

Numerical Analysis of Underground Structures**K.G. Sharma***(Indian Geotechnical Journal, Vol. 39, No. 1, January 2009, pp.1-63)*

Underground structures are increasingly used for various projects. With the phenomenal growth in the development of computers and software packages, various numerical methods such as finite element method, boundary element method and distinct element method are often adopted for the analysis and design of underground structures. These methods facilitate modelling of various complex features related to rock mass behaviour, support system and excavation sequence.

The paper highlights some of the results of research carried out at IIT Delhi on the numerical analysis of underground structures. The analysis of powerhouse caverns, interaction of tunnels, branching tunnels, tunnel in jointed rock mass, nuclear waste repository and rock support interaction analysis are presented and discussed. Elastic, elasto-plastic and strain softening models are used to characterize the rocks.

KEYWORDS: Finite Element Method; Boundary Element Method; Distinct Element Method; Elastic Analysis; Elasto-Plastic Analysis; Underground Structures; Thermo-Hydro-Mechanical Analysis

One-Dimensional Non-Reactive Contaminant Transport with Scale-Dependent Dispersion**E. C. Nirmala Peter, M. R. Madhav and E. Saibaba Reddy***(Indian Geotechnical Journal, Vol. 39, No. 1, January 2009, pp. 64-80)*

The classical convection-dispersion equation describing contaminant transport through porous media assumes a constant dispersion coefficient. However several field and laboratory studies indicated scale-dependent dispersion. Therefore this paper presents a study of the convection-dispersion equation (CDE) with a scale-dependent dispersion coefficient which varies as a power law function with distance of travel. The governing equation was solved numerically using the finite difference method and the solution is shown to be in good agreement with the experimental data of Huang *et al.* (1995) and also the data of the column test conducted in the laboratory.

KEYWORDS: Dispersion Coefficient, Scale-dependent Dispersion

Appraisal of Soil Nailing Design

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Soil nailing is being used increasingly as a feasible alternative to support vertical / near vertical cuts and embankments. Field practitioners concerned with analyses, design and construction of soil nail walls invariably refer to established analysis and design procedure such as Federal Highway Administration (FHWA), U.S. Department of Transportation, Analysis and Design Guidelines for the Soil Nail Walls (2003). With the increasing use of such design guidelines, it is desirable to evaluate the analyses and design methodology adopted. An effort in this regard is made by designing three soil nail walls supporting vertical cuts of height 6 m, 12 m, and 18 m with reference to the procedure of the Federal Highway Administration. The response of the three wall sections is obtained using numerical simulations based on finite element analysis. Various analyses parameters such as development of axial forces in nails, maximum displacements, and important failure modes have been studied to assess the stability of soil nail walls. A comparative study showed that the soil nailed walls designed from conventional procedure are conservative.

KEYWORDS: Vertical cuts; Soil nailing; Design appraisal; Numerical simulation.

Validation of Analysis Developed for Soiled Nailed

Cuts by Model Tests

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The main aim of the paper is to validate the theoretical procedure with results from model tests. For this purpose two models of nailed open cuts have been made. The heights of cuts were kept 1.0 m and 2.0 m respectively. Each model was supported with nails in tow configuration giving the F.O.S. more than 1.5. The backfill of these models were surcharged with uniform load till the failure of model cuts occurred. The F.O.S of these cuts at these surcharge intensities were obtained by the developed analysis and found very close to unity thus validating the analysis.

KEYWORDS: Soil nailing, Open cuts, Factor of safety, Model tests

Seismic Soil-Structure Interaction Analysis of Ventilation Stack Structure**V. Jaya, G. R. Dodagoudar and A. Boominathan***(Indian Geotechnical Journal, Vol. 39, No. 1, January 2009, pp. 116-134)*

In this paper, the seismic SSI responses of a ventilation stack are examined in terms of response spectra at different levels of the structure. A computer program named SASSI 2000 which employs the finite element method and flexible volume substructure method is used for the SSI analysis. For analysis, the ventilation stack is modelled as 3D lumped mass beam stick model. The rigid links represented by beams of large flexural and axial stiffness are used to connect the stick model to the corresponding location of the basemat. The basemat is modelled using 3D solid elements. The soil material properties are assumed to be viscoelastic with the complex modulus representation of the stiffness and damping properties of the soil layers. The stiffness and damping of each layer is adjusted using the equivalent linear method to consider the strain dependency of the soil properties. The SSI analysis of the ventilation stack is carried out with different ground conditions and foundation embedment. It is noted that the amplitude of spectral acceleration decreases about 25% by the foundation embedment and the frequency of the stack and soil system is slightly increased.

KEYWORDS: Soil-structure interaction, SASSI 2000, Response spectra, Foundation Embedment.