

---

01 May 2013, 5:20 pm - 5:50 pm

## General Report - Session 7

Scott Newhouse

*Bechtel Power Corporation, Frederick, MD*

Cholachat Rujikiatkamjorn

*University of Wollongong, Australia*

Gary F. Goodheart

*Patrick Engineering Inc., Lisle, IL*

Ahijit Sheth

*Gannett Fleming Inc., Audubon, PA*

Philip Robins

*Golder Associates Pty Ltd., Australia*

Follow this and additional works at: <https://scholarsmine.mst.edu/icchge>



Part of the [Geotechnical Engineering Commons](#)

---

### Recommended Citation

Newhouse, Scott; Rujikiatkamjorn, Cholachat; Goodheart, Gary F.; Sheth, Ahijit; and Robins, Philip, "General Report - Session 7" (2013). *International Conference on Case Histories in Geotechnical Engineering*. 7. [https://scholarsmine.mst.edu/icchge/7icchge/session\\_13/7](https://scholarsmine.mst.edu/icchge/7icchge/session_13/7)



This work is licensed under a [Creative Commons Attribution-Noncommercial-No Derivative Works 4.0 License](#).

This Article - Conference proceedings is brought to you for free and open access by Scholars' Mine. It has been accepted for inclusion in International Conference on Case Histories in Geotechnical Engineering by an authorized administrator of Scholars' Mine. This work is protected by U. S. Copyright Law. Unauthorized use including reproduction for redistribution requires the permission of the copyright holder. For more information, please contact [scholarsmine@mst.edu](mailto:scholarsmine@mst.edu).

## GENERAL REPORT - SESSION 7

### 7a. Case Histories on Application of Geotechnics

### 7b. Monitoring of Critical Geotechnical Constructions

**Scott Newhouse**  
Senior Engineer  
Bechtel Power Corporation  
5275 Westview Drive  
Frederick, MD 21703 (USA)

**Cholachat Rujikiatkamjorn**  
Centre for Geomechanics and  
Railway Engineering  
University of Wollongong  
NSW 2522  
Australia  
[cholacha@uow.edu.au](mailto:cholacha@uow.edu.au)

**Gary F. Goodheart**  
Patrick Engineering Inc.  
4970 Varsity Drive  
Lisle, IL 60532  
USA  
[ggoodheart@patrickco.com](mailto:ggoodheart@patrickco.com)

**Abhijit Sheth**  
Geotechnical Project Engineer  
Gannett Fleming, Inc.  
1010 Adams Avenue  
Audubon, PA 19403  
USA  
[asheth@gfnet.com](mailto:asheth@gfnet.com)

**Philip Robins**  
Associate  
Golder Associates Pty Ltd.  
Level 3, 1 Havelock Street  
West Perth, WA 6005  
Australia  
[probins@golder.com.au](mailto:probins@golder.com.au)

### ABSTRACT

The authors have prepared this General Report for Conference Session 7. Session 7 includes two divisions with themes in transportation projects, and the use of instrumentation and monitoring methods, as described below in the introduction. The authors reviewed a total of 16 papers from 10 countries. The General Report includes a summary table of all of the submitted papers, and individual summaries of each.

### INTRODUCTION

This general report presents the papers submitted to Session 7. The themes of Session 7 are:

- Rail and Highway Case Histories (Session 7a)
- Geotechnical Monitoring Methods Used for Mining, Excavation, Warning Systems, Large Scale Mapping of Response for Heavy Civil Construction Control (Session 7b)

The session drew a total of 16 papers from 10 countries:

- Session 7a: Scotland, Canada, Albania, USA, Nigeria, India, Italy
- Session 7b: Greece, Malaysia, Iran, USA

Submitted papers span a wide range of topics. These are tabulated in the summary table below. Individual paper summaries follow the summary table. These components, the summary table and collection of individual summaries, inform the reader and allow focus on the chosen topic/theme. Topics in the submitted papers include case histories on:

- Roadway construction, bridges and retaining walls for rail and highways, including use of instrumentation for these types of projects
- Dam instrumentation
- Landslide prediction using sophisticated instrumentation/data acquisition
- Ground subsidence prediction using sophisticated instrumentation/data acquisition
- Excavation bracing design

#### SUMMARY TABLE

<b>Paper No. &amp; Authors</b>	<b>Title of Paper</b>	<b>Summary of Content</b>	<b>Country</b>
7.01a Paul Nowak	M74 MOTORWAY, GLASGOW – GEOTECHNICAL ASPECTS OF DESIGN AND CONSTRUCTION	Discusses numerous design and construction challenges for earthwork and foundations	Scotland
7.02a Chris Barker, Alan Phear, Romeo Ciubotario, Robert Talby, Paul Quigley, Richard Deakin, Andrew Cushing	GROUND ENGINEERING FOR THE AUTOROUTE 30 PPP PROJECT, MONTREAL CANADA	Describes geotechnical solutions designed and constructed on major self-certification infrastructure project	Canada
7.03a Luljeta Bozo Skender Allkja	SEISMIC REFRACTION DATA AND DANGEROUS PHENOMENA'S IN BY-PASS VLORA ROAD	Describes geophysical studies and engineering analyses performed to evaluate new roadway corridor	Albania
7.05a Abhijit R. Sheth Craig M. Benedict Ara G. Mouradian John Brun	TWO-TIER RETAINING WALL SYSTEM TO SUPPORT RAILROAD EMBANKMENT WIDENING	Describes geotechnical engineering design of new two-tier retaining wall system to support railroad embankment widening	USA
7.06a So-ngo Clifford Teme, Mayne David-West and Nathan Iboroma	ALIGNMENT AND DESIGN OF A 73-KM LONG COASTAL ROAD IN THE SOUTHCENTRAL SEGMENT OF THE NIGER DELTA, NIGERIA	Presents a series of geotechnical investigations including Deep borings, Shallow borings and Dutch Cone Penetrometer Tests along a 73-km East-West Coastal Highway. This paper describes the geotechnical characteristics of the sub-soils along the entire 73-km of the road alignment and with the adopted pavement design considerations.	Nigeria
7.07a Matthew D. Breitenbach, Dawn	CSX RAILROAD BRIDGE REPLACEMENTS	Presents the geotechnical design of Phase II bridge foundation where the design process was modified	USA

<b>Paper No. &amp; Authors</b>	<b>Title of Paper</b>	<b>Summary of Content</b>	<b>Country</b>
Edgell, Gary F. Goodheart		based on the observation in Phase I bridge construction. It is found that the piles with larger diameter increase potential of soil plug which significant impact the required pile length.	
7.08a Ravin M. Tailor, Jigisha M. Vashi and Mahesh D. Desai	RELOOK AT FOUNDATION DESIGN OF RE STRUCTURES IN INDIAN ENVIRONMENT BASED ON CASE STUDY	The Authors revisit the design issue of reinforced embankment on steep slope in India. The issue can be attributed to the permeable backfill and foundation trenches. The pre-monsoon or rains floods during construction creates water logging in the foundation trench in clayey subsoil, causing the distress in the reinforced wall. The case studies are discussed and analysed to illustrate problems and solutions.	India
7.13a Paolo Mazzanti	INVESTIGATING THE BEHAVIOUR OF NATURAL SLOPES AND MAN MADE STRUCTURES BY TERRESTRIAL SAR INTERFEROMETRY	This paper presents some interesting case histories on remote sensing techniques used to monitor the deformation of steep slopes. The paper describes the use of Terrestrial SAR interferometry (TInSAR).	Italy
7.01b C. Stamatopoulos, P. Petridis, L. Balla, I. Parharidis, M. Foumelis N.Nikolaou, N. Spanou	PREDICTING LANDSLIDE RISK COMBINING SPACE MEASUREMENTS AND GEOTECHNICAL MODELING: APPLICATION AT KERASIA SLIDE	presents the mitigation measures for a landslide prone areas using past displacement measurement and geotechnical model prediction. The case history analysis showed that accurate displacement prediction of landslides can be obtained.	Greece
7.02b C. Stamatopoulos, P. Petridis, L. Balla, I. Parharidis, M. Foumelis, D. Fountoulis, S. Lalehos, Ch. Metaxas	PREDICTING GROUND SUBSIDENCE INDUCED BY PUMPING COMBINING SPACE MEASUREMENTS AND GEOTECHNICAL MODELLING: APPLICATION IN THE THESSALY REGION, GREECE	presents a new geotechnical design approach incorporating space measurement and geotechnical modeling to predict ground subsidence due to ground water table lowering. The case study at the Thessaly plain - Carla region, Greece due to excessive pumping was analyzed to show the better accuracy of the new model.	Greece
7.03b Zamri Chik and Taohidul Islam	PREDICTION OF LANDSLIDES USING SURFACE WAVE ANALYSIS INCORPORATING WITH GIS: A CASE STUDY IN SELANGOR, MALAYSIA	presents the case studies of soil properties within landslide areas in Selangor, Malaysia. Shear velocity profiles of soil were obtained to predict landslide prone areas. The paper provides a guide for implementing emergency procedures and response actions towards geological hazards.	Malaysia

<b>Paper No. &amp; Authors</b>	<b>Title of Paper</b>	<b>Summary of Content</b>	<b>Country</b>
7.04b Amir Eslami Amirabadi, Atefeh Zamani and Cambyse Behnia	ACCESS ROAD CONSTRUCTION OF THE LARSI BUILDING USING REINFORCED EARTH WALLS	Presents the design options of reinforced earth wall for mountainous road construction in Shemshak, Iran. The detailed construction procedures on unstable slopes were discussed with additional ground stabilization techniques such as soil nailing and grouting.	Iran
7.06b Mohammad Sharif Rajabi, Farzin Kalantary	DEEP EXCAVATION IN AN URBAN AREA: A CASE STUDY	This paper presents a case history of a 20m deep excavation in an urban area, where unexpected shallow groundwater was encountered. Presents the selection of bracing method and related analysis methods- conventional stability analysis and FEM	Iran
7.07b Dorsa Elmi, Ali Asghar Mirghasemi	EFFECTS OF ARCHING ON MEASUREMENT OF EMBEDDED PRESSURE CELL IN EMBANKMENT DAM	This paper presents numerical analysis of arching effects in zoned earth dams related to placement of earth pressure transducers within the dam.	Iran
7.09b Don W. Dotson, Christopher J. Ramsey	REBUILD OF US 27	The paper discusses about the design, site challenges, construction, and monitoring aspects of a retaining wall, i.e., anchored soldier pile and lagging wall with cast-in-place concrete facing, proposed to support a cut section of a segment of US 27 located in Tennessee, U.S.A, to facilitate roadway widening.	USA
7.10b Georgette Hlepas, William Walker	WOLF CREEK DAM INSTRUMENTATION AND MONITORING	The paper discusses about various methods implemented to treat the seepage problem at Wolf Creek Dam (designed and constructed between 1932 and 1952) located on the Cumberland River near Jamestown, Kentucky, and extensive instrumentation and monitoring program implemented to verify the effectiveness of the proposed methods.	USA

## SUMMARY OF SUBMITTED PAPERS

### SESSION 7a

Paper No. 7.01a, M74 MOTORWAY, GLASGOW – GEOTECHNICAL ASPECTS OF DESIGN AND CONSTRUCTION, by Nowak: The 7.8 kilometer long M74 urban route corridor around the city of Glasgow, Scotland presented many geotechnical challenges to the design and construction teams. The Design-Build contract was let in 2007, construction began in May 2008, and the project was completed in June 2011. The route was heavily contaminated by historical industry (19<sup>th</sup> and 20<sup>th</sup> century iron works and chemical plants which deposited chromium, slag and hydrocarbons). In addition, coal was mined beneath the corridor for more than a century. Subsurface conditions were composed of 1 to 5 meters of fill materials (predominantly industrial waste), underlain by up to 35 meters of Recent, lightly over-consolidated Clyde Alluvium, Glacial Till and Carboniferous Coal Measure Sandstone bedrock. The paper details the geotechnical design and construction challenges for earthwork and foundations. The client wanted to minimize excavation due to the presence of contaminated material, which resulted in a fill deficit of some 1.5 million cubic meters (much if the fill deficit was made up with locally available waste materials, sand and gravel, and excavated alluvium). The mined out coal seams were filled by injection with sand/PFA/cement grout. Various pre-treatment methods were considered and used in different areas of the project (depending on site and environmental constraints), including vertical band drains, vibro stone columns, vibro concrete columns, and piled raft foundations. Surcharging was also employed to achieve primary consolidation. Differential settlement problems between structural elements (e.g., abutments) and adjacent earthworks were addressed with pre-cast piles 20-35 meters in length. Deep foundations (Continuous Flight Auger piles and pre-cast piles) were used to principal structures. The major structure along the corridor was the 12-span 740-meter long Port Eglinton Viaduct.

Paper No. 7.02a, GEOTECHNICAL ENGINEERING THE A30 PPP PROJECT, MONTREAL, CANADA, by Barker, et al.: The Nouvelle Autoroute 30 project is the largest and second Public Private Partnership (PPP) transportation project procured in the province of Québec, Canada. Built at a cost of \$1.54B (Canadian), it will operate as a tolled two-lane, 42km divided highway with 31 bridges including two major bridge crossings of the St Lawrence River and Beauharnois Canal and a short tunnel. The project is located approximately 30km south-west from downtown Montréal and will relieve traffic congestion on Montréal Island by providing the final section of an alternative southern bypass route. The project is located in a seismic, cold climate region and is underlain by deep deposits of soft sensitive Champlain Clay along much of the route. The ground engineering solutions developed for the project include driven steel piles, drilled shafts and micropiles, spread footings, and earthworks (cuts and fills, including lightweight fill and surcharged embankments on soft clays

with vertical drains). The project employed pile load tests, as well as geotechnical instrumentation and monitoring. This paper describes the geotechnical solutions designed and constructed on this major self-certification infrastructure project, and local and international experience with subsurface investigation, geotechnical design and construction certification were successfully integrated into the project. The project included a total of nearly 6.35 Million cubic meters (CM) of excavation, 5.4 Million CM of fill, 747,000 CM of lightweight fill, and 1.9 Million CM of imported granular pavement material. Much of the embankment area was surcharged with vertical drains to accelerate consolidation. Lightweight fill was used for high embankments were required but time constraints precluded surcharging. Advanced deep foundations were used to support the two major bridges, and deep foundations were used to support the 20 smaller bridges along the route. Seven smaller bridges were supported on shallow foundations. The tunnel was constructed using cut and cover techniques.

Paper No. 7.03a, SEISMIC REFRACTION DATA AND THE DANGEROUS PHENOMENA'S IN BYPASS VLORA ROAD, by Bozo, et al.: This paper presents a study of the behavior of soil along the Vlora By-pass road in Albania. These soils are evaluated under static and dynamic loads from geophysics data and in situ tests. The new road passes through hilly as well as field terrain and encountered areas susceptible to landslides. Geophysical studies included seismic refraction which were correlated to information from boreholes drilled along the route. Slope stability calculations were performed to evaluate colluvial slides.

Paper No. 7.05a, TWO-TIER RETAINING WALL SYSTEM TO SUPPORT RAILROAD EMBANKMENT WIDENING, by Sheth, et al.: This paper discusses design and construction of a new bridge to replace the 1907-era two-track bascule bridge over the Niantic River between East Lyme and Waterford, Connecticut. The bridge is located along the heavily traveled National Railroad Passenger Corporation (Amtrak) Northeast Corridor. Prestressed concrete sheet pile retaining walls were selected to support the new higher approach embankments along both the east and west approaches to the new bridge. Along the west approach a two-tiered wall design was utilized to support a new recreational walkway elevated above the 100-year storm surge elevation for the Niantic Bay, while at the same time keeping the walkway below the level of the adjoining tracks. The design of the two-tier wall system needed to take into account two simultaneous Cooper E-80 train live loads, the influence of electric traction catenary structure foundations along the wall alignment, and live load surcharge from maintenance vehicles at the walkway level, while at the same time minimizing long-term impacts to the public beach. The concrete sheet pile wall was designed to support the upper prefabricated modular T-WALL® along with all imposed loads, while at the same time protecting the railroad embankment from the scour and wave action of a 100-year storm event in Long Island Sound, and taking into consideration challenging subsurface conditions.

Paper No. 7.06a, ALIGNMENT AND DESIGN OF 73-KM LONG COASTAL ROAD IN THE SOUTH-CENTRAL SEGMENT OF THE NIGER DELTA, NIGERIA, by Teme, et al.: The paper presents a series of geotechnical investigations including Deep borings, Shallow borings and Dutch Cone Penetrometer Tests along a 73-km East-West Coastal Highway. This paper describes the geotechnical characteristics of the sub-soils along the entire 73-km of the road alignment and with the adopted pavement design considerations.

Paper No. 7.07a, CSX RAILROAD BRIDGE REPLACEMENTS, by Edgell, et al.: Presents the geotechnical design of Phase II bridge foundation where the design process was modified based on the observation in Phase I bridge construction. It is found that the piles with larger diameter increase potential of soil plug which significant impact the required pile length.

Paper No. 7.08a, RELOOK AT FOUNDATION DESIGN OF RESTRUCTURES IN INDIAN ENVIRONMENT BASED ON CASE STUDY, by Vashi, et al.: The Authors revisit the design issue of reinforced embankment on steep slope in India. The issue can be attributed to the permeable backfill and foundation trenches. The pre-monsoon or rains floods during construction creates water logging in the foundation trench in clayey subsoil, causing the distress in the reinforced wall. The case studies are discussed and analysed to illustrate problems and solutions.

Paper No. 7.13a, INVESTIGATING THE BEHAVIOR OF NATURAL SLOPES AND MAN MADE STRUCTURES BY TERRESTRIAL SAR INTERFEROMETRY, by Mazzanti: This paper presents some interesting case histories on remote sensing techniques used to monitor the deformation of steep slopes. The paper describes the use of Terrestrial SAR interferometry (TInSAR).

#### SESSION 7b

Paper No. 7.01b, PREDICTING LANDSLIDE RISK COMBINING SPACE MEASUREMENTS AND GEOTECHNICAL MODELING: APPLICATION AT KERASIA SLIDE, by Stamatopoulos, et al.: This paper presents the mitigation measures for a landslide prone areas using past displacement measurement and geotechnical model prediction. The case history analysis showed that accurate displacement prediction of landslides can be obtained.

Paper 7.02b, PREDICTING GROUND SUBSIDENCE INDUCED BY PUMPING COMBINING SPACE MEASUREMENTS AND GEOTECHNICAL MODELLING: APPLICATION IN THE THESSALY REGION, GREECE, by Stamatopoulos, et al.: The paper presents a new geotechnical design approach incorporating space measurement and geotechnical modeling to predict ground subsidence due to ground water table lowering. The case study at the Thessaly plain - Carla region, Greece due to excessive pumping was analyzed to show the better accuracy of the new model. The case studies of soil properties within landslide

areas in Selangor, Malaysia. Shear velocity profiles of soil were obtained to predict landslide prone areas. The paper provides a guide for implementing emergency procedures and response actions towards geological hazards.

Paper 7.03b, MULTI-LAYER SOIL ELECTRIC RESISTIVITY MODEL COMPARING WITH TWO-LAYER CHARACTERIZATIONS IN GEOTECHNICAL INVESTIGATIONS, by Chik and Islam: The paper presents the case studies of soil properties within landslide areas in Selangor, Malaysia. Shear velocity profiles of soil were obtained to predict landslide prone areas. The paper provides a guide for implementing emergency procedures and response actions towards geological hazards.

7.04b, ACCESS ROAD CONSTRUCTION OF THE LARSI BUILDING USING REINFORCED EARTH WALLS, by Amirabadi, et al.: Presents the design options of reinforced earth wall for mountainous road construction in Shemshak, Iran. The detailed construction procedures on unstable slopes were discussed with additional ground stabilization techniques such as soil nailing and grouting.

7.06b, DEEP EXCAVATION IN AN URBAN AREA: A CASE STUDY, by Rajabi and Kalantary: The paper presents a case history of an excavation 20m deep where unexpected groundwater was encountered. It discusses the unique aspects of local hand-dug wells as both the source of the groundwater and as a part of the solution. The analyses used to design excavation bracing includes FEM and conventional slope stability (limit equilibrium). An optimization process is also described. The paper concludes that the soil-nailed excavation bracing resulted in successful excavation with stable structure walls.

Paper No. 7.07b, EFFECTS OF ARCHING ON MEASUREMENT OF EMBEDDED PRESSURE CELL IN EMBANKMENT DAM, by Elmi and Mirghasemi: This paper presents numerical analysis of arching related to embedded pressure cells in zoned earth dams. The authors present FEM analysis showing the variation in vertical stress in vicinity of the trench where the cell is placed. They draw conclusions re: under-prediction of stress due to local arching effects, and development of arching effects developed during placement of the initial 15mm of fill within the dam.

Paper No. 7.09b, REBUILD OF US27 (SR29), by Dotson and Ramsey: The paper discusses about the design, site challenges, construction, and monitoring aspects of a retaining wall, i.e., anchored soldier pile and lagging wall with cast-in-place concrete facing, proposed to support a cut section of a segment of US 27 located in Tennessee, U.S.A, to facilitate roadway widening. The complicated geological setting encountered at the project site is discussed along with the philosophy behind estimation of soil parameters and lateral earth pressures for the wall design. The use of finite element method to analyze staged construction of the wall is discussed along with 2-dimensional limit equilibrium methods. The paper ends with discussion about techniques implemented to

perform construction monitoring of the wall such as use of inclinometers and briefly touches on the structural aspects of the soldier pile section.

Paper No. 7.10b, WOLF CREEK DAM INSTRUMENTATION AND MONITORING, by Hlepas and Walker: The paper discusses about various methods implemented to treat the seepage problem at Wolf Creek Dam (designed and constructed between 1932 and 1952) located on the Cumberland River near Jamestown, Kentucky, and extensive instrumentation and monitoring program implemented to verify the effectiveness of the proposed methods. The paper discusses occurrence of various seepage related issues and associated remediation work since the construction of the dam with the first seepage feature being evidenced back in 1967-1968. Construction of a seepage concrete barrier wall with grout curtains is discussed along with key to a successful implementation of instrumentation and monitoring program.

#### FINAL REMARKS AND TOPICS FOR DISCUSSION

Submitted papers in this session offer a broad range of topics. They show a great deal of expertise in geotechnical engineering across many countries. The topics and material presented in the many, various, quality papers in Session 7 should foster significant discussion and dialogue between the authors and attendees. Some suggested discussion topics include:

- Highway and rail design- what are the most crucial geotechnical aspects that are essential to address- e.g. stability of cut slopes, seismic performance?
- Predictions used in geotechnical engineering- what are the most promising instrumentation/monitoring techniques for the future, e.g. predictions re: landslides dam performance, settlement, retaining wall stability.
- Instrumentation and monitoring for dam performance and stability- what techniques work and provide useful, reliable data, and which do not.