Introduction by John Dunnicliff, Editor

This is the 91st episode of GIN. Two articles this time.

Fully grouted piezometers again

The Groundwater section of September 2017 Geotechnical News consisted of an article by Marefat et al about fully grouted piezometers in a soft Champlain clay deposit. The article caused significant discussion among some of my colleagues. The same authors submitted "an improved paper" on the same subject to Geotechnical Testing Journal (GTJ), which is currently under review.

The authors have prepared the following update to the Geotechnical News article, indicating that "the GTJ reviewers raised some interesting questions about the paper that should be mentioned in Geotechnical News". I encourage you to read the GTJ paper. As indicated at the end of this article, the updated paper will be available on the Geotechnical Testing Journal website in the coming months (https://www.astm.org/DIGITAL_LIBRARY/JOURNALS/GEOTECH/). You can also email francois.duhaime@etsmtl.ca for a copy and an update on timing.

Extract / Transform / Load (ETL) processes for instrumentation data transfer.

Garrett Bayrd of Shannon and Wilson, Inc. explains that establishing communications with a datalogger does not move the data around. Extract / Transform / Load (ETL) processes move the data from an instrument or datalogger to a computer or server. ETL processes *extract* the data from the datalogger, *transform* it into a format that the storage system can input, then *load* the data into the specific file (database, text file) for long term storage, post-processing, or graphing.

Real-time performance monitoring as a risk management tool

In June 2017 Allen Marr, founder and CEO of Geocomp Corporation, Acton, MA, made a presentation in Cambridge, England on the above subject. The presentation covered:

- Why monitor?
- What we've learned in recent years
- How to achieve an effective instrumentation and monitoring program
- Importance of real-time monitoring

In my view this is an excellent presentation, appealing to me primarily because of its focus on what I've called "people issues" (others are using the term "human factors"), which are so vital to what we do. It's available online at www.youtube.com/watch?v=67gAXmxcokA. Here's an example of some pithy words about human factors:

Contractors talk every day about how to manage risk.

All the 'reasons for monitoring' help us identify and manage risk. Risk is something that not only we, but our clients and our construction contractors really understand. Contractors talk every day about how to manage risk. I want to suggest to you that that reason for doing instrumentation and monitoring is a far more powerful reason than simply saying "we're geotechnical engineers, we have uncertainties in our design, so we'd like to put some instruments in". That argument doesn't go over very well to owners. But if we talk about the fact that everything we do involves uncertainties and risk, we can then have an open discussion about methods of managing risks and the role and usefulness of instrumentation and monitoring.

10th International Symposium on Field Measurements in Geomechanics (FMGM)

The 10th FMGM will be held in Rio de Janeiro, Brazil during July 16-20, 2018. FMGM symposia have been held every four years since 1983, in Zurich, Kobe (1987), Oslo (1991), Bergamo (1985), Singapore (1999), Oslo (2003), Boston (2007), Berlin (2011) and Sydney (2015). I refer to these as "The once-every-four-years meeting of our club". Be there! Details are on http://fmgm2018.com/2018/

The program will include special lectures, technical presentations, a forum for young FMGM engineers, poster sessions, exhibitions, workshops and technical tours, as well as a parallel non-technical program. And a very important session about **Human Factors.**

Fifth International Course on Geotechnical and Structural Monitoring, May 22-24, 2018 in Rome, Italy.

The course schedule is now on **www.geotechnicalmonitoring.eu**. Registration for the course can be made on that site and also for the Master Classes that will be held on May 21, 2018. The total attendance for the four courses to date (2013-2017) has been 440 from 49 different countries.

Master Classes and leaders will be:

- Piezometers with Martin Clegg and Chris Spalton, Geosense Ltd, UK

- Inclinometers with Giorgio Pezzetti, SMAK s.a.s., Italy
- Extensometers with Daniel Naterop, DNGeo Switzerland
- Total stations with Werner Lienhart, Graz University of Technology, Austria.
- Vibration monitoring with Vincent Le Borgne, GKM Consultants, Canada
- Terrestrial Radar with Paolo Mazzanti, NHAZCA, Italy

Each class will cover the following main topics: installation, data acquisition, data processing, tricks and tips from everyday experience.

During the main course we will again have sessions on "New Monitoring Trends" and "Case Histories and Lessons Learned", with presentations given by registrants

Come and join us in magnificent Rome - a city of huge historical and cultural interest!

The care and feeding of individual consultants and their clients

About 15 years ago Harvey Parker (then and now an individual consultant who had previously worked for an engineering design company that contracted with individual consultants) and I published in this magazine an article with the above title. It included our views on:

- General expectations of the client and the consultant
- Issues before the client has the job
- Contractual issues
- Fees
- Miscellaneous day-to-day issues
- The client's professional issues
- The consultants personal and professional issues

The article generated significant interest among our fellow professionals, nineteen of whom submitted discussions. Many discussers supported the fact that these issues were "finally put into print", and made valuable suggestions for improvement of the article, which we summarized in our closure. Both Harvey and I have used the material to smooth our relationships with our clients over the years, and I've been wondering whether any of you (as *Stephen King says: "constant reader"*) might find it useful, particularly individual consultants and employees of companies who contract with individual consultants. If yes, please let me know by email (john@dunnicliff.eclipse.co.uk), and I'll send you pdfs of the material from four issues of Geotechnical News.

Closure

Please send an abstract of an article for GIN to john@dunnicliff.eclipse.co.uk—see the guidelines on www.geotechnicalnews.com/instrumentation_news.php

Gezondheid ("To your health"). Netherlands.

Fully grouted piezometers in a soft Champlain clay deposit. Update on the article in the Groundwater section of September 2017 issue of Geotechnical News

François Duhaime, Vahid Marefat, Robert P. Chapuis, Vincent Le Borgne

The Sainte-Marthe test site in southern Quebec was introduced in the Groundwater section of the September 2017 issue of Geotechnical News (GN, Marefat et al. 2017). This experimental test site was developed as part of the instrumented watershed project (BVE-Sainte-Marthe) at École de technologie supérieure for the teaching of hydrology and geotechnical engineering. As part of this project, a series of fully grouted and standpipe piezometers were installed in collaboration with GKM Consultants. Two grout recipes were used to obtain contrasting grout permeability values. The site also includes a bedrock well that will allow the vertical hydraulic gradient in the clay layer to be changed to look at the transient response of fully grouted piezometers.

An improved version of the GN article was submitted to the Geotechnical Testing Journal (GTJ) in September 2017 (Marefat et al. 2018). A revised version is currently under review. Compared to the GN article, the new paper puts more emphasis on numerical results. Parametric studies are presented regarding the response of fully grouted piezometers to seasonal water table fluctuations and an increase in total stress.

The GTJ reviewers raised some interesting questions about the paper that should be mentioned in Geotechnical News and, with John Dunnicliff's agreement we're doing so in GIN. First, the high-permeability grout that was used in one borehole led to significant segregation, as expected from the low Marsh funnel viscosity. As a result, the real grout permeability is difficult to estimate. The ratio between grout and soil permeability values could be well over 1100, the ratio stated by Marefat et al. (2017). Reviewers also wanted to stress the importance of adding bentonite to the grout to reach a proper viscosity and

stability. The Marsh funnel viscosity of a stable and pumpable grout should be around 50 s (Chapuis et al. 1984; Contreras et al. 2007; Marefat et al. 2018). Since bentonite properties and field conditions vary between projects, it is usually not possible to specify a definitive grout recipe with an exact bentonite proportion.

The updated paper will be available on the Geotechnical Testing Journal website in the coming months (https://www.astm.org/DIGITAL_LIBRARY/JOURNALS/GEOTECH/). You can also email us for a copy (francois.duhaime@etsmtl.ca). For an update on timing, please contact François.

References

Chapuis, R. P., Paré, J.-J., Loiselle, A. A. 1984. Laboratory tests results on self-hardening grouts for flexible cutoffs. Canadian Geotechnical Journal, 21:185-191.

Contreras, I. A., Grosser, A. T., VerStrate, R. H. 2007. The Use of the Fully-grouted Method for Piezometer Installation. Proceedings of the 7th International Symposium on Field Measurements in Geomechanics (FMGM), Boston.

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Francois Duhaime
francois.duhaime@etsmtl.ca

Extract / Transform / Load (ETL) processes for instrumentation data transfer

Garrett Bayrd

Introduction

Geotechnical instruments have changed slowly over the past few decades. With some notable exceptions, a geotechnical engineer practicing in 2001 would be familiar with the majority of instruments in 2018. For example, the manufacturing process used to make an inclinometer sensor may have changed, but the principle of the inclinometer is itself much the same.

Conversely, the way we are able to acquire and process data has dramatically changed over the past decade in several significant ways:

- Telemetry options are more plentiful, cheaper, and smaller.
- Dataloggers are less expensive, smaller, and many have built-in telemetry options.
- Less expensive processing and data storage tools allow for more data storage and more diverse ways of examining the data.
- Easier to use programming languages like Python process and display large quantities of data.

These changes, combined with a modern culture that emphasizes instant availability and access to information, have increased the number of monitoring projects that require near-real time data availability. Establishing this data availability can be more difficult than some realize when bidding on these projects, as it requires systems for data telemetry, Extract / Transform / Load (ETL) processes, data storage, data processing, and data visualization.

As a result, there have been more budgetary and conceptual mistakes in the design of these data acquisition systems – frequently with regard to ETL programs. It seems that many project managers, cost estimators, and engineers feel that if they establish a connection between a computer and a datalogger system, the data will easily flow back to them and be displayed in a timely manner. Instead, it takes careful planning and organization to create effective data acquisition systems. As is the case with any instrumentation project, designing data acquisition processes (and designing an applicable monitoring system) requires an understanding of the geotechnical setting that is to be monitored and the purpose of the system.

ETL processes move the data from an instrument or datalogger to a computer or server.

What is ETL?

Establishing communications with a datalogger does not move the data around. Extract / Transform / Load (ETL) processes move the data from an instrument or datalogger to a computer or server. ETL processes can be

purchased programs, specialty-written code, or open-source solutions.

ETL processes *extract* the data from the datalogger, *transform* it into a format that the storage system can input, then *load* the data into the specific file (database, text file) for long term storage, post-processing, or graphing. Depending on the ETL needs, commercially available programs that perform these tasks can add $1,000 to over $10,000 to the budget of a job. Configuration and programming of these programs requires labor, in addition to the cost. The type of ETL process will influence power-usage requirements, datalogger design, data storage design, and telemetry design. Manual data downloads / uploads, an admittedly low-tech variety of ETL, are outside the scope of this discussion.

The following questions should be answered when designing an ETL system:

1. How much data will the telemetry system handle?
    a. Are there increased costs for additional data transfer?
2. Is there a need for near-real time data from the system?
    a. If not, what frequency of readings and downloads are required?
3. What are the power requirements from the datalogger components?
    a. Will more frequent downloads deplete the battery?
    b. Will more frequent readings or continuous readings deplete the battery?
4. How should the data "look" once it has been transformed?
    a. What format does the data need to be in?
5. How is the data loaded into whatever storage system that is established?
    a. Is data appended to a text file?
    b. Is data loaded into an existing or new database?
6. What are the server storage space / processing power needs?
    a. Are more frequent readings going to fill the storage or require more processing time?
7. How frequently is the data being examined?
8. Are alarms established based on this data?

Answering these questions will prompt iterative reviews of the data transfer design. For example, a need for additional download frequency may change the plan for data telemetry, or a need for more frequent readings may prompt the installation of additional solar panels to meet power requirements.

Common methods of ETL

Commercially available programs

ETL is most commonly setup with commercially available programs, usually written by a vendor. Some examples include; LoggerNet from Campbell Scientific, Cloud and Enterprise from Sensemetrics, and DEX from dataTaker. These programs typically take care of the Extract and Transform part of the ETL process. They can be scheduled to communicate with the datalogger, *extract* the data, and *transform* the data to a format of your choice. Most of these programs can *load* the data into some storage format, whether it is a text file or proprietary database. These programs cannot load data into an internally developed database, as they would not "know" the database setup. These programs need to run on a computer, virtual machine, or cloud service.

Some advantages of using commercially available programs are:

1. They typically take care of the connections to the datalogger with relative ease.
2. They can handle difficult communications settings and networks, including configurations to download data at a specific time or repeat downloads if the downloads were unsuccessful.
3. Typically, they have some (but not full) functionality to control the format of the data.

Some disadvantages of using commercially available programs are:

1. You will need to configure your database uploading function to process the data as formatted by the program.
2. Only the manufacturer provides updates and support, as needed.

Purpose-written code

Code written specifically for the application is another commonly available ETL process. This purpose-written code can be more agile and flexible than a vendor program, and can automate any or all the required ETL processes. For example, when using a commercially available program like Loggernet to connect to the datalogger and save the data into a text file, a piece of code could be written to upload this data into a specific database. In this example, Loggernet would be performing the Extraction and Transforming parts of ETL, and the piece of code would be performing the Loading part. With more control of the process, the data can be saved in the format best suited for the project or application.

Advantages of using purpose-written code are:

1. Control of the format of the data.
2. Capability to automate the necessary data transfer steps, including loading into a database.
3. Not paying for functions of a system that aren't used.
4. Not beholden to any costly forced updates or lack of support for an older product.

Disadvantages of using purpose-written code are:

1. More time possibly spent in man-hours to develop the code than the cost of a commercially available project.

2. There may be difficulty in passing the project from one party to another using the proprietary code.

Open-source solutions

Open-source solutions are also available for some ETL options. The availability of this code is largely dependent on the size and culture of the group that is using the datalogger products. Essentially, there needs to be a large, dedicated group of technically savvy people to write, update, and maintain an open-source program to deal with data like this. Two examples of programs like this are the open-source HyperTerminal emulators (commonly used for basic communications and downloads from many dataloggers) and Earthworm (an open-source system used by regional seismic networks to monitor seismographs).

Advantages of using open-source solutions are:

1. It's free and some of the programming has already been done.
2. Not beholden to a specific company for software updates.

Disadvantages of using open-source solutions are:

1. They have a steep learning curve, and inconsistent documentation / manuals.
2. There is not a customer service department to call for help with problems.

Conclusions

When selecting among several bids on an instrumentation project, it's important to ensure that the firms bidding are aware of and capable of dealing with more than just the connections to the datalogger. Look for thorough bids that thoughtfully plan for ETL protocols and answer all the design questions presented here. Conversely, when bidding on a project, ensure that your bid and cost estimate take into account the needs and cost of ETL protocols.

There are five crucial elements of instrumentation data automation - Telemetry, ETL protocols, Storage, Processing, and Visualization – are all equally important to the proper setup of a near-real time instrumentation monitoring system.

Garrett Bayrd
Senior Engineering Geologist
Shannon and Wilson, Inc
400 North 34th Street
Seattle, WA 98103
206-695-6668
gbb@shanwil.com

5th IcGSM

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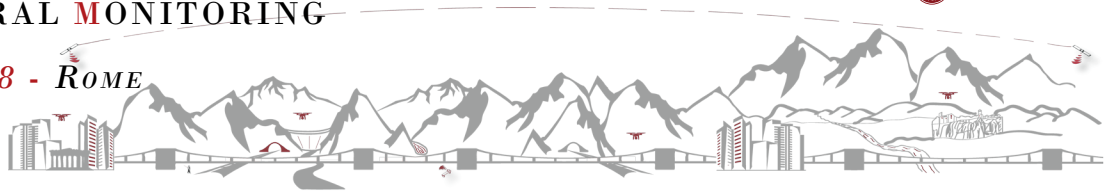
Master Classes



The IcGSM is growing year by year since its first edition in 2014 and, up to now, more than 450 attendees improved their technical knowledge with us!
40 international leaders have joined the courses as invited speakers and have presented their interesting projects from all around the world.
The course is a great opportunity to get in touch with important international companies in the field of monitoring who will show their products in the exhibition area.

Main topics:

- Basic concepts on monitoring
- Contact monitoring methods
- Remote monitoring methods
- Vibration monitoring
- Analysis and interpretation of data

Who should attend the course:

Engineers, geologists and technicians who are involved with performance monitoring of geotechnical features of civil engineering projects, managers and other decision-makers who are concerned with risk management during construction.

Schedule of the Course

21st May: Master Classes
22nd-24th May: Main Course
25th May: Field Trip

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Piezometers
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info@geotechnicalmonitoring.com
geotechnicalmonitoring.eu