9	20.0
5.5			3.5	0.9	19.6
8.0			1.75	0.6	21.9
11.0			3.0	0.8	20.7
13.0			4.5	0.9	17.9

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

Depth, ft.	TEST DATA	
	Q _u , ksf	P.P., of
8.0	1.2	1.75
19.4	19.8	9.0
23.3	32.0	9.0

From	To	Rea	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

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: 1.00004191



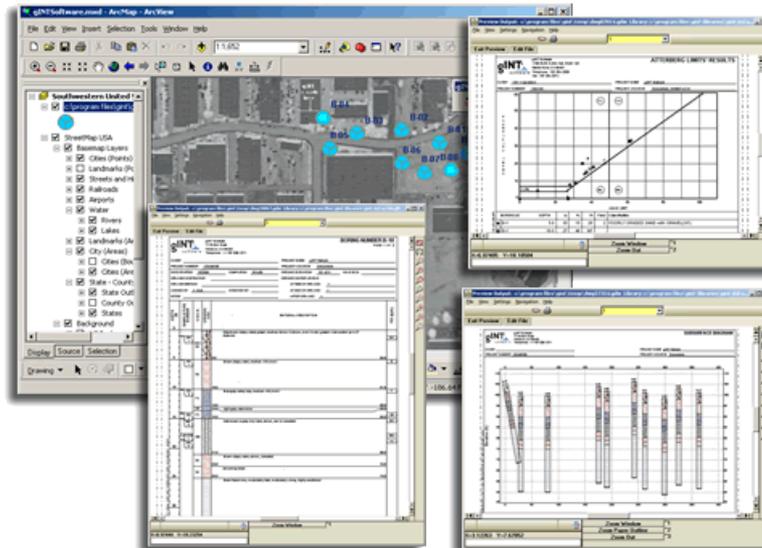
MoDOT – Now!

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

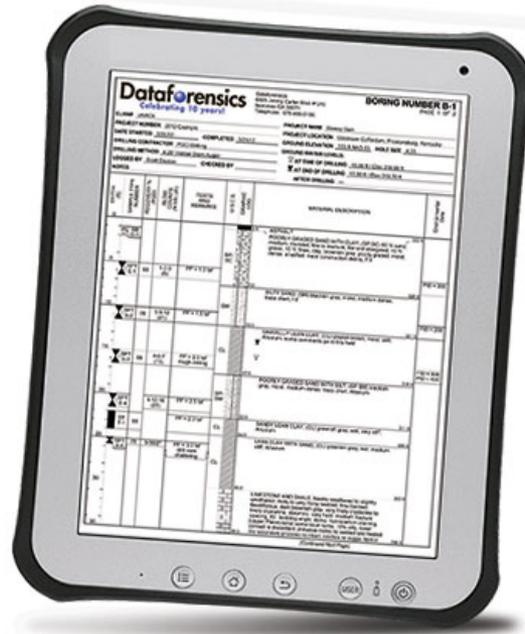


MoDOT – Now!

- *Electronic Data Management and Reporting (Office)*
 - Software – gINT , Key Lab
 - Hardware - pLog Enterprise



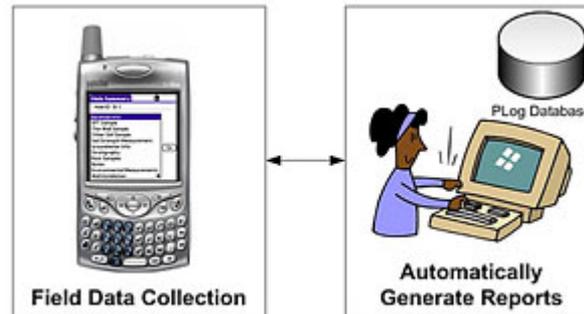
Why the Change?



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-135 (EMD)
Rev. 12/97
I = 67.58

MISSOURI DEPARTMENT OF TRANSPORTATION
Division of Materials

BORING DATA (CORE & SPT) Sheet ___ of ___

Job No. J2S2158
County Wain Route W W Design A7931
Over Clark Branch Skew 10° L.A.
Logged by Davis Operator Murray
Equipment CME 45 Drillers Hole No. F-17-54
Hole Stab. by hollow-stem augers Date of Work 7/23-7/24/2012
Automatic Hammer Efficiency % 57.63 Drill No. 57963

Best	Station	Location	Surface Elevation	LOG OF MATERIALS *	
2	68+42	16' RT	793.8	Inaccessible 32' to slope, bridge and	
off	68+36.3	8.5 RT	793.0	0-5.4' Gray lean clay, moist; med. um	
		152259.5 DE, 141406.5 DN	795.0	stiff to stiff trace gravel	
		152259.5 DE, 141406.5 DN	795.0	5.6-9.3' Gray sandy lean clay, trace gravel,	
		152259.5 DE, 141406.5 DN	795.0	with med. um stiff	
1.0	5.0	2-2	0.8	9.3-21.8' Gray, lean clay, moist, stiff moist	
0.6	10.0	2-1	0.75	21.5-29.5' Gray clayey sand, scattered gravel	
1.5	15.0	1-0	0.0	loose, var	
1.5	20.0	0-2	1.25	29.5-33.4' Brown gravelly sand with lean	
0.6	20.0	3-16-22	4.4	clay lens, saturated	
0.9	35.0	17-35.5	5.0	33.4-37.8' Gray clay shale, soft, cut with	
0.4	37.5	35.0-3	5.0	rock bit	
6.8	35.0-3	50	-	37.8-59.2' Gray, thinly laminated to thickly	
				laminated silt shale, unweathered,	
				soft	
				59.2-61.1' Light gray fine-grained thin- to	
				med. um bedded limestone, hard	
				61.1-66.0' Dark gray, thickly laminated organic shale	
				to coal, hard	

CORING LOG (NX Double Tule Barrel)

From	To	Run	Rec	Loss	% RQD	Notes
37.8'	42.8'	5.0'	4.0'	0	0	shale 12M GHD 274 47.7-50.5'
42.8'	47.8'	5.0'	5.0'	0	0	shale 12M GHD 275 56.7-59.0'
47.8'	52.8'	5.0'	5.0'	0	0	" 12M GHD 276 59.6-60.2'
52.8'	57.8'	5.0'	5.0'	0	0	" 12M GHD 277 63.8-64.2'
57.8'	62.8'	5.0'	5.0'	0	0	shale 66.0-68.0' Gray, thinly laminated clay shale

WATER TABLE OBSERVATIONS

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

* N_{60} - Corrected N value for standard 60% SPT efficiency.
 T_{60} - Measured transfer efficiency in percent.
 N_m - Observed N-value.

* Persons using this information are cautioned that the materials shown are described 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.: 69577
 Height of Fill: _____ Water Table Depth: _____ Moisture Can No.: 124E1T029

Depth From	Length Recovery	P.P., tsf	Tv, tsf	Tare	Sample #	Test	DESCRIPTION	Type Sampler	Sid. Pen. Blows/ft
5.0	1.5	1.50	0.40	264	0301 ASTM	0.0' - 0.3' - Pec		S	4
6.6					0310	0.3' - 3.4	Dk. brown lean clay w/ gravel, moist, stiff.	P	3 10
9	1.0	1.50				3.4' - 16.5'	Dk tan lean clay (cc-me), trace gravel, moist, stiff.	T	4
10.0						Sample fall in the hole			
12.5						which retrieving.			
12.5	1.4	1.25	0.50	280.6	032 ASTM			S	3
15.0				313	033 GUS				
15.0	2.0	0.50	0.30	411	024 ASTM	16.5' - 20.0'		S	2 7
17.5		0.75		238	036	20.0' - 32.2'	16.5' - 20.0' Browns, speckled blue lean clay, moist, stiff	T	3
20.0	1.5	1.0	0.45	251	038			S	2 6
22.5				12.5	039	4 tan lean clay, moist, med. stiff - soft		T	2
25	1.0	0.25						S	1 6
								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)



MoDOT Improvements

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



Thank You

