Geothermal Heat Pump Research Funded by the National Science Foundation

By

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National Science Foundation

- An independent agency of the US Government
- Provides funding for basic science and engineering research
  - 45% of basic engineering research performed by US universities comes from NSF
- FY10 budget: $6.9 billion
  - Engineering: $725 million
  - Geotechnical Engineering: approx. $10-12 million, incl. geotechnical earthquake engineering
- Most funding is for unsolicited proposals that are 3 years in duration with a budget of $200k to $600k

Geomechanics & Geomaterials
Program Element 1634
Richard J Fragaszy, Program Director

Program Description

The Program supports basic research on mechanics and engineering properties of geologic materials, and on natural processes, such as hydraulic, biological and thermal, that affect the behavior of these materials

Disciplinary Areas

- Soil & Rock Mechanics and Dynamics (including liquefaction)
- Particulate Mechanics
- Mechanically Stabilized Earth
- Biological Modification of Soil/Rock
- Constitutive & Numerical Model Development
- Groundwater Hydrology
- Soil-Structure Interaction

Current High Priority Topics

- Bio-Geo Engineering
- Deep Underground Science and Engineering Laboratory (DUSEL)
- Unsaturated Soil Mechanics
- Mico- and nano-mechanics of soil and rock
- Thermal properties of soil and rock

Geotechnical Engineering
Program Element 1636
Richard J Fragaszy, Program Director

Program Description

The Program supports basic research on geotechnical aspects of civil infrastructure systems, with emphasis on sustainability and resilience.

Program Areas

- Foundation Engineering
- Geotechnical Earthquake Engineering
- Site Characterization
- Geoenvironmental Engineering
- Underground Construction and Mining
- Geohazards (tsunamis, slope instability, scour/erosion)

Current High Priority Topics

- Sustainability
- DUSEL
- Life-Cycle Energy and Materials Use
- Geoenvironmental Engineering
- Multi hazard mitigation
- Real-time construction monitoring and design modification
- Non-Intrusive Site Characterization

NSF-Funded Research on Geothermal Heat Pump Systems

- Prior to 2009, no proposals had been submitted on topics related to geothermal heat pump systems to either geo-engineering program
- Prior to 2009, no NSF awards had been made on geothermal heat pump systems, other than those directed at heat pumps in general
- In 2009, three awards were made
  - Two by the geo-engineering programs
  - One by the Education and Human Resources Directorate

Research Award in 2009

- CMMI-0928807, “The Use of Energy Piles for Sustainable Energy” Virginia Tech, Guney Olgun and James Martin, 2 years, $199,443
  - Full-scale tests on isolated piles in 2 or more different locations
  - Numerical modeling
  - Cost-benefit feasibility studies
  - Working with pile contractor

Research Award in 2009

- CMMI-0928159, “Soil Structure Interaction in Geothermal Foundations,” University of Colorado, John McCartney, Hon-Yim Ko, Tad Pfeffer, Moncef Krarti and Richard Regueiro, 3 years, $495,093
  - Numerical modeling of the coupled thermal/mechanical/hydraulic foundation-soil interaction.
  - Issues such as effects of cyclic temperature changes on interface friction and foundation capacity/settlement; potential for ground freezing and frost heave; long-term soil temperature changes
  - Numerical modeling to be validated by centrifuge tests
  - Association of Drilled Shaft Contractors (ADSC) collaborating with development of Design guidelines

Education Award

- DUE-0903279, “Geoexchange Initiative,” Dennis Sherwood, Gateway Technical College, 1 year, $141,063
  - Developing a course for drillers to train them for installation of vertical geothermal heat pumps systems

Government Incentives

- 30% Federal Tax credit on total cost of an installed geothermal heat pump system.
  - Some states and utilities provide additional tax credits or grants e.g., Georgia provides a 35% tax credit up to $2,000

- **June 2, 2009 - Secretary Chu (DOE) Announces Nearly $50 Million of Recovery Act Funding to Accelerate Deployment of Geothermal Heat Pumps**
  - **Demonstration projects of 50 tons capacity or more**
  - **Development of life-cycle cost tools**
  - **National certification and accreditation program**