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EDITORIAL BOARD

Experimental study on static pressure penetration of bucket foundation in cohesionless soil

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Abstract: Bucket foundation is an important foundation type of the offshore structures, especially for offshore wind turbines. Study on its penetration law is the key to the successful application of this kind of foundation type. Previous method for penetration resistance was based on cone penetration test (CPT) and considered the impact of seepage on the soil effective stress. The resistance coefficient for side wall and tip of the bucket were obtained experimentally, which was used for calculating the final penetration resistance. However, the change rules of the extrusion and the friction between soil and bucket under negative pressure were less analyzed. In this paper, three different wall thickness bucket foundation are penetrated by static pressure. Earth pressure inside and outside the bucket wall, as well as the tip resistance and total penetration resistance were measured in the experiments Based on the cavity expansion and soil plug theory, a calculation method of internal and external earth pressure was established, the range of the friction coefficient between soil and bucket was analyzed. According to the bearing capacity formula, a calculation of bucket tip resistance was derived. Studies have shown that coefficient of friction between side wall and the soil is about 0.4 during the penetration process, $k_f = 0.001 \sim 0.003$ recommended by DNV(1992)only applies to calculating the outer wall friction resistance, measured inner wall friction resistance is much greater than the calculated value. Tip resistance coefficient k_p is related to the internal friction angle, calculated value agreed well with the experimental results when k_p=1.8.

Key words: offshore wind turbines; bucket foundation; penetration resistance by static pressure; extrusion

Influence of potassium–sodium ratio on the early age cracking sensitivity of cementitious materials with high alkalinity

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Abstract: The influence of potassium–sodium ratio on early age cracking sensitivity of cementitious materials in high alkalinity added with and without fly ash was investigated, using techniques of multi–channel ellipse ring shrinkage cracking apparatus, comparator, isothermal calorimeter and mercury intrusion porosimetry (MIP). The results indicate that initial cracking time of cementitious materials shortens by about 3% with each doubling of potassium–sodium ratio, the mechanism of which is that high potassium–sodium ratio accelerates hydration and increases content of pores that under 50nm of diameter, which reduces the amount of capillary water and raises pore pressure, resulting in increasing of early shrinking ratio and shrinkage stress, and tensile strength and crystallinity of cementitious materials are reduced, resulting in the decreasing of ability of tensile stress resistance, and increasing sensibility of early cracking. Fly ash has little impact on the influence of potassium–sodium ratio on early age cracking sensitivity of cementitious materials, but it can efficiently improve early age cracking sensitivity of cementitious materials by delaying early hydration, and reducing pore pressure to some degree, fly ash can also help to increase ability of tensile stress resistance of cementitious materials, and thus, improving the ability of resistance of early age cracking of cementitious materials.

Key words: alkali metal ions; crack; shrinkage; hydration process; pore structure

Experimental study on impact of horizontal weak layer on dynamic failure mechanism of Roller Compacted Concrete Arch Dam

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Abstract: Due to the characteristics of Roller Compacted Concrete(RCC) dam construction technology as well as special circumstances, the dam is easy to form horizontal weak layers locally. In order to study the impact of horizontal weak layers on overload capability and failure mode of RCC arch dam, a dynamic rupture test was carried out on the shaking table. The establishment of the model was based on elasticity-gravity similarity law. Meanwhile, the rate sensitivity of the mechanical properties of materials was taken into account in designing the dam model. In order to provide the material properties information, several groups of splitting tensile test which containing a weak layer were carried out under dynamic loading. Sine waves corresponding to fundamental frequency loaded on the dam progressively to observe the responses of arch dam under overloading. The results show that structural joints are opened to release the arch constraints, which leads to the horizontal weak layer of crown cantilever prone to damage. Compare the results of this test results to previous study regardless of horizontal weak layer, it can be concluded that the presence of weak layer mainly affects the dam failure mode, but does not significantly reduce the overall overload capacity of the dam structure. The result of this study is helpful to understand the effect of horizontal weak layers on the overload capacity and failure modes of RCC arch dams.

Key words: roller compacted concrete; arch dam; horizontal weak layer; shaking table; overload capability; failure mode

Study on opening time difference of the adjacent multi-stages pump stations in water transfer projects

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Abstract: In order to alleviate the contradictory between supply and demand caused by the uneven spatial and temporal distribution of water resources, China has constructed a number of water transfer projects with multi-stages pump stations. If water level of the downstream pump station is below the minimum operating water level due to the improper control of the opening time of the adjacent multi-stages pump stations, it would endanger the safe operation of pump stations. To solve this problem, a 1D-2D coupled numerical model of inter-stage section between the adjacent multi-stages pump stations has been developed to simulate the water level variation in the downstream pump station under different water transfer conditions and ascertain the scientific and reasonable opening time difference of the adjacent multi-stages pump stations. Then a study on the Xiaji lake section of the eastern route of South-to-North Water Transfer Project was conducted by this research method, which proposed the critical opening time difference and the critical water level of opening the pump stations under different conditions. Based on two variables of annual pumped water and the regulated water level, the authors derived respectively the regress equation of the critical opening time difference and the critical water level by Levenberg-Marquardt Algorithm and Universal Global Optimization Algorithm, which could be regard as the decision condition to open the multi-stages pump stations. The research findings provide technical support for the operational control of the eastern route and other similar projects.

Key words: hydrodynamics; multi-stages pump stations; water level of the downstream of the pump station; opening time difference; 1D-2D coupled model

Experimental study on the effect of pipeline turbulence on killing *Limnoperna fortunei* larvae II. Efficiency comparison

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Abstract: Golden mussel (*Limnoperna fortunei*) is an invading macro-invertebrate species and easily leads to heavy pipe clogging, which casts great threat to the technical water supply system. The previous experimental study explored the influence from turbulence-generating materials (TGMs) on hydraulic characteristics inside a pipeline. To examine the actual efficiency of such TGMs and installation patterns on killing golden mussel larvae, four types of TGMs were installed with intervals of 50 and 25 cm in the same pipeline system of the hydraulic experiment. Direct test (water supply to the pipeline = 0.018 m^3/s) and circulation test (water supply to the pipeline $\approx$ 0 m^3/s) were conducted to compare the killing efficiency of different materials. Water samples were taken before and after the treatment of pipeline turbulence. The total density and mortality of the larvae in water samples were obtained by counting under a microscope. It was found that most of the larvae were prediveligers during the entire experiment period. The tissues of the prediveligers were damaged and released out from the shells or the shells of the veligers were broken after they went through the experimental pipeline. The 6 mm pore plate exhibited significant enhancement of larvae mortality among all the tested materials. The dense layout (interval=25 cm) improved the larva killing efficiency of the wire meshes. A relative length scale d^* (the ratio of shell size to the Kolmogorov length) was utilized to evaluate the efficiency of TGMs. The material is supposed to be efficient in improving the mortality of the larvae if the downstream $(d^*)_{max} > 0.7$. Larvae mortality was promoted rapidly in 5 min and kept steady afterwards during the circulation experiments, indicating that the larvae were likely to be removed if they were treated in the turbulent field for a certain period of time, e.g. 5 min.

Key words: Limnoperna fortunei larvae; pipeline; turbulence-generating materials; high frequency turbulence; mortality

Research on mathematical model for homogeneous earthen dam breach process due to overtopping failure and its application

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Abstract: A large number of model tests show that headcut erosion is the major mechanism of homogeneous earthen dam breaching due to overtopping failure. In recent years, an array of mathematical models which can consider the headcut erosion are put forward, however, the initial headcut position is assumed at the dam toe downstream in these models. According to the large scale model tests of homogeneous earthen dam due to overtopping failure, for the dam with large height, the location which the initial headcut occurred is related to the water head of overtopping flow and the slope ratio of downstream, meanwhile, the velocity of headcut migration is connected to the physical and mechanical indexes of dam soil. It has great importance to choose the appropriate parameters to determine the initial scour position and headcut migration velocity. Based on the mathematical models of homogeneous earthen dam breaching due to overtopping failure at home and abroad, a mathematical model for homogeneous earthen dam breach process due to overtopping failure considering headcut migration is put forward. The model determines the initial scour position by means of the characteristics of overtopping flow and dam figuration parameters; it adopts a time-averaged headcut migration rate using an energy-based empirical formula, the headcut migration parameter which can consider the clay ratio, water content and dry density of dam soil is obtained through the indoor and field model tests; the vertical undercutting and horizontal expansion are simulated utilizing the erosion rate formula which is derived from shear stress principle of water flow. The model adopts broad-crested weir flow formula to calculate the breach discharge, in addition, limit equilibrium method is used to analyze the breach slope stability; the model adopts iterative calculation method to simulate the whole breaching process. The typical dam breaching cases of large scale model tests and actual dam which have measured data are chosen to verify the model, and the impact on the calculation results whether considering the headcut erosion or not are taken into account. The analysis results show that the proposed model is applicable in modeling the dam breaching process for homogeneous earthen dam due to overtopping failure.

Key words: homogeneous earthen dam; overtopping; headcut; mathematical model; verification

Review of regionalization methods on streamflow prediction in ungauged basins

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Abstract: Continuous streamflow prediction in ungauged basins is a difficult issue and challenge in surface hydrology. Regionalization, defined as the process allowing transfer of hydrological information from gauged to ungauged locations, offers the effective solution for this issue. Regionalization methods based on regression, spatial proximity and physical similarity are the most common methods for continuous streamflow prediction. However, there is no universal method so far because the diversity in catchment physiographic attributes and climate variability produces different performances in various basins. This paper presents the basic theory, limitations and advances of the three regionalization methods in last three decades. Based on the reviewed regionalization studies, the most frequently used parameters of hydrological model and the basin attributes are concluded. Moreover, the error indices and uncertainty analysis methods are summed up, as well as the prospects. This paper can offer the scientific reference for the selection of regionalization methods in the ungauged basin.

Key words: ungauged basins; regionalization methods; streamflow prediction; hydrological model; review

A model for the flocculation–settling–resuspension process of cohesive sediment

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Abstract: The motion characteristic of cohesive sediment is an important research subject. In order to study the movement of cohesive sediment and its mechanism, this paper presents a model to simulate the flocculation–settling–resuspension process of cohesive sediment by taking the resuspension amount of sediment floc with different sizes as the lower boundary condition, based on flocculation kinetic equation. The model was checked through comparing simulation results with published experiment data. The verification results show that the proposed model can be used to simulate the flocculation–settling–resuspension process of cohesive sediment, and has certain accuracy. Finally, the paper used the volume distribution of sediment floc as an index to discuss the function of flocculation, settling and turbulent diffusion through the proposed model. The result shows that, in strong turbulent flow, the settling and turbulent diffusion determine the distribution of sediment floc in upper zone, the flocculation in middle zone, while the flocculation and turbulent diffusion in lower zone.

Key words: cohesive sediment; flocculation; settling velocity; resuspension; fractal

Force analysis on water barrier curtain for released flow with low temperature from deep reservoirs

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Abstract: Water barrier curtain is a kind of structure which can improve the temperature of hypothermia water released form deep reservoirs. Force analysis plays an important role in the project implementation. Numerical calculation model of the water barrier curtain is set up according to the terrain and overall layout of deep water reservoirs. Numerical simulations of flow field, temperature field and force are made by using software FLUENT and compare with model test. The results show that the temperature of released flow can be improved by the curtain. The greater the flow rate, the more instability of flow regime, and the negative pressure on the lee side of curtain transfers to power plant side. The farther away a curtain is from the power station, the greater the flow rate and the smaller the overflow, the greater force on the curtain will be. Changing water levels have little effects on the force. Lowering curtain is an effective way to reduce the force on curtain in flood.

Key words: temperature control curtain; deep water reservoirs; hypothermia water releases; numerical simulation; model test

Study on the daily optimized dispatching and economic operation of cascade pumping stations in water conveyance system

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Abstract: Miyun Reservoir Regulating and Storage Project for incoming water from South-to-North Water Diversion Project is the key content of Beijing matching constructions, and the former part of the project transfers water from Tuanchenghu Lake to Huairou Reservoir through six pumping stations. To achieve the goal of efficient and economical operation, a large system decomposition-coordination model is established to solve the problem of daily optimized dispatching and economic operation of this project based on the rule of time-of-use power price in Beijing. The large system is divided into three sub-systems. Firstly, it adopts the Dynamic Programming method to realize optimization of each subsystem, and then realizes global optimization of the large system according to the overall goal of the large system and the relationship among three subsystems. The results show that the model has strong practicability, allotting more rate of flow in the period of low price, which is of significance for the guidance of efficient and economical operation of the project.

Key word: optimized dispatching; economic operation; cascade pumping stations; large system decomposition-coordination model; dynamic programming method

Laboratory study on mechanical behaviours of the single-intermittent cracked masses under the combined action of water chemical corrosion and dry-wet cycles

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Abstract: In consideration with the actual environment of the hydro-fluctuation belt of a typical bank slope, by using prefabricated-cracked rock-like materials to simulate jointed rock mass, one test scheme of dry-wet cycles is adopted to explore the mechanical behaviors and failure characteristics of the fractured rock. The variation of mechanical behaviors of the fractured specimens with different dry-wet cycle times and different chemical soak solutions is analyzed. Experimental results show that, under natural state and with different chemical solutions, both the peak strength and elastic modulus of fractured specimens initially decrease and then increase with the continuous increase of the inclination angle. It is found that, with the increase of the number of dry-wet cycles and also with different chemical soak solutions, the mechanical behaviors of fractured specimens are gradually deteriorated, and the deterioration tendencies of peak strength and elastic modulus are basically consistent, but there is some difference: the maximum deterioration of the fractured specimens occurs at the crack inclination angle 45°, the moderate situation is at crack inclination angle about 90° and 30°, and the minimum situation meets with at 60° and 0°, respectively. It is also found that the acid chemical solutions are able to aggravate the deterioration of wet-dry damage of fractured specimens, while the alkaline solutions have some resisting effect. Additionally, it is observed from experimental results that: the intact specimens and the ones with 90° crack inclination angle have similar failure mode, and it is tensile failure mode; the specimens with 0° crack angle are broken with the H-tensile failure mode; the fracture specimens with the crack inclination angle between 30° ~ 45° will have a mixed tensile-shear failure model; the shear failure mode is found when specimens have 60° crack inclination angle.

Key words: rock mechanics; jointed rock mass; chemical erosion; dry wet cycle; mechanical characteristics; damage characteristics

Field observations and analysis of surface displacement of ice cover on reservoir

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Abstract: Ice strain dominates the static ice loads. Field investigations on surface ice displacements in six directions were conducted in Hongqipao Reservoir. An improved model was developed to predict the surface ice stress and to determine the impacts of environmental conditions, such as boundary constrains, ice cracks, and winds, on static ice stresses. The observations indicate that the ice cover is able to expand and contract under boundary constrains. Accumulated residual displacements are produced due to the daily differences between contractions and expansions, and show a significant anisotropy. The surface ice strain consists of thermal strain and environmentally adjusted strain. The first principal strain can rotate due to the joint impacts of cold spells and strong winds. Stress modeling argues that, generally, the environmentally adjusted strain reduces slightly the thermal stress. However, as the ice temperature increases sharply, it leads to a much higher stress than thermal stress. Accordingly, the ignorance of displacements due to boundary displacement and crack development (i.e. environmentally adjusted strains) would result in considerable error in predicting static ice loads.

Key words: ice; temperature; strain; observations; modeling; thermal stress