software CTRAN/W administers a rational, feasible and precise assessment of the moving trend of the pollutant in the filter. The break through curve obtained from the software CTRAN/W cannot afford a proper assessment of the total time of the break through curve formation in the clinical ambience. However, numerical model calculates the nitrate fracture with a very good approximation which is close to laboratory model. The shape of the obtained break through curve from both numerical and clinical models is both rational and feasible with respect to the statistical and physical considerations.

Key Words: Pollution contamination, earth filter, modeling, removal of nitrate, low-priced absorbents.

NUMERICAL STUDY OF USING DEEP SOIL MIXING METHOD FOR SLOPE STABILITY

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Abstract
In this study, slopes' stability was examined by soil deep mixing method with parametric analyses. To perform the required analyses, the finite element numerical method and PLAXIS software were used, and then the results of this method were compared with the results of limit equilibrium method obtained from Slope/w software. These parameters include the effect of the location of the first row of deep mixing columns along slope foundation, area replacement ratio along foundation slope, length, diameter, coefficient of cohesion, distance between deep mixing columns, position of the water level in the foundation, as well as the effect of the surcharge load. According to the obtained results of the analyzed model with both finite element and limit equilibrium methods, the factor of safety of slope stability constantly increases upon the increase of parameters such as amounts of area replacement ratio, diameter, materials viscosity (cohesion of soil deep mixing materials), length of deep mixing columns, and depth of groundwater level to the level of slope foundation.

Key Words: Slope, soil deep mixing, finite element and limit equilibrium, stability safety factor, the lateral deformation.

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Abstract

Diagrid structural system is an efficient lateral load-resisting systems. Diagrid system contains diagonal truss elements through the height of the structure. Since lateral resisting elements is located in perimeter of the structure, this system acts as tubular system. The stability and shear rigidity of diagrid system is due to axial performance of diagonal elements. Recent studies have showed that tube increases lateral stiffness of the structure in tube systems. The purpose of this paper is to investigate the combined behavior of outer diagrid tube and inner core tube under lateral seismic loading. In this paper, twelve 36-story diagrid structures with inner core with different arrangements of incline angles for perimeter braces were designed. Composite structural systems were investigated in the form of a diagrid tube with an inner steel moment frame core and a diagrid tube with an inner concentrically-braced core. The combined behavior of these structures was evaluated under lateral seismic loading. A linear dynamic response analysis was used to obtain the interaction behavior of diagrid tube with internal core. The performance of the diagrid structures with inner cores indicates that most of the transferring lateral force in all stories is tolerated by the diagrid system; only in the last story was the shear absorbed by the internal core. Analytical results show that the effect of higher mode shapes of the structure in tall buildings causes the reduction of the shear stiffness of the diagrid at the building top. The analysis results show that diagrid system carried the significant lateral loads. Shear rigidity of diagrid systems increased when the angles of diagonal elements were reduced and the maximum shear rigidity was obtained for angle of 50.19 degree. Composite diagrid structural system with different arrangements of incline angles for perimeter braces is modeled in SAP2000 and analyzed for combined performance.

Key Words: Composite diagrid structures, Inner core, shear absorption rate.

BIO-GEOFILTER MODELING IN PILOT SCALE FOR REMOVAL OF DISSOLVED NITRATE

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Abstract

Currently, in many parts of the world and even in Iran, the high concentration of nitrate in drinking water has shown to be a serious problem, mainly caused by introduce of agricultural wastewater and home and industrial sewage runoffs to the water resources, and especially in the groundwater. The ultimate goal of the present study is to design and investigate the bio-geofilters in order to eliminate of nitrate from the runoffs. In this research, alternate layers of non-woven geotextile filters and sawdust with granular soil (PRB) have been used for reduction and removal of pollution. These layers are of paramount importance in terms of their permissibility and absorption capability and are thus used for the reduction of opacity and amount of absorbed pollutants. For selection of materials some points have been considered, which include the material capability for pollution elimination, their accessibility, and maximal cost-effectiveness. After conduction of permissibility tests and investigation of the results, the ratio of the weight mixture of the applied materials in PRB has been considered as 25% sand, 20% zeolite, 20% iron borings, and 10% poplar wood sawdust. For determination of the fracture curvature of the filter with artificial backwater injection with preliminary concentration of 100 milligrams per liter of nitrate, the nitrate characterization and break through happens after 25 minutes from the start of test. PRB break through curve can be classified with engineering approximation of pseudo-Gaussian. Break through curve is considered to be a normal curve and the value of longitudinal diffusion coefficient is $1 \times 10^{-7} m^2/s$. After the growth of biologic mass in its environment, the filter was able to decrease the amount of nitrate up to 99% after the elapse of 9 days. In the modeling of the prepared filter, the software SEEP/W has calculated the discharge value at each transverse section to be $9.0027 \times 10^{-5} m^3/s$. The

Among the significant discussions pertaining to the project design and planning, minimizing uncertainties is an important issue. Usually the uncertainties in subsurface projects arise from the unknown ground conditions which may cause the designer to fail to consider all the potential issues prone to occur during the construction procedure. Total time and cost uncertainties can be considered as the most important uncertainties; the time and costs are directly connected with thorough cognition of the subsurface conditions. Accordingly, in subsurface projects the actual time and costs are not ascertainable, and hence the probability methods should be used to assess such factors.

In order to evaluate the uncertainties probabilistically, different tools (probabilistic models) have been introduced, including Decision Aids for Tunneling (DAT) tool. DAT was first introduced by Einstein; it was then developed by Prof. Einstein group and major advancements have been achieved in DAT research projects since then. The present study was undertaken on a Hamro road tunnel of 1310m length and cross section of $97m^2$ as part of the under construction Sanandaj - Marivan road. In this paper, using DAT method and considering the preconstruction data of a Hamro tunnel, the probabilistic time and cost of the tunnel were predicted. In most cases in order to estimate the data needed for DAT method, a number of questionnaires were distributed among the tunneling experts and eventually the mean values of the respondents were applied to the model. Afterwards the time and cost obtained through DAT method were compared with the actual post-construction time and cost of the Hamro tunnel execution for model validation and reducing the uncertainty for the future projects. Finally, it was revealed that the obtained results of the DAT method has high similarity with the actual results, confirming the validity of DAT method for decreasing the total time and cost uncertainties in execution of future projects.

Key Words: DAT; Total time and cost uncertainty; geological model; construction model; hamro road tunnel.

EFFECTS OF SOIL DENSITY AND GEOTEXTILE REINFORCEMENT ON CALIFORNIA BEARING RATIO OF SANDY SOIL

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Successful use of geosynthetics is ensured in a given geotechnical application, as it is not only compatible, but also effective in improving the soil properties when appropriately placed. This study investigates the behavior of unreinforced and reinforced sandy soil with nonwoven geotextile using CBR tests. The soil used, has poor CBR value due to its low compaction and moisture percent. In a series of tests, Geotextile is placed in various depths from the top of samples. The effect of thickness of dense layer (with 97% compaction) on the soft subgrade is also investigated, and the results are compared with reinforced condition. To study the effect of embedment depth of reinforcement, the geotextile layer is placed in depths of 1, 1.5, 2, 3, 4, 6 and 8 cm from the top of the sample. Furthermore, a comparison between reinforced samples with one layer and two layers of geotextile is done. The results of the CBR tests demonstrate clearly considerable amount of increase in CBR value of soil with geotextile reinforcement. It is also shown that the maximum increase in CBR value is obtained when one layer of geotextile is placed at depth of 1.5 cm. The rate of increase in CBR value was reduced with increase in the placement depth of reinforcement layer. The thicker dense layer leads to more increase in CBR. In the same density and thickness of the replaced soil layer, the highest increase in the CBR value was achieved when the sample was reinforced by two layers of geotextile. To achieve a specified design CBR value, using less depth of replaced soil layer in the reinforced subgrade is possible as compared with unreinforced subgrade. For example, using a depth of 1.5 cm and 3 cm of replaced soil, CBR value equaling 6 is achieved for reinforced and unreinforced subgrades, respectively. Although the replacement of compacted soil layer or the use of reinforcement layer could increase the bearing capacity, achieving a certain capacity needs to consider the details of economic issues and performance limits.

Key Words: Sandy soil, geotextile, soil density, penetration, CBR.

INTERACTION BETWEEN PERIPHERAL DIAGRID AND INNER CORE IN DIAGRID STRUCTURAL SYSTEMS

current, electro-osmosis flow and energy consumption in different processes have been studied and the ability of each processes for the removal of zinc and nickel from sludge is determined. The results of pre test showed that enhanced electrokinetic process (the use of EDTA and citric acid as the electrolyte) compared with conventional electrokinetic (the use of water as the electrolyte) has a better performance in the removal of metals from the sludge. In this study, removal of zinc using enhanced electrokinetic process was 31% more than that in conventional method. The results revealed that leaching-electrokinetic combined process increases the removal efficiency of zinc and nickel to 94% and 82%, respectively. Decreasing pH and removing unwanted elements by leaching were the major factors to improve the electrokinetic performance. The results also showed that the magnetic separation-electrokinetic combined process has no considerable effect on heavy metal removal from sludge.

Key Words: Electrokinetic; sludge; leaching; magnetic separation; Zn.

ASSESSMENT OF GEOTECHNICAL CHARACTERISTIC OF BENTONITE CLAY CONTAMINATED BY GASOLINE

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Abstract

Petrochemicals and transport fuel pollutants can change soil characteristics. The geomechanical and geotechnical behaviors of oil contaminated soil are therefore reviewed to ascertain their potential reuse as engineering material. Cook et al. (1992), Puri et al. (1994), Meegoda & Ratnaweera (1994) and Al-Sanad et al. (1995) reported the reduction in shear strength and stress-strain behaviors of clays, significant reduction in permeability, strength and compressibility of the contaminated soil, reduction in maximum dry density and optimum moisture content and increase in liquid and plastic limits of the soil. The reuse of contaminated soil as civil engineering materials is one of the effective alternative methods of disposing contaminated soil. However, this is subject to either the containment of the agent of contamination in soil or effective remediation of the contaminated soil. The pollutants can alter the consolidation characteristics of clayey soil, increasing the total or differential settlements of the foundations of engineering structures resting on it. This paper studies the effects of gasoline on geotechnical characteristics of commercial montmorillonite clay as, one of the most abundant clay minerals. The bentonite clay is artificially contaminated by gasoline. For this propose, bentonite clay is mixed with 4, 8, 12, and 16% of dry weight of soil by gasoline. Results show that with increasing gasoline, liquid limit increases 11% and the maximum dry density and optimum moisture content are decreased 1.5% and 40%, respectively. Unconfined compression strength and the cohesion of bentonite clay with increasing gasoline decrease more than 60%. The compressibility index with increasing gasoline up to 4 % increases, then it decreases between 4 % to 12 % of gasoline, and finally with increasing gasoline to 16 %, the compressibility index increases again. A linear model for evaluating compressibility index (Cc) of contaminated soil mainly composed of high plasticity clay is presented on the basis of liquid limit.

Key Words: Bentonite clay, compressibility index, contaminated soil, consolidation.

REDUCING THE TIME AND COST UNCERTAINTY OF TUNNELING PROJECTS USING DAT METHOD CASE STUDY: HAMRO ROAD TUNNEL IN IRAN

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STABILITY ASSESSMENT OF GMPES FOR IRANIAN GROUND MOTION DATABASE

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Abstract

Selection of Ground Motion Prediction Equation (GMPE) is one of the key elements within a seismic hazard analysis. The variety of available GMPE models makes this selection a scientific challenge. Therefore, the stability assessment of a set of GMPE models is investigated in this paper by employing the new emerged Re-Sampling Analysis (RSA) methodology (Azarbakht et al., 2014). Four GMPE categories are examined in this paper which are: (1) The local GMPE models which are developed based on Iranian events; (2) Regional GMPE models which are for Europe and Asia; (3) The NGA-WEST1 GMPE models (Power et al., 2008); (4) The NGA-WEST2 GMPE models (Bozorgnia et al. 2014). The ground motion database, in this study, consists of 691 acceleration time series resulted from 85 seismic events. The magnitude range is between 5 to 7.4 and all the records have the distance less than 200 km (BHRC, 2013). The analysis is performed for spectral accelerations corresponding to the eight periods (T = 0.0, 0.1, 0.2, 0.5, 0.75, 1.0, 1.5, and 2.0 sec).

The conventional statistical tools show good performance for nearly all the considered GMPEs, and they are not sensitive to the given database. However, the RSA results illustrate the bias versus magnitude, distance (R_{JB} is identical to R_{epi} in this study) and shear wave velocity (V_{s30}). Based on the RSA methodology, the better model is the one in which the bias decreases when the size of sampling increases. Therefore, based on the results obtained in this study, GMPE model of Rahpeyma et al. as well as that of Zafarani et al. show good agreement with these criteria. In addition, both NGA GMPE groups (NGA-WEST1 and NGA-WEST2 GMPEs) show poor performance based on the RSA results. It is worth mentioning that the given GMPE performance is not the same in different periods. The results of the RSA methodology can be used in order to establish a logic tree analysis in further studies.

It is worth mentioning that all the results in this paper are constrained to the given assumptions as well as the considered methodologies and database. The results may change by using different databases and enrichment of the data during future studies.

Key Words: Seismic hazard analysis, GMPE, Iranian ground motion database, RSA.

REMOVAL OF ZINC AND NICKEL FROM WASTEWATER TREATMENT SLUDGE BY COMBINED MAGNETIC SEPARATION AND LEACHING WITH ENHANCED ELECTROKINETIC PROCESS

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Abstract

Heavy metals are among the most serious environmental pollutants. Contamination of industrial waste water treatment sludge with heavy metals represents a potential threat to human and animal health. Electrokinetic remediation is one way of removing pollutants such as heavy metals from the contaminated soils. This technique is also highly cost-effective and practical for remediation of industrial sludge. In electrokinetic remediation a low-intensity electrical current is made to flow through electrodes (cathode and anode) embedded in the contaminated soil. Small ions and charged particles migrate between the electrodes encased with water. Due to electrical potential differences, pollutants, such as heavy metals influenced by the flow of electric current, move into the electrolytic solution. The main objective of this study is to investigate the effect of magnetic separation and sulfuric acid leaching pretreatment as a way of boosting zinc and Nickel removal from industrial wastewater sludge through an electrokinetic process. This laboratory-scale study uses real sludge samples taken out from a wastewater treatment plant of industrial park. In this study, changes in pH, electrical

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Abstract

In recent years, the asphalt production cost has been increased appreciably. On the other hand, by decreasing the construction projects, the cement industries could not work at full capacity. In order to overcome these problems a considerable attention has been attracted to the development of concrete pavements. This study was thus conducted to investigate the durability and mechanical characteristics of Roller Compacted Concrete Pavements (RCCP).

The influence of variation in water content was investigated by using different w/c of 0.33, 0.35 and 0.38. Three different cement contents of 325 kg/m^3, 350 kg/m^3, and 375 kg/m^3 were also made for comparison purposes. A pozzolanic cement concrete and a concrete mixture with 7% cement replaced by silica fume were also compared to the plain concrete.

The concrete mixtures had 28days compressive strengths higher than 35 MPa, surpassing the recommended minimum level of ACI325-10R. Increasing the cement content, in conjunction with decreasing w/c content, led to higher compressive strengths at 7 and 28 days. Silica fume concrete outperformed the other mixtures at 28days. Similar trends were obtained for flexural strength test results.

The durability results indicate that by decreasing the w/c content from 0.33 to 0.38, the penetration depth of water was reduced from 10 mm to 14 mm. The lowest penetration depth was observed for the mixtures containing silica fume and the pozzolanic cement. This shows a more tortuous and discontinuous microstructure in these mixtures due to pozzolanic reactions.

The salt scaling resistance results indicate that the mixture containing silica fume had higher deicer salt scaling resistance compared to the other mixtures. The mixtures with pozzolanic cement and that with the lowest w/c content (0.33) had also higher resistance against salt scaling compared to the other plain mixtures. Increasing the w/c content significantly influence the salt scaling resistance of the mixtures, leading to lower salt scaling resistance.

Key Words: Roller compacted concrete pavement (RCCP), mechanical properties, durability characteristics, salt scaling resistance, vebe time.

NUMERICAL SIMULATION OF A HIGH ROCKFILL DAM CONSIDERING PARTICLE BREAKAGE PHENOMENON

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Abstract

Particles breakage phenomenon can strongly affect deformational behavior of the coarse granular materials, especially rockfill materials. Large deformations can be recorded due to this phenomenon in high rockfill dams. Common geotechnical constitutive models cannot simulate volumetric strains due to this phenomenon with a sufficient accuracy. In this research, a known hardening/softening constitutive model on the basis of Mohr-Coloumb model, which is available in FLAC program, was used to predict the deformational behavior of the coarse granular materials. In this constitutive model, the strain hardening/softening feature can be simulated by the means of mobilized friction angle concept. Also, the potential function of it was defined on the basis of the mobilized dilatancy angle concept. Some modifications were applied to the potential function of this model to improve its ability to predict contractive volumetric strains due to particles breakage phenomenon. The Masjed-e-soleyman dam is a high central clay core rockfill dam, located in the south-west of Iran. A series of large scale tri-axial tests was performed on the rockfill materials of its shells. The results of the large scale tri-axial tests indicate that these materials have a high potential of crashing under shearing. The tri-axial tests were numerically simulated, and the parameters of the improved hardening/softening constitutive model were determined using back analyses. A three-dimensional finite difference numerical model of the Masjed-e-soleyman dam was developed during construction. Good agreement between numerical results and instrument data in the fields of deformation and stress confirms the accuracy and efficiency of the improved constitutive model to predict the deformational behavior of the rockfill shells due to crashing under shearing.

Key Words: Particle breakage, rockfill material, hardening /softening constitutive model, large scale tri-axial test.

Abstract
Whilst booster chlorination stations are suggested to resolve the drawback of chlorination at water resources, determination of exact amount of injection is still a problem with respect to formation of THM as disinfection by-product (DBP) of chlorination. In this paper, a multi-objective genetic algorithm is used to optimize both the location of chlorination stations and their schedule with respect to residual chlorine and formed THM which is indirectly estimated by a linear relation based on the amount of chlorine consumed. The objectives are to minimize the total amount of consumed disinfectant and to maximize percent of safety drinking water (SDW) assuming a specific number of disinfectant stations. The results show the increase in the number of stations would lead to both a decrease in DBP and maintenance of residual chlorine in standard limits in many parts of the network. Particularly, distant points with a very long resident time often suffer both residual chlorine less than standard limit and DBP with high concentrations. A maximum amount in which no risk of cancer would occur due to DBP is then determined for each specific number of chlorination stations.

Key Words: Disinfection by-product, optimal chlorination stations, urban water distribution system.

EVALUATION OF BEARING CAPACITY OF STRIP FOUNDATION BASED ON CONSECUTIVE LAYERS OF WEAK AND STRONG CLAYS BY CHARACTERISTIC LINES METHOD

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Abstract
Most of the available soils in nature are non-homogeneous and can be considered as a homogeneous layer with simplifications. So far, different methods have been presented in order to achieve bearing capacity of these soil types. Stress Characteristic Lines Method, presented by previous researchers, is one of the best numerical methods able to determine the bearing capacity of foundations. The important advantage of this method over the other numerical methods is that it neither requires the customary and troublesome meshing nor uses complex and specific behavioral models of soil, whereas only the stress field is required at the collapse moment not the strain field, and the computations are performed with higher speed and simplicity. So far, previous researchers have been able to provide programs through this method in order to estimate the bearing capacity of homogeneous soil. However, this is not true in all cases. Layered soils are mostly encountered in practice. The thickness and also cohesion of layers are the effective parameters in this regard. The present article evaluates the bearing capacity coefficient (N_C^*) of a strip in foundation for two undrained clay soil layers (upper layer is weaker than lower layer) with respect to changes in the upper layer thickness as well as variations in cohesion ratio of two layers by using the mentioned method. Therefore, in addition to briefly reviewing the technical literature and calculation procedure of strip foundation based on homogeneous soil, an algorithm for two layered soil is presented. Then, by using BCTL software (Bearing Capacity of Two Layer) obtained by this algorithm, changes of static load bearing capacity of the strip foundations (N_C^*) on the two undrained clay layers have been evaluated. As expected, by increasing the ratio of Cu1/Cu2 to one (for different thickness of top layer over width of strip footing), bearing capacity coefficient (N_C^*) is converged into number 5.142.

Key Words: Bearing capacity, strip foundation, two-layered clay soils, characteristic lines.

THE MECHANICAL AND DURABILITY CHARACTERISTICS OF ROLLER COMPACTED CONCRETE PAVEMENT (RCCP)

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ter test for estimation of internal friction angle are evaluated. Some theoretical methods are based on unloading portion of pressuremeter stress-strain curve due to fewer disturbances. It is realized that empirical methods have greater errors in prediction of friction angle in comparison to theoretical approaches. An optimized method is proposed for estimation of friction angle.

Key Words: Numerical modeling, evaluation of cavity expansion interpretation methods, estimation of internal friction angle of soil.

EXPERIMENTAL INVESTIGATION OF THE FLOW PATTERN AROUND T-HEAD SERIES OF SPUR DIKES IN STRAIGHT CHANNEL

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Abstract

Spur dikes are hydraulic structures that are used to protect river banks. In this paper, parameters influencing flow pattern around non-submerged attracting series of T- head spur dikes in straight channel are investigated. Evaluating of the flow pattern indicates that using spur dikes causes reversed flow and increasing the horizontal and vertical components of velocity at upstream of spur dikes. Longitudinal component of velocities at the front of the first spur dike wing is more than longitudinal velocities in the front of the second and third spur dike wing and in front of the second spur dike wing is more than third spur dike wing. The horizontal component of velocity are maximum the surface near to bed in reversed flow region and the negative transvers velocities of reversed flow are maximum near the free surface between spur dikes and in the front of the second and third spur dike wing. The deep positive velocities are seen in the edge of wing upstream of first spur dike and between spur dikes. Investigation of turbulence kinetic energy in flow pattern shows that it is maximum in the edge of wing upstream of first spur dike and has increased in wing of spur dikes' shear layer. Investigation of Reynolds stresses in flow pattern shows that component $-\rho u_i' \nu_i'$ is maximum compared to two other components and the maximum value of that is occurred in the downstream and among of spur dikes. The maximum value of $-\rho u_i' \nu_i'$ component is respectively about 5 and 6 times the values of $-\rho u_i' w_i'$ and $-\rho \nu_i' w_i'$ components. Component $-\rho u_i' w_i'$ is at minimum compared to two other components and component $-\rho \nu_i' w_i'$ at the edge of wing upstream of spur dikes and the minimum value of that occurs in the downstream and among of spur dikes. Investigation of bed shear stress shows that the maximum of bed shear has occurred at the edge of wing upstream of the first spur dike.

Key Words: Flow pattern; t-head series spur dikes; turbulence parameters; bed shear stress; straight channel.

OPTIMAL CHLORINATION OF WATER DISTRIBUTION SYSTEMS WITH RESPECT RESIDUAL CHLORINE AND FORMATION OF THM

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Abstracts of Papers in English

NUMERICAL MODELING OF PRESSUREMETER TEST AND EVALUATION OF THE METHODS OF CAVITY EXPANSION INTERPRETATION IN SAND

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Abstract

In-situ tests are reliable for determination of soil properties since larger amount of soil is tested in real stress levels. Pressuremeter is one of the most important in-situ tests in geotechnical engineering. The main advantage of this instrument is the continuous measurement of soil stress-strain curve which is applicable to determination of soil parameters using cavity expansion theories. In this study, self-boring pressuremeter test has been modelled using the commercial FLAC software. The soil is assumed to behave elastic-perfectly plastic, and the Mohr-Coulomb constitutive model is chosen. The results of the numerical analyses are validated by the measurements of in-situ pressuremeter test results which can be found in the literature. Effect of cavity diameter on the cavity expansion curve is observed because pressuremeters have various diameters. It can be concluded that cavity diameter has no effect on cavity stress-strain curve obtained from numerical analysis. Also, the difference between small deformation and large deformation analysis of cavity expansion curve has been assessed. Results show that in the strains smaller than 10 percent, the difference is marginal. Since cavity is generally expanded up to 10 percent strain in the pressuremeter test, small deformation analysis can be applied to the interpretation of this instrument. After that, different theoretical methods of cavity expansion have been compared to the results of numerical analysis. Theoretical methods are based on assumptions which are not appropriate for all conditions and consideration of all aspects of soil behavior is not feasible due to complexity. Also, theoretical and empirical methods of interpretation of pressureme-