Welcome to the UCA and UC&T Fall Kick-Off and Info Session!

WEDNESDAY, August 24th
UC&T = Caverns + Shafts + Adits + Excavations + Tunnels

Manhattan Caverns
New York City
(10 blocks long; under Grand Central Terminal)
Olympic Cavern Hall (Gjøvik, Norway)
UC&T = Caverns + Shafts + Adits + Excavations + Tunnels
UC&T = Caverns + Shafts + Adits + Excavations + Tunnels
Tunnels: Water Conveyance

Niagara Falls Hydroelectric Tunnel
Tunnels: Wastewater

Deep Rock Tunnel (Indianapolis)
Tunnels: Transportation

Road

Transit
Tunnels: Multiple Use

SMART Tunnel – Stormwater Management & Road Tunnel (Kuala Lumpur, Malaysia)
Tunnels: Mining
What is Underground Construction and Tunneling and what is UCA?

https://www.youtube.com/watch?v=KBgvBEtzQq4
Center for Underground Construction & Tunneling (UC&T)

Developing Leaders. Advancing Knowledge.
A Little Bit about Us…

We are a collaborative, interdisciplinary group of faculty and students from:

- Civil and Environmental Engineering
- Geology and Geological Engineering
- Mining Engineering

Additional involvement from:
Geophysics,
Mechanical Engineering,
Electrical Engineering,
Computer Science,
Economics and Business
UC&T Center Staff

Begoña Ruiz
Center Administrator

Jacob Grasmick
PhD Student and Research Associate

Rick Bearce
Post Doc
Mike Mooney
Grewcock Chair & Professor, UC&T Center Director
Teaching: Tunnel Design & Construction; Earth Retaining Structures
Research:

- TBM Look Ahead
- Soil Conditioning
- Jet Grout Monitoring
- TBM Vibration
- Learning from Data
Teaching Interests:

- Mechanics of Materials
- Civil Engineering Materials
- Earth Retaining Structures
- Tunnels in Hard Rocks

Research Interests:

- Geomechanics
- Rock Mechanics
- Fracture Mechanics
- Ground-Support Interaction
- Geophysics
- Flow in Porous Media
Priscilla P. Nelson

Teaching:

CSM Courses:
- Tunneling
- Underground Engineering and Construction
- Earth Materials and Resources

Education Innovation at CSM:
- Development of a Tunnel “Geo-Wikipedia”
- Development of graduate field course in geological engineering
- CELERY – a web site for kids to write their own books about engineering (mycelery.org)
- Develop new short courses for the construction and mining industries
- STEM+C: Pathways to the Future for K-12 Education

Research:

- Sustainability of Urban Infrastructure
- Surface and Underground Excavation
- Geologic Uncertainty and Risk
- Subsurface Research in Geothermal Energy
- Microwave damage of rock
- History of underground infrastructure development and the growth of the United States
Rennie Kaunda

Teaching:

• Rock Slope Engineering
• Computational Neural Networks in Mining
• Mine Water & Environment
• Mining Equipment Maintenance and Automation

Research:

• Mining Geotechnics and Rock Mechanics
• Artificial Neural Networks
• Slope Stability and Internal Erosion
• Rock Fragmentation Optimization
• Mechanical Excavation and Tunneling
• Environmental aspects in Mining
Eunhye Kim

Academic Activities:
• MNGN 408 “Underground Design and Construction”
• MNGN 404 “Tunneling”
• MNGN 504 “(Advanced) Tunneling”
• MNGN 559 Underground Construction Engineering in Hard Rock
• MNGN X99 Independent Study

Research Activities:
• Mechanical and hydraulic properties of geomaterials
• Mechanical interactions between cutting tools and geomaterials (cutting tool design)
• Stability of geo-structures

Also, interested in helping students who pursue independent study (rock mechanics/UCTE topics). Please ask me (BB 214 or ekim1@mines.edu).
Marte Gutierrez
J.R. Paden Distinguished Professor, Civil and Environmental Engineering

Teaching:
• Soil Mechanics
• Foundation Engineering
• Soil Behavior

Research Interests:
• Geomechanics
• Environmental and Energy Sustainability

Current Research:
• Enhanced Geothermal Systems (EGS)
• CO2 Geological Sequestration
• Tunneling in Rocks
• Low Impact Hydro
Gabriel Walton

Teaching:
- Geological Data Management
- Engineering Geology
- Applied Numerical Modelling

Research:
- Post-yield behaviour of hard rock
- Lab-field relationships
- Rockmass characterization
Earth Mechanics Institute
Mining Engineering Department - Brian Asbury

Mechanical Excavation
Tunneling, Mining, Drilling, etc.
Rock Mechanics Testing
Laboratory Full-Scale Testing
Machine Performance Modeling
Novel Excavation Methods (water jet, thermal/chemical/laser)
How Can You Get Involved in UC&T??

- Courses and Degrees
- Research Projects and Positions
- Field Trips
- Scholarships: Information and Deadlines at uct.mines.edu
- Internships: Career Center and Diggernet
Education

- 20+ UC&T Courses
- Undergraduate Minor
- M.S. (Thesis and Non-Thesis)
- Ph.D.
  (Only UC&T advanced degrees offered in North America!)
- See CSM Bulletin
  (link on uct.mines.edu)
Area of Special Interest - ASI

The Underground Construction & Tunneling ASI consists of a minimum of 12 credit hours

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEEN312 SOIL MECHANICS</td>
<td>3.0</td>
</tr>
<tr>
<td>MNGN321 INTRODUCTION TO ROCK MECHANICS</td>
<td>3.0</td>
</tr>
<tr>
<td>MNGN404 TUNNELING</td>
<td>3.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electives Offered This Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEEN314 STRUCTURAL THEORY</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN415 FOUNDATIONS</td>
<td>3.0</td>
</tr>
<tr>
<td>GEOL309 STRUCTURAL GEOLOGY AND TECTONICS</td>
<td>3.0</td>
</tr>
<tr>
<td>MNGN408 UNDERGROUND DESIGN AND CONSTRUCTION</td>
<td>2.0</td>
</tr>
</tbody>
</table>
Undergraduate Minor

The Underground Construction & Tunneling minor consists of a minimum of 18 credit hours

**Required Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEEN312</td>
<td>SOIL MECHANICS</td>
<td>3.0</td>
</tr>
<tr>
<td>MNGN321</td>
<td>INTRODUCTION TO ROCK MECHANICS</td>
<td>3.0</td>
</tr>
<tr>
<td>MNGN404</td>
<td>TUNNELING</td>
<td>3.0</td>
</tr>
<tr>
<td>GEGN466</td>
<td>GROUNDWATER ENGINEERING</td>
<td>3.0</td>
</tr>
<tr>
<td>or GEGN467</td>
<td>GROUNDWATER ENGINEERING</td>
<td>3.0</td>
</tr>
<tr>
<td>GEGN468</td>
<td>ENGINEERING GEOLOGY AND GEOTECHNICS</td>
<td>4.0</td>
</tr>
</tbody>
</table>

*Offered This Semester*

**Electives Offered This Semester**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEEN314</td>
<td>STRUCTURAL THEORY</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN415</td>
<td>FOUNDATIONS</td>
<td>3.0</td>
</tr>
<tr>
<td>GEOL309</td>
<td>STRUCTURAL GEOLOGY AND TECTONICS</td>
<td>3.0</td>
</tr>
<tr>
<td>MNGN408</td>
<td>UNDERGROUND DESIGN AND CONSTRUCTION</td>
<td>2.0</td>
</tr>
</tbody>
</table>

*Offered This Semester*
Required Minor Courses this Fall

- **Soil Mechanics (CEEN 312)** – Alexandra Wayllace
  - MWF 9-9:50 + Lab
  - Prerequisites: Mechanics of Materials

- **Intro to Rock Mechanics (MNGN 321)** – Ugur Ozbay
  - MW 9-9:50 + T 1-3:50
  - Prerequisites: Statics or Dynamics for Mining Engineers

- **Groundwater Engineering (GEGN466)** – Kamini Singha
  - TR 2-3:15
  - Prerequisites: Calculus, Differential Equations, Structural Geology, Sedimentology & Stratigraphy, Geologic Fluid Mechanics or Fluid Mechanics

- **Engineering Geology and Geotechnics (GEGN468)** – Jerry Higgins
  - MWF 10-10:50 + R 11-1:50
  - Prerequisites: Intro to Rock Mechanics and Soil Mechanics
MS and/or PhD in UC&T

Required Courses for M.S. Thesis, M.S Non-Thesis and Ph.D. Degrees

The following 21 credit hours are required. Students are required to attend the UC&T seminar series and M.S. non-thesis and Ph.D. students must complete an internship-related project, registering as an independent study in the home department of the faculty advisor (CEEN 599, GEGN 599, or MNGN 599).

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEGN 468</td>
<td>Engineering Geology</td>
<td>4.0</td>
</tr>
<tr>
<td>GEGN 561</td>
<td>UCE Lab I</td>
<td>0.5</td>
</tr>
<tr>
<td>GEGN 562</td>
<td>UCE Lab II</td>
<td>0.5</td>
</tr>
<tr>
<td>CEEN 513</td>
<td>Adv. Geomaterial Mechanics</td>
<td>4.0</td>
</tr>
<tr>
<td>CEEN 523</td>
<td>Underground Construction Engineering in Soft Ground</td>
<td>4.0</td>
</tr>
<tr>
<td>MNGN 504</td>
<td>Underground Construction Engineering in Hard Rock</td>
<td>3.0</td>
</tr>
<tr>
<td>MNGN 509</td>
<td>Construction Engineering and Management</td>
<td>3.0</td>
</tr>
</tbody>
</table>

*Offered This Semester
*Spring 2017
# MS and/or PhD in UC&T

**Example Elective Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEEN510</td>
<td>Advanced Soil Mechanics</td>
<td>3.0</td>
</tr>
<tr>
<td>CEEN541</td>
<td>Design of Reinforced Concrete Structures</td>
<td>3.0</td>
</tr>
<tr>
<td>GEGN466</td>
<td>Groundwater Engineering</td>
<td>3.0</td>
</tr>
<tr>
<td>GEGN563</td>
<td>Applied Numerical Modeling for Geomechanics</td>
<td>3.0</td>
</tr>
<tr>
<td>GEGN573</td>
<td>Geological Engineering Site Investigation</td>
<td>3.0</td>
</tr>
<tr>
<td>GEGN673</td>
<td>Advanced Geological Engineering Design</td>
<td>3.0</td>
</tr>
<tr>
<td>MNGN424</td>
<td>Advanced Mine Ventilation</td>
<td>3.0</td>
</tr>
<tr>
<td>MNGN506</td>
<td>Design and Support of Underground Excavations</td>
<td>3.0</td>
</tr>
<tr>
<td>MNGN507</td>
<td>Advanced Drilling and Blasting</td>
<td>3.0</td>
</tr>
<tr>
<td>MNGN598C</td>
<td>Grouting in Underground Construction</td>
<td>3.0</td>
</tr>
</tbody>
</table>

*Offered This Semester
Example Elective UC&T Grad Degree Courses this Fall

• **Applied Numerical Modelling for Geomechanics** – Gabe Walton
  • F 1-3:50
  • Prerequisites: Engineering Geology, Soil Mechanics, or Rock Mechanics

• **Groundwater Engineering (GEGN466)** – Kamini Singha
  • TR 2-3:15
  • Prerequisites: Calculus, Differential Equations, Structural Geology, Sedimentology & Stratigraphy, Geologic Fluid Mechanics or Fluid Mechanics

• **Grouting in Underground Construction (MNGN598C)** – Ray Henn
  • F 5-7:50
  • Prerequisites: none

• **Advanced Mine Ventilation (MNGN524)** – Juergen Brune
  • M 5-7:50
  • Prerequisites: Mine Ventilation
Research Projects – UC&T Undergraduates Fall 2016

- LiDAR-based Underground Deformation Measurements
- Finite-Element Modeling of Liner Deformation
- Geological Controls on Rock Strength
- Decorative Stone Mining Database
- Rock Joint Roughness Quantification
- Geophysical Imaging of Rock Joints
- Development of an Apparatus for Soil Testing
- TBM/EPBM Performance in Weak/Sensitive Rock
- Fracture Mechanics
- Cutting Tool Wear
- Rock Mechanics Database
- Computer Numerical Simulation
Research Projects – UC&T Undergraduates Fall 2016

Undergraduates in Civil, Geological, Mining, Mechanical, Electrical, Geophysics, Computer Science, etc. - join us and participate in applied research such as site investigation and characterization, ground imaging, numerical modeling, tunnel boring machine performance prediction and more!

5-15 hours per week; $11-$14/hr; flexible schedule; possible site visits

See flyer for full information, sign up for email notification or email uct@mines.edu

Applications due September 2, 2016
Previous Undergraduate Researchers - Examples

Christopher Britschge
Major: Mechanical Engineering
Project: TBM performance in weak/sensitive rock

Grayson Sander-Olhoeft
Major: Geophysics
Project: Jet grout monitoring

Sean Cowie
Major: Geological Engineering
Project: Geological controls on rock strength

Joseph Gibson
Major: Applied Physics
Project: Development of a geophysical measurement system

Morgan Sander-Olhoeft
Major: Geophysics
Project: Slurry Infiltration

Tasha Markley
Major: Geophysical Engineering
Project: Impact of Artificial Fractures on Rock Strength and Deformation
Scholarships – UC&T Students

Scholarships related to the field of UC&T will be listed on the website at uct.mines.edu.

Examples:

**UCA of SME Scholarship - Application Deadline ~ December-January**
Established to encourage undergraduate and graduate academic pursuits and careers in the field of tunneling and underground construction and associated disciplines involved in the development, planning, design, and construction of underground infrastructure.

**RETC Attendance Award**
The RETC Attendance Award provides selected students with an opportunity to attend the RETC Conference. Applicants must be full-time sophomore, junior, senior, or graduate students with a designated major in an applicable field of engineering (civil, mechanical, mining, electrical, geological) or construction management. Applicants must have a demonstrated interest in the underground construction or tunneling industry.
Many companies support UC&T student internships:

- Kiewit
- J.F. Shea Construction
- Jay Dee
- Traylor Bros.
- Arup
- Golder Associates
- Atkinson Construction
- Moretrench
- USGS
- CTL Thompson
Next Seminar: Monday 8/29 @ Noon

Günther Meschke

Recent Advances in Computational Simulation in Mechanized Tunneling - From material flow in the pressure chamber to real time TBM steering support
What is the UCA?

- UCA is the Underground Construction Association
- Subsection of the Society for Mining, Metallurgy and Exploration (SME)
- CSM has the only student chapter in the nation
- Through the UCA student chapter you can:
  - Learn about projects and technologies in the tunneling industry
  - Network with industry professionals
  - Learn about tunneling research at CSM
New UCA officers for the 2016-2017 school year:

- President: Shrey Arora
- Vice President & Outreach: Ali Nazem
- Secretary: Lucila Dunnington
- Treasurer: Bradley Meyer
Plans for the 2016-2017 school year:

- Celebration of Mines
- Field trips to underground construction and tunneling projects
- 2 Community service events
- Tunneling short courses
- Networking events
- Biweekly seminars