

Standardized Geotechnical Data Formats: Applications and Examples using the Argus Geotechnical Database

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Standardized Data Exchange Format

- The objective of this presentation is to provide specific examples of how a standardized data exchange format can be incorporated into project (or agency) databases
- Examples will show how to introduce new data, how to convert previous entered data, and how the use of a robust database that incorporates these standard data exchange formats can be used on geotechnical projects
- These examples will include geotechnical boring logs, laboratory testing results, geotechnical instrumentation, and overall underground geotechnical information management

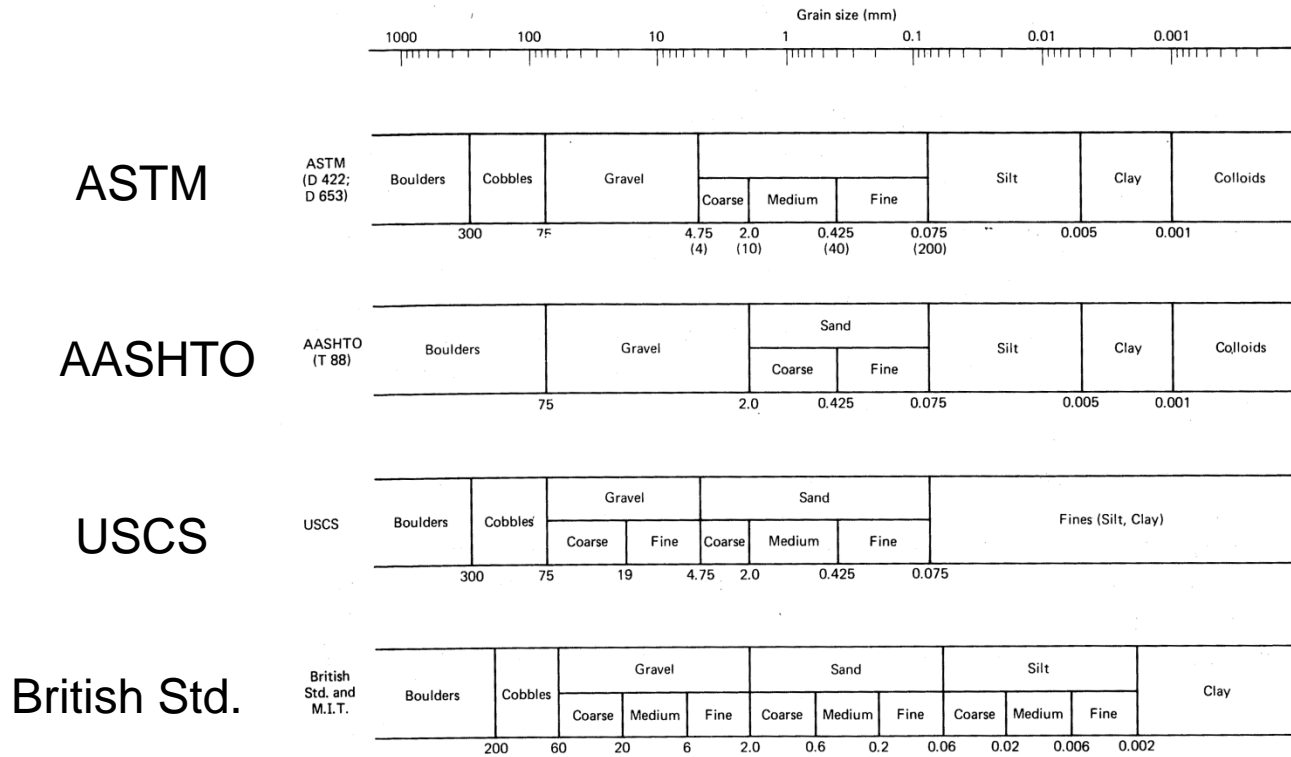
Standardized Geotechnical Data Formats: Applications and Examples using the Argus Geotechnical Database

- What is a Standardized Geotechnical Data Format?
- Why use a Standardized Geotechnical Data Format?
- OK, I am Sold...What Do I Need To Do?
- What is the Argus Geotechnical Database?
- Examples and Applications

What is a Standardized Geotechnical Data Format?

- Established set of rules to describe your geotechnical data
 - Requirements of data (i.e., compulsory information, including “required fields”, and “primary keys”)
 - Type of data (e.g., text string, date, number)
 - Format of the data (e.g., integer vs. decimal, date style, field length)
 - Relationship between tables (e.g., project data, boring location data, test result data)
 - e.g., Boring locations stored in one table, boring log data stored in *related* table
 - Boring and sounding data reflects different information at specific depths
 - blow count, sample description
 - tip resistance, sleeve friction, pore pressure
 - Laboratory data reflects information at specific depth
 - moisture content includes single specimen
 - triaxial test results may include three related tests

Why Standardize Geotechnical Data?



Holtz & Kovacs, 1981

- A 3.0 mm grain of soil can be “Coarse Sand”, “Gravel”, or “Fine Gravel” – depending on what classification is being used.

Why use a Standardized Geotechnical Data Format?

- Why do we use the English language at this conference?
 - It facilitates communication
 - “It easier makes life if rules common we follow”
- Why do we have dictionaries?
 - We have unique meanings for our words
 - It provides (but limits) options
- What does this have to do with a Standardized Geotechnical Data Format?
 - In a word.....everything!

Why use a Standardized Geotechnical Data Format?

- “Everything”, you say??
 - You had previously adopted LogPlot to prepare boring logs but your new boss decides to switch to gINT
 - Your consultants use LogPlot, gINT, MicroStation, AutoCAD, and a custom database to prepare logs and you now have a really big project and you would like to use all of your consultants, but would prefer a way to prepare common logs
 - You do not know which program you will use and do not know which vendor to believe is “the best”

Why use a Standardized Geotechnical Data Format?

- Everything, you say??
 - Allows you to apply good database practices by storing, documenting, and sharing data effectively
 - Gives you an opportunity to select any software package you desire
 - Allows you to interchange and exchange data into your custom application
 - Vendors and developers would be able to innovate and improve products because they do not have to “translate” every client’s data
 - You can hopefully learn from others and not be worried about “reinventing the wheel”

Why use a Standardized Geotechnical Data Format?

- Others are doing it
 - Environmental analytical data:
 - USEPA Electronic Data Deliverables (EDDs)
 - Computational instrumentation data:
 - Standard Data Format (SDF) for Analyzers (Hewlett-Packard)
 - Weather data:
 - ESWD (European Storm Agencies) – used to standardize severe weather report data

Why use a Standardized Geotechnical Data Format?

- “Best of Both Worlds”
 - Tasks and software that are designed to accept the standard format can use it directly
 - Tasks and software that are not compatible with the format can be used via a “data translator” that converts between the standardized and proprietary formats
 - Once translated INTO the standardized format, data are de facto quality-controlled and documented...no need to document any additional “schemas”

OK, I am Sold...What Do I Need To Do?

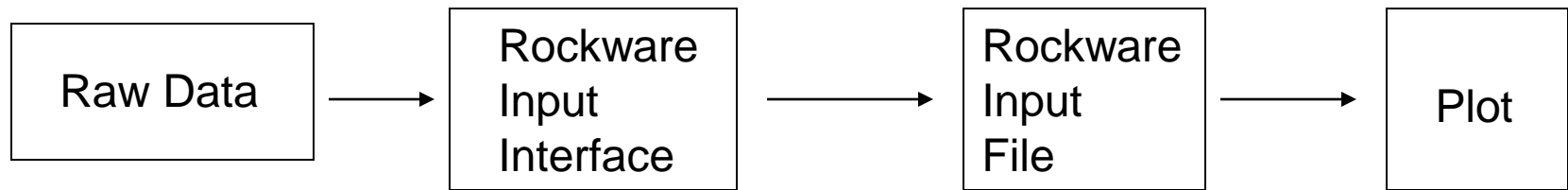
- Follow instructions, follow the rules, learn the language (or learn where the language is described) and reference the dictionary
- Geotechnical engineers have recently recognized the benefits of incorporating “standardized” data management concepts
- Efforts focused on development of a standardized “data exchange format”
 - Association of Geotechnical and Geoenvironmental Specialists (AGS) in the U.K first by an ad hoc group of practitioners
 - Consortium of Strong Motion Observations Stations (COSMOS) in the U.S. by public-private consortium to exchange strong motion earthquake records
 - Data Integration for Geotechnical and Geoenvironmental Specialists (DIGGS) format in the U.S. under pooled-fund study from FHWA

Standardized Data Exchange Format

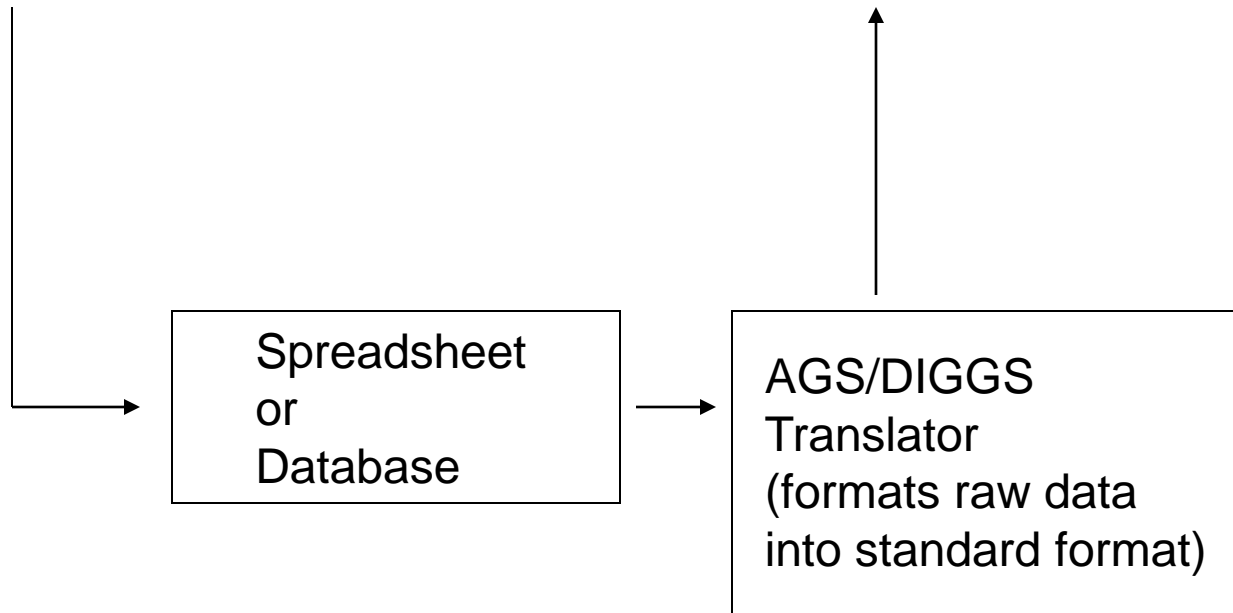
- One of the obstacles to the widespread implementation of these standardized data formats is that they are (as the name implies) standardized formats for the exchange of geotechnical information
- A data exchange format is not a standardized data format that can be readily implemented into a relational database
- One does not develop a database to mimic an exchange format
- Written in computer-code XML and/or GML that is (worse than) Greek to most geotechnical engineers
- There has been little previous discussion or physical demonstration in the U.S. regarding how to include the standard data exchange format into a new or existing relational database.... until now

Example using LogPlot

Old School



New School
(Standardized)



Can we show example of raw, template, input file and plot and then a database format...doubt if we can do the translator

Standardized Data Format

Capture Data

Paper Logs

Spreadsheet

Database

User-Specified
Format

Spreadsheet

Database

Standardization

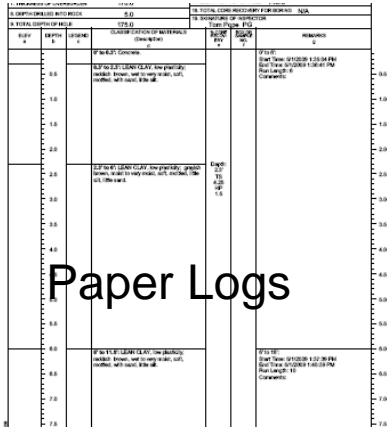
DIGGS
Translator

Standardized
Data

Data
Warehouse

Standardized Data Format: Core Logging

Capture Data



User-Specified
Format

BORING	START	STOP	CLASS
GP-1-10	0.0	9.0	FILL
	9.0	11.0	SP
	11.0	18.0	ML
	18.0	19.0	OL
	19.0	25.0	ML
	25.0	29.0	ML
	29.0	30.0	GW
	30.0	35.0	ML
	35.0	38.0	SP

Spreadsheet

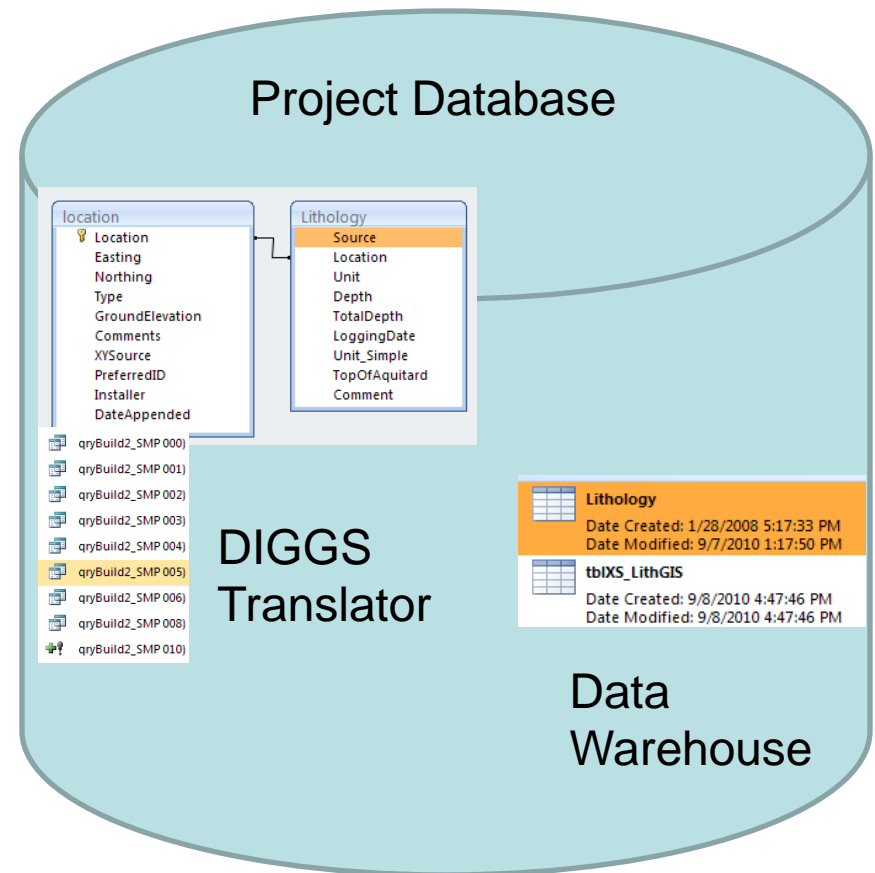
Location	Depth	Unit
B1	10.5	FILL
B1	13.5	CL
B1	18	ML-OL
B1	40	CL
B-1_1986	14	FILL
B-1_1986	15.5	ML
B-1_1986	18	SM
B-1_1986	24	ML
B-1_1986	25.5	SM

Database

Electronic Form

Standardization

Standardized
Data



Standardized Data Format: Workflow (core logging)

1. Geologist logs core directly into a tablet PC with an electronic field form (enter borehole ID start depth, end depth, lithology, observations for each segment)
2. Field form transmits data to a translator which reformats the logged data into the DIGGS geology table format, and appends data to master database (which has coordinate information for each borehole)
3. Master database is used as source for computer model, GIS, CAD, etc.
4. Later on, database manager exports all project core data in DIGGS format (export file)
5. Export file is used as input to other software packages that use DIGGS format...

The DIGGS Format (Data Dictionary)



<http://www.diggsml.com/>

Example Table Description

Geotechnical.MoistureContent

[Contents](#)

Derived from [Kernel.LaboratoryTest](#)

Related table

Status	Heading	Unit	Description	Example
	g		The language that strings in this DIGGSML Object are _predominantly_ written in (this can be redefined on a per-property level). As per RFC3066 at http://www.ietf.org/rfc/rfc3066.txt	
	associatedFiles	AssociatedFile	Reference to a set of external files associated with this Object	
	remarks	Remark	Any general remarks about this Object	
	equipment	Reference	Equipment relevant to this Object	
	roles	Role	Business Associates (companies or individuals) who have a role in the activity described in this item	
	specificationReferences	Reference	A link to the Specification that provides definitions of the procedure(s) used for this Object	BS5930
	status	gml:CodeType	The status of this item	Preliminary, Draft, Archive
Mandatory	id	Identifier	The unique identifier of this Object	DIGGSINC-BH127
	sources	Reference	The sources that this test applies to.	
	timing	ArbitraryTimeSpan	Date and Time this test was conducted (start and optional duration / end)	

Field name

Required field

Related field

Documentation already provided

What is Argus?

- For this discussion, the Argus database will be introduced and specific techniques will be demonstrated regarding the incorporation or introduction of the standardized data fields.
- Argus is a *proprietary* database that can read a *standard* data file format

Argus – Project Database

- ITM has been developing and implementing IMS for Geotechnical and Structural Instrumentation since early 1990's (pre MS Windows).
- ITM currently owns a working and proven suite of IMS including the open source (Linux/Apache/MySQL/PHP) web based “Argus”
- Argus stores data into a relational enterprise database (MySQL), which:
 - performs the required calculations on the data
 - presents the results in graphical and numerical format (creating automated PDF reports and more)
 - generates alarm messages

Argus – Project Database

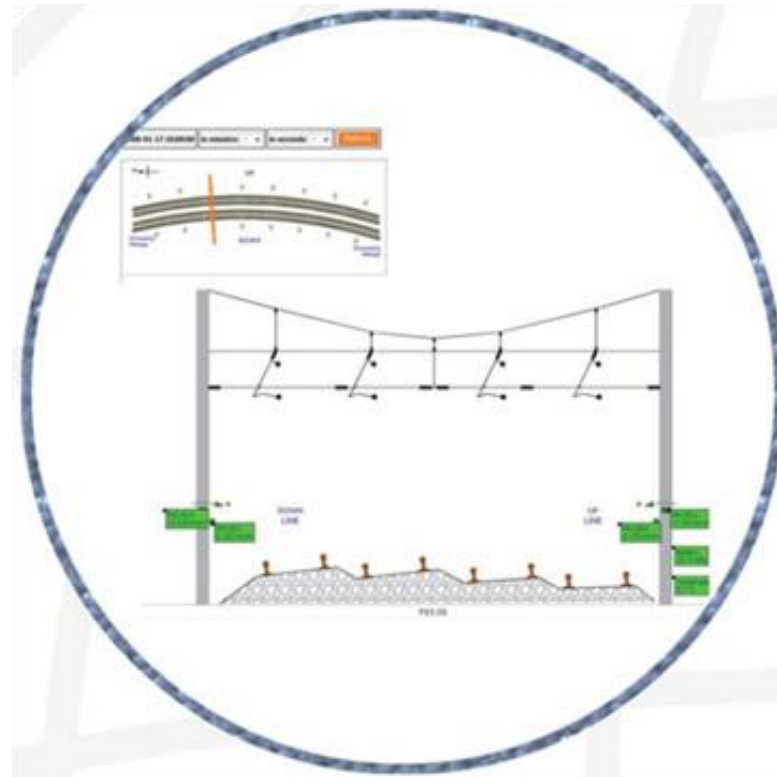
- Argus interacts with users via web-browser without the need to install any software on the work stations (Software-as-a-Service model)
- Argus is platform-independent and can be accomplished from the local network or, when connected to the Internet, from any location in the world.
- Argus has been in use in many active projects in the UK and all over the world including USA, Germany, Asia, Australia and Russia

Croft Spa Project

- **Location**: Near Darlington on the East Coast main line railway in the UK
- **Scope of Work**:
 - Use radio tiltmeters to monitor the overhead catenaries
 - Readings taken hourly; data downloaded twice a day
- **Alert Notification**: Automated alarm system is not implemented.

Croft Spa Project

- **Reason for Monitoring:**
 - Monitoring due to the movement in the embankment which is making the catenaries masts unstable.

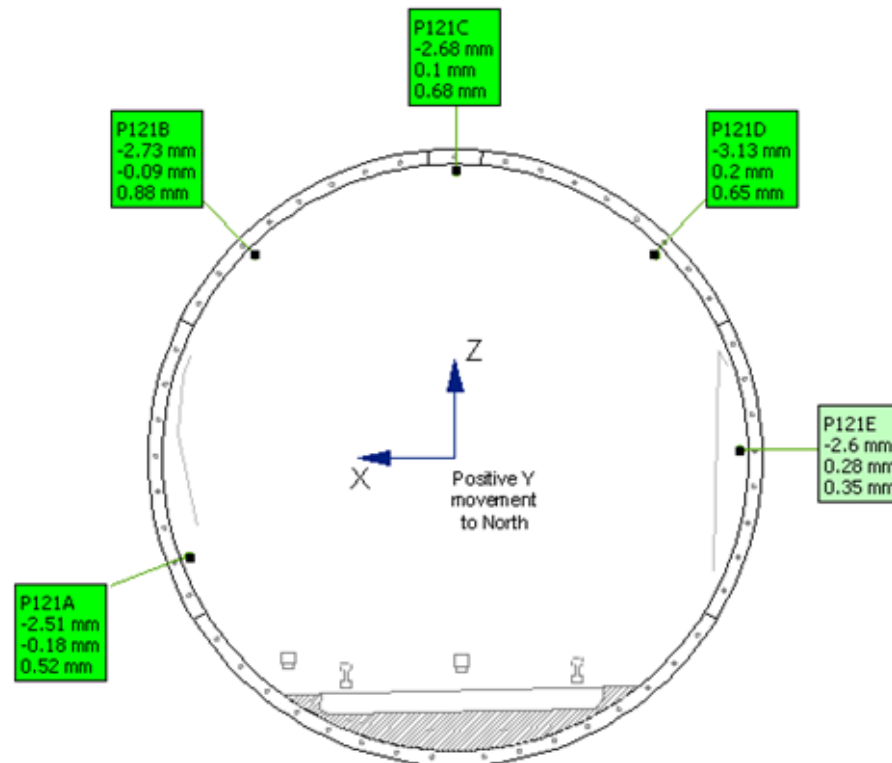


Old Street Project

- **Location:** East London EC2
- **Scope of Work:**
 - Monitoring the network rail tunnel just south of Old Street station for movement using an RTS and 5 point prism arrays over a distance of 100m
 - RTS is controlled by a battery powered and rugged data logger
 - Battery is charged by low voltage AC down the tunnel
 - Communication via short haul modems back to the communication room where we share a BT line
 - Data logger dials ITM head office in Uckfield after a measurement cycle is completed
 - Data are recorded and collected hourly
- **Alert Notification:**
 - Client uses Argus to track the tunnel deformation and receives text and email alerts when preset threshold is exceeded.

Old Street Project

- **Reason for Monitoring:**
 - Monitor pitch and roll of the tunnel during adjacent piling and excavation



Hooley Cut Project

- **Location**: Just north of the M25 on the London to Brighton line just outside Coulsdon.
- **Scope of Work**:
 - Monitor rock fall netting on the cutting by measuring the bulging in the netting through draw wire mounted on the king pile wall
 - Sensors are read 4 times a second and stored each hour unless there is an alarm where the data is stored instantly
 - Data logger is backed up with two cameras one wide angle and one telephoto these all make use of a 3G router track side.
- **Alert Notification**: Network rail view the data in Argus and receive text and email alerts. Should an alert is received they use the cameras to assess if the trains need to be slowed or even stopped.

Hooley Cut Project

- **Reasons for Monitoring:**

- Monitor any rock falls or embankment movement that has the potential to block the track and de-rail the trains
- Lost train minutes cost tens of thousands of \$\$/££ a minute



Next Generation – Argus V

- Compatible with AGS data format
- Compatible with DIGGS ...via translator
- GIS interface developed using open source applications
 - Underground Construction Information Management System (UCIMS)

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Summary

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- Examples and Applications

- Thanks for your participation and interest