关于美国 Bucknell 大学 Jeffrey C Evans 教授系列学术报告的通知

报 告 人： Prof Jeffrey C Evans

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报告地点： 安中大楼A420

报告时间一： 2014 年 5 月 20 日（星期二）下午 2:30-4:00

报告题目： (1) The TRD Method for In Situ Mixed Vertical Barriers in Dams and Levees
(2) Improved Modeling of Stresses in Soil-Bentonite Slurry Trench Backfill

报告时间二： 2014 年 5 月 22 日（星期四）上午 9:30-11:00

报告题目： (3) In Situ Evaluation of a Shallow Soil Bentonite Slurry Trench Cutoff Wall
(4) Thermal and Hydraulic Conductivity Properties of Geothermal Well Seals Subjected to Cyclic Heating and Cooling

报告人简介

Dr. Evans has over thirty-five years of teaching, research and consulting experience with a wide variety of geotechnical and environmental projects. Projects ranged from planning and supervision of subsurface explorations to engineering analyses for design and construction. Project experience during the over ten years with Woodward-Clyde Consultants included geotechnical and environmental studies for small to large single-discipline and multi-disciplinary projects. Contributions came at all levels from entry level staff engineering assignments to senior project engineer to project manager. At Bucknell University, teaching experience includes courses in geotechnical engineering, environmental geotechnology; ground improvement engineering, engineering graphics with computer-aided drafting, science of materials, comprehensive senior design and short-term study abroad in the UK, Argentina, Norway and Sweden. Research has focused on the fundamentals of slurry trench cutoff wall behavior, the physio-chemical effects of hazardous wastes upon soil and grout properties, the nature and applications of organophilic and zeolitic clays, and stabilization of petroleum sludge. Consulting experience while an academic at Bucknell University included expert opinions for citizens concerned with foundation and landfill stability issues in New York, for owners with substantial cost over-runs on deep foundations, a contractor regarding his involvement with a building exhibiting excessive settlement, and a designer regarding lagoons that failed during operation. Other consulting projects include consulting on issues with slurry cutoff walls in Florida, Wisconsin, Arizona, Delaware, Ohio, Colorado, Utah and Quebec, Canada. On-going consultation includes foundation stability of highway wire-rope safety barriers and the Wolf Creek Dam in Kentucky.

浙江大学岩土工程研究所
软弱土与环境土工教育部重点实验室
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报告简介

The TRD Method for *In Situ* Mixed Vertical Barriers in Dams and Levees

Conventional slurry trench methods of constructing low-permeability vertical barriers have been widely used in the past but more recently in situ mixing using the **T**rench **R**emixing and **D**eep wall method (TRD) has been introduced to the US. The TRD method is a one-phase process that involves the simultaneous, full-depth cutting and mixing of *in situ* soils with additives to create, in place, a continuous soil mixed wall. A blend of cementitious materials (granulated ground blast furnace slag and Portland cement) and slurry are injected as the milling/cutting proceeds horizontally resulting in continuous vertical mixing of in situ soils with the injected materials. Details of the technique will be presented as well as an evaluation of the wall performance at the Herbert Hoover Dike at Lake Okeechobee, Florida.

Improved Modeling of Stresses in Soil-Bentonite Slurry Trench Backfill

Soil-bentonite slurry trench cutoff walls have been widely employed as vertical barriers as a means to control subsurface contaminant transport and groundwater flow primarily through the low hydraulic conductivity of the backfill. Research has shown the hydraulic conductivity of soil-bentonite backfill decreases as the effective consolidating stress increases. Early research (Evans and Fang, 1985) noted that the state-of-stress within a soil-bentonite wall is significantly less than would be predicted by a geostatic pressure distribution. The first quantitative model to predict the state-of-stress (Evans et. al 1995) applied arching principles, conventionally used to predict stresses above buried pipelines, to predict the state-of-stress in a vertical cutoff wall. A revised model, term lateral squeezing (Filz 1996), accounts for the movement of the sidewalls. The latest model (Ruffing et al. 2010) provides a method to account for the non-linear relationship between stress and strain and then uses this non-linear relationship in a lateral squeezing model to equilibrate the horizontal earth pressures inside and outside the trench. The presentation describes the revised model, a methodology to compute the state-of-stress and results from the revised model compared with those of the previous models.

In Situ Evaluation of a Shallow Soil Bentonite Slurry Trench Cutoff Wall

Soil bentonite (SB) slurry trench cutoff walls have been widely used in the USA to control ground water flow and the migration of contaminants in the ground water. While substantial laboratory testing has been conducted, field studies are limited. Researchers at Bucknell University were afforded the opportunity to conduct *in situ* tests on a SB cutoff wall constructed during the summer of 2008. Cutoff wall properties were measured *in situ* employing cone penetration tests (CPT), Marchetti dilatometer tests (DMT), vane shear tests (VST), and ground water level monitoring on both sides of the wall. Tests were conducted during construction and at times of 3 months, 6 months and 9 months after construction to evaluate the change in wall properties with time. In addition, bulk samples and a Shelby tube SB backfill sample were obtained during construction for laboratory testing which included water content, grain size distribution, consolidation and rigid wall hydraulic conductivity. The field and laboratory data were analyzed to develop a consistent understanding of the *in situ* properties of the cutoff wall backfill. The VST and CPT showed an increase in backfill shear strength over the time-frame of the study. A slight increase of shear strength with depth was also found. However, a comparison of shear strength measured compared with that predicted using typical ratios of strength to consolidation stress indicated that the *in situ* stress is less than geostatic. Laboratory testing revealed a decreasing hydraulic conductivity with increasing consolidation stress demonstrating the importance of a reliable estimation of the stress state in the wall. Soil bentonite (SB) slurry trench cutoff walls have been widely used in the USA to control the movement of ground water and contaminants in ground water. This paper presents findings from in situ testing using the dilatometer, long-term monitoring ground water levels from monitoring wells and moisture sensors embedded during the wall during construction and is compared to previously published results from CPT testing and numerical modeling. Data from these devices was obtained during construction as well as at times of 3 months, 6 months and 9 months after construction to evaluate the change in wall properties with time. Laboratory testing on field mixed samples over the stress range anticipated in the field revealed a decreasing hydraulic conductivity with increasing consolidation stress demonstrating the importance of a reliable estimation of the stress state in the wall. For this project the dilatometer provided a unique opportunity for direct measurement of the in situ horizontal earth pressure. Due to the variability in stress in all three directions, the dilatometer test was conducted oriented both perpendicular and parallel to the trench line Time Domain Reflectometer (TDR) probes were installed at various depths in the wall to enable measurement of the volumetric water content versus time beginning with the day of backfill placement. Dilatometer data revealed differences in stress state as a function of orientation within the trench. The data also revealed stresses somewhat less than those predicted by the modified lateral squeezing model. Moisture probes revealed decreasing moisture content with time. The decrease in moisture content can be related to consolidation of the backfill material. Additional decreases in moisture near the top of the trench were consistent with drying of the backfill above the water table.

Thermal and hydraulic conductivity properties of geothermal well seals subjected to cyclic heating and cooling

This lecture presents the results of a study of the effects of cyclic heating and cooling on the thermal and hydraulic conductivity properties of a geothermal well seal. In the US, bentonite is widely used in the annulus between the fluid circulating pipes and the formation for geothermal well systems and is subjected to many cycles of heating and cooling throughout the design life. In particular, the seal is expected to maintain contact with the circulating pipes and the adjacent formation in order to effect efficient transfer of heat into and out of the earth. Secondly, since many of these wells are 100 m deep and more, the seal must maintain a low hydraulic conductivity in order to isolate various aquifers over the well depth from cross-contamination. In the study, after 23 cycles of heating and cooling, the thermal conductivity remained constant but was different for cycles of heating and cooling. After 12 cycles of hydraulic conductivity testing, there appears to be some degradation in the hydraulic conductivity and intrinsic permeability.