Grouting and Education – Panel Discussion

Michael Byle - Moderator

PANEL:

- Cumaraswamy Vipulanandan – University of Houston, CIGMAT
- Chadi El-Mohtar – University of Texas, IAP
- Allen Cadden – Schnabel Engineering
- Brian Perrier - Keller

Grouting and Education

Technological advances and effective performance of grouting depends upon having well trained individuals. In practice, this is a combination of formal education and on-the-job training.

Grouting and Education

As technology advances, more preparation through formal education may be appropriate. At present there is no program or coursework specifically focused on grouting

Grouting and Education

Continuing advancement is also dependent on research. Grouting research may be done within commercial enterprises or in the university arena. Some of both occurs. Science is what keeps grouting from being a dark art.

Grouting Education Needs

- Diverse Specialties are involved in many aspects of grouting
  - Chemistry
  - Mechanics
  - Geotechnical Engineering
  - Construction Management
  - Computer Science
  - Geology
  - Hydrogeology
  - Materials Science
  - Sales and Marketing
  - Electrical/Instrumentation
- How many of these are needed and in what combination? Others?

Grouting Industry Needs

- How well prepared are college graduates for work in the grouting industry?
  - Materials manufacturers and suppliers
  - Equipment manufacturers and suppliers
  - Consultants (geotechnical engineering)
  - Contractors
- What should be learned on the job and what should be included in education?

University Needs

- Research begets programs
- Courses need ABET approval
- Program size and scale can be an issue
- Prerequisites and topics may cross programs (differing disciplines)
- Well defined understanding of industry needs

How do we get there from here?

Let’s Find Out

What do our panelists think?

Experience with CIGMAT and Influence on Courses

PROF. C. VIPULANANDAN PH.D., P.E., L.M. ASCE

HONORABLE DANIEL WONG ENDOWED PROFESSORSHIP

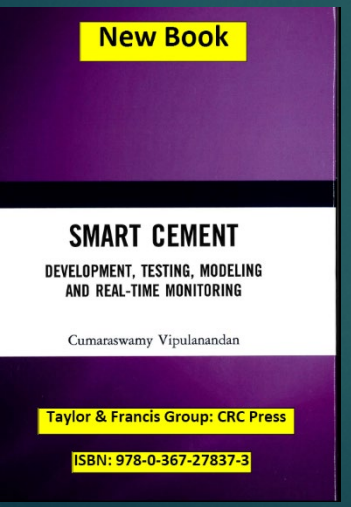
"SMART CEMENT" INVENTOR

"VIPULANANDAN RHEOLOGICAL MODEL"

"VIPULANANDAN FAILURE MODEL"

DIRECTOR OF CIGMAT, UNIVERSITY OF HOUSTON

DIRECTOR OF THC-IT, UNIVERSITY OF HOUSTON



OBJECTIVES

How to Educate and Communicate about the Grouting Materials and Potential Applications ?

1. **Educate the Students at the Undergraduate and Graduate Levels.**
2. **Improve the Communication between the Uses, Owners, Industries and Educators.**
3. **Demonstrate the Potential Applications and Benefits of Grouting**

CIGMAT

(Center for Innovative Grouting Materials and Technology)

University – Industries Consortium (Established in 1994)

1. Research: Grouts (Cement and Polymer (Chemical)) and Verification (EPA, NSF, Cities, Oil and Grout Industries)

2. Innovations: Smart Grouts and Real-time Monitoring (DOE, Industries)

3. Develop Testing Standards (EPA/ETV Program)

4. CIGMAT Annual Conference: – Improve Communication between the Owners, Potential Users and Industries. Educate the communities.

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ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM: PROTOCOL FOR THE VERIFICATION OF GROUTING MATERIALS FOR INFRASTRUCTURE REHABILITATION AT THE UNIVERSITY OF HOUSTON – CIGMAT

Citation:

NSF International, AND GIGMAT. ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM: PROTOCOL FOR THE VERIFICATION OF GROUTING MATERIALS FOR INFRASTRUCTURE REHABILITATION AT THE UNIVERSITY OF HOUSTON - CIGMAT. U.S. Environmental Protection Agency, Washington, DC, 600/R-04/183, 2004.

Impact/Purpose:

Inform the public

Contact

ORD Science Inventory Contact
http://cfpub.epa.gov/si/si_public_comments.cfm

Impact/Purpose:

Inform the public

Description:

This protocol was developed under the Environmental Protection Agency's Environmental Technology Verification (ETV) Program, and is intended to be used as a guide in preparing laboratory test plans for the purpose of verifying the performance of grouting materials used for infrastructure rehabilitation. More specifically, materials such as acrylamides, acrylic, polyurethane or other chemical substances are used to control infiltration and inflow (I/I) of either stormwater or wastewater into residential collection systems. These materials have been commonly used for leak control in below-grade wet wells and holding tanks, manholes, sewer and storm lines. Other uses include cracked retaining walls and other underground structures. The primary goal of in-situ grouting is to return the structure to an acceptable working condition. However, there is no systematic method for evaluating the performance of grout materials under service conditions. This protocol establishes a comprehensive approach for testing grout materials for leak control applications in both old and new wastewater collection systems and other concrete repairs. The protocol includes the application of testing procedures developed by the American Society of testing and Materials (ASTM), and those developed by the Center for Innovative Grouting Materials and Technology, at the University of Houston. The protocol addresses the requirements for testing facilities, as well as experimental design; Sample preparation; physical and mechanical properties testing, and model tests. Also included are requirements for developing a quality assurance project plan, requirements for data reporting and assessments, and safety considerations. The protocol was developed by a technology panel representing municipal engineers, engineering consulting firms, and grout manufacturers working with the University of Houston and the National Sanitation Foundation, International (NSF), EPA's partner organization for the ETV Program's Water Quality Protection Center.

URLs/Downloads:

ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM: PROTOCOL FOR THE VERIFICATION OF GROUTING MATERIALS FOR INFRASTRUCTURE REHABILITATION AT THE UNIVERSITY OF HOUSTON - CIGMAT

Record Details:

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Product Published Date: 09/30/2004
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EDUCATION

(Cannot Have a Course in Grouting (ABET))

1. Undergraduate Course CIVE 4369: Foundation Engineering
2. Graduate Course CIVE 6323:Advanced Foundation Design

CHAPTER 6: Ground Improvement

Grouting and Applications

- Permeable Grouting (Chemical/Polymer Grouts)
- Jet Grouting and Oil Wells (Cement Grouts)
- Compaction Grouting (Concrete Grouts Flowability = 0)

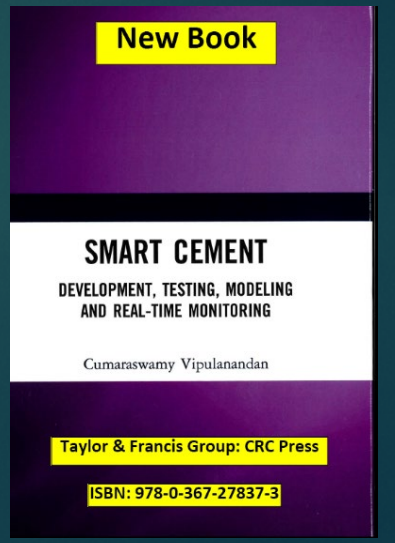
2. Exam Questions on Grouts and Applications

3. CIGMAT Conference (All Attend): Exhibitors and Questionnaire

Thanks

Texas Hurricane Center
for Innovative Technology

CIGMAT



Contractor Hiring and Education Perspective

Brian Perrier

Talent Acquisition Manager
Keller – North America

keller.com

Recruitment: Entry Level Engineering

January 17, 2023

Qualifications: Successful Candidates at Keller

- Degree in Civil Engineering - concentration in Geotechnical
  - Or Construction Management degree with geotechnical background
  - Know and understand our line of work
- Internship/Co-Op working for a construction company
  - They have hands on experience of what a work site looks and feels like
  - Know the demands of the job (long hours, conditions, etc.)
  - Know they want to work in the industry
- Candidacy mobility/flexibility
- Interpersonal skills
  - Demonstrated ability to work with all levels in an organization (laborer to executive)
- Computer skills: basic network environments, Microsoft Office Suite, construction management software, and ability to learn new software.

Keller Hiring and Development Programs

- Annual Keller Internship/Co-op Program
  - Currently hiring more than 80% of our engineering interns/co-ops
- Development Program – Field Engineer/Project Engineer
  - Career Pathing (has become a critical topic over the past 5 years) – data from exit interviews
- Internal training: Leadership, Field leadership, PM Academy, Sales School, etc.
- Currently offering scholarships ($10K) to selected interns/co-ops/new engineers

Keller Hiring and Development Programs

- Placing entry level engineers in a location with other new engineers (provides peer support)
- Competitive Benefit Packages and Compensation
  - Always monitoring to make sure we offer competitive packages (401K match, health and welfare, etc.)
  - Education assistance
  - Competitive base salary and bonus Program
- Referral Program

Industry Practices - Recruiting

- Build relationships with colleges/universities/engineering groups and become a familiar name with the students during career fairs and hiring events.
- Keller supports university research programs
  - Participating students gain valuable knowledge which enhances their value.
  - Keller is able to build relationships with students over time
  - Examples:
    - CGPR (Center for Geotechnical Practice and Research) at Virginia Tech
    - CBBG (Center for Bio-Mediated and Bio-Inspired Geotechnics) at Arizona State, UC Davis, New Mexico State and Georgia Tech.

Thank You

Consultant Hiring and Education Perspective

Allen Cadden, PE, D.GE.

Principal

Schnabel Engineering, Inc.

Experience and future needs for grouting in consulting engineering

- Mike highlighted many of the fundamental coursework understanding that is critical.
- Where is the grouting expertise? Can it really be within universities?
  - Given the pace of change over the past 20 yrs, knowledge is growing in the field daily
  - At the undergraduate level, there is no extra time
  - At graduate levels, is it better focusing on understanding geotechnical systems
  - Learning critical thinking so we use the data being collected in a grouting program to improve the results, systematic process towards a clear goal.
- Undergrad and Grad should include example of grouting projects to stimulate interest and awareness.

These are large data challenges.

- We collect data in many forms and have to be able to use this to make timely decisions.
- There are a wealth of tools available for visualization, and analysis
- We need to be efficient with them and possibly even apply AI/ML tools to find meaning

Research and Education: Current State and Future Vision

Chadi El Mohtar, Ph.D., P.E.

University of Texas at Austin

Grouting Education

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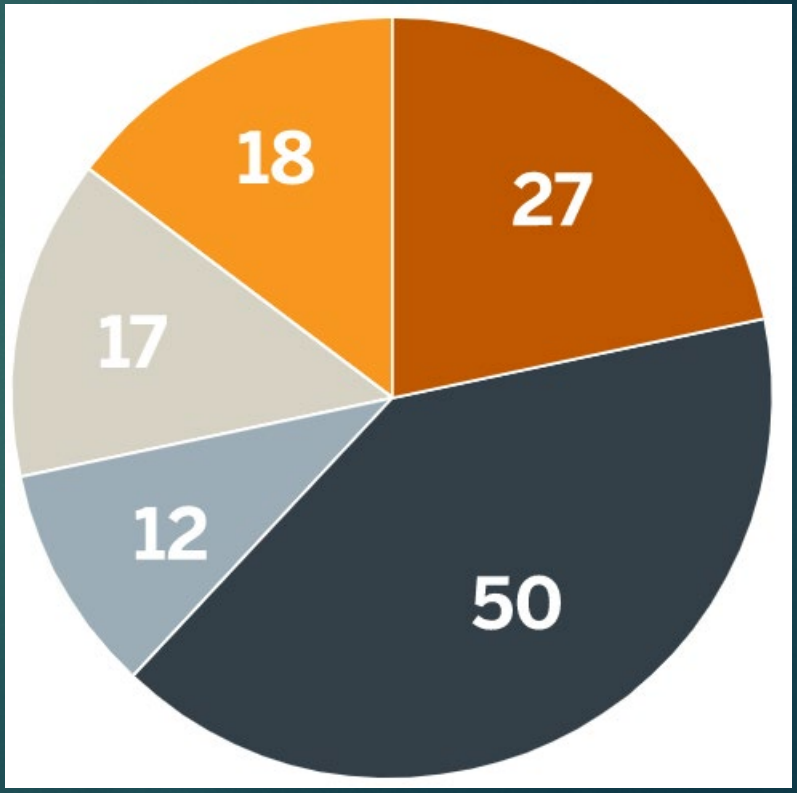
Let us focus on the formal education:

- Undergraduate Degrees
- Graduate Degrees

Grouting Education

Undergraduate Civil Engineering Bachelor Degree:

- 124 Semester Credit Hours (SCH)
  - 27 SCH Core Courses
  - 12 SCH Math Courses
  - 17 SCH Science Courses
  - 50 SCH ABET Required CE Courses
  - 18 SCH for Technical Electives



Numbers based on CAEE program at UT-Austin

Grouting Education

Undergraduate Civil Engineering Bachelor Degree:

- 18 SCH for Technical Electives
- 6 Total Electives Courses
- ABET requires at least one elective in 3 different areas

Area	# of Electives
Structures	7
Geotech	2
Transportation	4
Materials	2
Construction	3
Environmental	4
Water Resources	4



Grouting Education

Undergraduate Civil Engineering Bachelor Degree:

- Limited technical electives credits available
- Traditionally, Geotechnical Engineering electives are considered challenging and not as popular (except …)
- Adding a technical elective on grouting can be challenging to justify
- Working with professors teaching technical electives to add grouting content can be more achievable (geosythetics, ADSC … funded “educate the educator” workshops)
- But …. motivation??

Grouting Education

Graduate Civil Engineering MS and Ph.D. Degrees:

- Most MS degrees require 30 SCHs (10 courses).
- There are general ground improvement courses at different universities, but few, if any dedicated grouting courses.
- There is more flexibility to adding more dedicated Graduate courses on Grouting but ….
- Performance of University professors is evaluated based on:
  - Research
  - Teaching
  - Service



Grouting Education/Research

Continuing advancement is also dependent on research. Grouting research may be done within commercial enterprises or in the university arena. Some of both occurs. Science is what keeps grouting from being a dark art.

- There is a general stereotype in academia that the grouting industry rather do the research themselves (or at least keep the outcome to themselves).
- Unlike most Geotechical disciplines, most innovations in grouting is happening out in the field (at least in the US).
- But these efforts are usually more focused on the “what” makes it work and stay as “Institutional Knowledge” for the most part. Research can help with the “how” and “why” aspects and share it.

Grouting Education/Research

Deficiencies in our current state of Grouting in the USA:

- Many scientific federal funding agencies (like NSF) consider traditional grouting research too practical to fund.
- Lack of interest within academia in committing a career to grouting (challenge to get $$$) limits grouting courses, training more grouting researchers, and participation in service activities.
- Graduate students in the US are expensive (over 75K a year) …
- Very few companies can afford funding such studies.
- If committing this much money, the expectations for return on investment are higher (no public sharing of findings, …).

Moving Forward

Ground Improvement and Grouting Geotechnics (GIGGs) IAP:

- Industry Affiliates Program (IAP) is a formalized structure for academic and industry collaboration on research.
- Unlike other consortiums, IAPs are created to focus on a very specific research area, rather than a broad agreement of supporting research.
- Intent is to bring together all major players in the grouting industry (Owners, suppliers, consultants, contractors and researchers) and tackle the most critical topics facing the industry and/or advance current knowledge.

Moving Forward

Ground Improvement and Grouting Geotechnics (GIGGs) IAP:

- Each member will get to propose a project every year and get 1 vote when prioritizing the list of project.
- Each member will get to select one project to be more involved in year round, but will get the updates and outcomes from all projects.
- Plan is for June 1st, 2023 kickoff and inaugural annual meeting.
- All membership applications will be accepted up till March 31st, 2023.



Moving Forward

Ground Improvement and Grouting Geotechnics (GIGGs) IAP:

- Members can participate at Base Level (15K/year) or Advanced Level (25K/year) membership.
- Because of new emphasis on industry partnership at UT, we get to operate the IAP at 5% overhead (compared to 58.5% for regular research projects).
- Members can get their membership fees “refunded” by getting discounted testing at the UT Labs for their private work.
- Members will get the outcome of 150k-200K worth of research for their membership.
- Funds from external sources (DoD, DoE, NSF, …) will be pursued to supplement the IAP efforts.

