Varun – ITASCA Minneapolis

Senior Geomechanics Engineer and Consulting Manager

Expertise

Geotechnical Earthquake Engineering, Numerical Methods in Geotechnical Engineering, Soil Structure Interaction, Constitutive Modeling

Education

Ph.D. (Civil Engineering, Geosystems), 2010
M.S. (Civil Engineering, Geosystems), 2006
Georgia Institute of Technology, Atlanta, Georgia

B. Tech. (Civil Engineering), 2005
Indian Institute of Technology Delhi, New Delhi, India

Professional Affiliations

Member: American Rock Mechanics Association (ARMA), International Society for Rock Mechanics (ISRM)

Honors

Future Leader, American Rock Mechanics Association (2015)

Distinguished Ph.D. Student in Geosystems, George F. Sowers Award, Georgia Tech (2010)

Outstanding M.S. Student in Geosystems, James S. Lai Award, Georgia Tech (2007)

Best Undergraduate CEE Thesis, Premsheel Bhatnagar Award, IIT Delhi (2005)

Best All Round CEE performance, Dogra Gold Medal, IIT Delhi (2005)

Second Best All Round Institute performance, Alok Saxena Award, IIT Delhi (2005)

Merit Scholarship, IIT Delhi (2004-2005)

Professional Experience

ITASCA Minneapolis

2015 – Present Senior Geomechanics Project Engineer
2010 – 2015 Geomechanics Project Engineer

Georgia Institute of Technology, School of Civil and Environmental Engineering, Atlanta

2010 Course Instructor
2007 – 2009 Teaching Assistant
2005 – 2010 Graduate Research Assistant

2005 IIT Delhi, Dept. of Civil Engineering, Delhi, India
Junior Research Fellow

Project Experience

Seismic Performance of Embankment Dams: Performed numerical modeling to evaluate seismic stability of a hydraulic fill dam. The embankment dam had been retrofitted by adding an MSE wall and a buttress at the downstream toe and the owner wanted to evaluate any changes in seismic stability after retrofitting. Performed a variety of analyses for a suite of ground motions ranging from preliminary analysis for assessment of liquefaction susceptibility to coupled analyses for estimation of seismic deformations using constitutive models such as UBCSAND and PM4SAND. Post seismic stability analyses were also carried out to estimate factors of safety after shaking. Also helped the client with calibration of liquefaction constitutive model based on cyclic tests.

Seismic Performance of Tailings Dams: Worked on material property estimation for both sand and slimes for two different projects involving seismic stability of tailings dams. The first one required material property estimation from field tests while the second one relied on cyclic triaxial test data.

Tunnels in Soils: Performed numerical modeling for design of large diameter tunnels in glacial tills. Involved with dynamic analysis of deep excavations to determine susceptibility to racking. Involved with analysis to determine differential settlements and damage to existing structures due to volume loss during tunneling.

Retaining Structures in Soils: Stability analyses and factor of safety calculations for deep excavations in soils using retaining walls with and without anchors. Projects include shoring for deep excavations in glacial tills for TBM approach, sheetpile wall design for a tailrace structure and evaluation of remediation options for stability of retaining structures at a container terminal. Also implemented non-linear rotational spring in *FLAC* using *FISH* function to correctly model rotational restraint of a batter pile to lightly reinforced pile cap connection that was used by the client to model T-walls for hurricane flood protection system.

Site Response Analyses: Estimation of dynamic soil properties from geotechnical reports, site response analysis and ground motion deconvolution analyses for multiple projects.

Slope Stability in Rock: Slope stability analysis for large open pits, strip mines and natural rock slopes. Developed factor of safety contour plots to identify multiple potential failure surfaces for a surface mine. Also involved with research study for dynamic analysis of large open pit slopes. Developed charts for topographic amplification as a function of aspect-ratio of pit and correlation between ground motion intensity parameters and reduction in factor of safety. Also worked on stability of natural slope and excavations for foundations of a large railway bridge under both static and dynamic conditions.

Large Underground Excavations in Hard Rock: Performed numerical modeling for staged excavation of large underground mining facilities including ore bins, crusher chamber and workshops. Conducted analysis to determine the performance of ground support and develop ground reaction curves.

Tunnels and Shafts in Soft Rock: Performed 3D numerical modeling to test the adequacy of ground support for tunnels and tunnel-shaft intersections in soft rock.

Simulation of Material Flow in Block Caving: Used *REBOP* to analyze the effect of drawpoint spacing on draw and recovery from block caving for three different mines.

Software Development: Involved with development and testing of lattice based codes; *Slope Model*: a software to evaluate performance of large open pit slopes and *HF Simulator*: a software to simulate hydraulic fracturing in rocks.

Software Training: Conducted training sessions in ITASCA's yearly training courses for *FLAC* held in Minneapolis. Also delivered multiple *FLAC* and *FLAC3D* courses tailored to client needs at different client offices.

Seismic Risk Reduction for Port Systems: As part of NSF Grand Challenge team, developed simplified models to simulate pile response in both liquefiable and non-liquefiable soils at much faster speed and minimal loss of accuracy. The reduced complexity and computational time allowed numerical simulation of multiple hazard scenarios, both soil- and structural-remediation options and variation in soil properties. The results were used by other researchers to develop fragility curves and perform cost-benefit analyses to select optimal remediation strategies. The simplified model has broad range of application and also benefits state-of-the-art in foundation design in liquefiable soils. Also developed a hysteresis model for coupling in both horizontal directions during lateral loading of piles.

Dynamic Response of Caisson Foundations: Studied the response of caisson foundations using numerical analyses for small-strain cyclic loading. Developed and calibrated Winkler spring models to capture different soil resistance mechanisms. Analyses revealed range of loading frequency where destructive interference of wave fields prevents transmission of energy away from the foundation. Also developed transfer functions for response to seismic loading. The proposed model was shown to capture foundation response more accurately than the existing approach for either shallow or deep foundations.

Seismic Risk Analyses: Worked on seismic risk estimation for New Delhi region using synthetic ground-motion generation and site-response analyses. Also used synthetic ground motions and numerical analyses to estimate the damage to wharf structures during the 2001 Bhuj earthquake.