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CONTENTS

Spatial pattern of precipitation change in the main sediment-yielding area of the Yellow River basin in recent years

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Abstract: Based on daily precipitation data from 604 rainfall stations during 1966-2014 in the main sediment-yielding areas in the upper reaches of Tongguan of Yellow River, the spatial distributions of annual precipitation and the annual accumulated precipitation where daily precipitation was larger than 10, 25, 50 and 100 mm (P_{10}, P_{25}, P_{50} and P_{100}) for different periods during 1966-2014 were drawn based on Arc-GIS, and changes of total annual precipitation in different rainfall intensity magnitude and frequency of heavy rainstorm were analyzed in the study area. The results indicate that P_{50} accounted for 2.3%~7.8% of annual rainfall, while the corresponding runoff and sediment yield amount was 20% of the annual flood volume and 44% of annual sediment yield amount, respectively. For the period from 2005 to 2014, when the incoming sediment amount has been reduced by approximately 88% compared with the natural period, P_{10}, P_{25} and P_{50} of the main sediment-yielding areas in the most area from Hekou to Longmen and the upper reaches of Fenhe river as well as the upper and middle reaches of Jinghe river were larger than the annual average values overall; P_{25} and P_{50} were much more larger than the annual average values during 2010 to 2014, the areas where the abundance degree were larger than 5% reached 76.9% and 69.6% of the total study area respectively; and precipitation in the Zuli River and northwest region of the upstream of the Weihe River is less than annual average values. Precipitation of 2012 and 2013 were almost the most abundant period since 1966. Since 2001, the frequency of heavy rainstorm is higher in most area from Hekou to Longmen and the upper and middle reaches of the Jinghe River basin, and it is lower in other areas.

Key words: Yellow River; main sediment-yielding area; precipitation; heavy rainstorm; change

（责任编辑：祁　伟）

Construction simulation for high arch dams based on modified Bootstrap

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Abstract: Construction simulation is an important approach for high arch dam construction schedule management. For the construction simulation for high arch dams in current days, the construction simulation parameters are determined based on construction experience according to approximate projects. But the construction parameters vary between different projects, which may lead to the distortion of construction simulation. In the light of this problem, this research proposes the method that, the Bayesian updating algorithm is utilized to update simulation parameters based on the actual construction information. The Bayesian updating process needs a large number of accurate statistical data, but the collected data is not enough and accurate, because of human and mechanical factors. Therefore, the modified Bootstrap is introduced in Bayesian updating to improve the representative of simple data, and the estimated value of simple statistical data is more accurate. The simulation result shows that, compared with traditional methods, the real-time updating method of construction simulation proposed in this paper could improve the accuracy of simulation parameters.

Key words: high arch dams; Bayesian updating algorithm; modified Bootstrap; construction simulation; simulation parameters update

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60 years' perspective of the diaphragm wall technology for seepage control, Part II. Innovation and applications

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Abstracts: The rapid development of China water resources and hydropower projects has resulted in a variety of demands of new technology. This paper focuses on three typical areas: (1) building deep walls up to 150m; (2) strengthening old dams and dikes suffering from heavy leaking, and (3) special technology for coffer dam seepage control. This paper gives a comprehensive review on the key technology of these areas and the typical case histories. The highlights include: (1) innovative technology on slurry and drilling facility to construct walls as deep as 150 m; (2) special technology to form full barrier against seepage for old dams with high risk of piping potential, and (3) The coffer dam seepage control engineering methods.

Key words: super-deep diaphragm wall; strengthening of defective dams; coffer dam seepage control engineering; construction technology

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Transport rate of nonuniform suspended load

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Abstract: Based on integration of the Jasmund-Nikurads logarithmic velocity and the vertical profile of nonuniform suspended load concentration proposed by the author, a new formula for transport rate of nonuniform suspended load is presented. The new formula is an explicit function with a simple form and fit for arbitrary fraction of nonuniform suspended load. It is self-adaptability to uniform sediment in case of $D_i = D_m$ and $\sigma_D = 1$. Besides, the transport rate from bed to $z = a$ is taken into account so that the theoretical accuracy of the formula is improved. The proposed formula shows more advantages than the previous equations. Compared measurement of flow and sediment transport collected from Yangtze Estuary during 2005 to 2012 with calculation, good agreements are obtained.

Key words: suspended load; transport rate; nonuniform sediment; Yangtze Estuary

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Numerical simulation of dynamic mechanical behaviors of desert sand concrete

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Abstract: The dynamic mechanical behaviors of desert sand concrete are very complicated. 74mm-diameter Split Hopkinson pressure bar (SHPB) was used to study the mechanical behaviors of desert sand concrete under various impact speeds in this paper. The influence of impact speed on the dynamic mechanical behaviors of desert sand concrete was analyzed. A circular aggregate random distribution program was designed to simulate the dynamic failure process of desert sand concrete with different specimen dimension, impact speed, particle size of coarse aggregate and volume fraction of coarse aggregate by means of ANSYS/LS-DYNA software. The influences of specimen dimension, impact speed, particle size of coarse aggregate and volume fraction of coarse aggregate on the dynamic mechanical behaviors of desert sand concrete were analyzed. Numerical simulation shows that desert sand concrete has obvious size effect. With the increase of the minimum value of particle size of coarse aggregate, the peak stress of desert sand concrete declines. Whereas, with the increase of the maximum value of particle size of coarse aggregate, the peak stress of desert sand concrete increases firstly, then declines. The peak stress of desert sand concrete increases firstly, and then declines with the volume fraction of coarse aggregate, which provides basis for optimization and design of desert sand concrete.

Key words: desert sand concrete; dynamic mechanical behavior; numerical simulation; peak stress; impact speed

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Analysis of the dam overtopping failure fuzzy risk under consideration of the upstream dam-break flood

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Abstract: In this study a dam overtopping failure fuzzy risk is described under consideration of the upstream dam-break flood and a new risk model is presented to evaluate its failure fuzzy risk probability. Unlike other techniques previously proposed in the literature, the suggested approach is used the trapezoidal fuzzy number to show the complicated relationship between the fuzzy interval of risk indicator and failure probability and an uncompleted reservoir is taken as a case study. The results indicate that (1)the analysis model based on trapezoidal fuzzy number can describe the uncertainty of the complicated risk analysis system efficiently and accurately; (2)although the failure risk probability for the dam overtopping under consideration of the upstream dam-break flood is higher than the acceptable maximum probability at high water levels, establishing systems for early warning and lowering the water level can significantly reduce the risk and ensure the reservoir's safety operation.

Key words: overtopping failure fuzzy risk; dam-break flood; trapezoidal fuzzy number

（责任编辑：韩 昆）

Effects of effective confining stresses on cyclic resistance ratio of deep buried sands in deep alluvial soils

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Abstract: Liquefaction resistance of two dense sands with different relative density is investigated by laboratory cyclic undrained triaxial tests, and the effects of confining pressure from moderately high to high range on liquefaction resistance are discussed. The results indicate that: (1) effective confining stresses have significant effects on cyclic resistance ratio, which decreases with increasing effective confining stresses, and the larger the relative density is, the greater the cyclic resistance ratio decreases; (2) the effect of effective consolidated ratio (initial static shear stress) is very complicated, the presence of an initial static shear stress increases the cyclic resistance ratio of dense sands for relatively low confining stresses, and the larger the relative density is, the greater the cyclic resistance ratio increases; for high confining stresses, the effects of the presence of an initial static shear stress on dense sands depend on the relative density and the effective confining stress. if dense sands become more dilative under certain effective confining stresses, the cyclic resistance ratio increases with increasing confining stresses, and if dense sands become more contractive under certain effective confining stresses, the cyclic resistance ratio decreases with increasing confining; and (3) the complication of effects of the presence of effective consolidated stress state on the cyclic resistance ratio of dense sands actually reflects the complication of the dilative or contractive properties of sands influenced by effective consolidated stresses and relative density. For dense sands, in the transition process of shear dilatancy to shrink, there is a critical stress state which distinguishes shear dilatancy state and Shear shrink state, and the value of the critical stress state increases with increasing relative density.

Key words: deep alluvial soils; deep buried sand; cyclic resistance ratio; confining stress

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Research on water quality transformation mechanism in Sluice-controlled river reaches I. Development of the mathematical model

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Abstract：Based on the complex action mechanism of water environment system in the sluice-controlled river reaches，the general idea of multi-phase transformation of water quality in the interface of water body，suspended solids，sediment and organism was proposed. Firstly，the mathematical expression was derived to describe the mass transfer process among different phase states by application of environmental hydraulics，adsorption-desorption kinetics，and aquatic biological growth dynamics theory. Secondly，the water quality multi-phase transformation model in the sluice-controlled river reaches with a certain physical mechanism was established on the basis of MIKE 11 model. Finally，the parameters of hydrodynamic model and water quality multi-phase transformation model was identified and validated combined with the Huaidian Sluice scheduling experimental data in April 2013 and November 2014，and the transformation rule of dissolved phase and suspended phase in experimental period was analyzed. The results show that the flow velocity and the sluice scheduling mode have significant effect on the water quality concentration change of different phase states in the upper and lower section of the sluice，and the more frequently the sluice scheduling changes，the more complex the water quality multi-phase transform process will be.

Key words：sluice-controlled river reaches；multi-phase transform；mathematical modeling；distribution analysis

（责任编辑：韩　昆）

Evaluation of salt discharge by subsurface pipes in the cotton field with film mulched drip irrigation in Xinjiang, China I. Calibration to models and parameters

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Abstract: The technology of film mulched drip irrigation (FMDI) is applied widely for planting cotton in Xinjiang, China. Salts in the soils where FMDI is practiced tend to be leached downwards from the shallow root zone (0~40 cm) and to accumulate in the lower root zone (40~60 cm) where they become a secondary salinization hazard. Numerical simulation should be one of the most effective and rational methods to evaluate the effect of salt discharge by subsurface pipes in the cotton field with FMDI. In this study, a field experiment, in which the leaching water was supplied at the soil surface and the leachate was discharged using subsurface pipes (SSPs) located 60 cm below the soil surface in unsaturated soil with an interval of 500 cm, was conducted in Manas, Xinjiang, and numerical models were established to simulate soil water flow and salt transport under the drainage conditions of SSPs. Results from the field experiment were used to calibrate hydraulic parameters and verify the numerical models using the Hydrus-2D/3D software package. Simulated and observed soil water content distributions were in good agreement with the maximum root mean squared error (*RMSE*) and minimum coefficient of determination (R^2) of 0.025 cm^3/cm^3 and 0.88, respectively. Correspondingly for soil salinity distributions, the values of maximum *RMSE* and minimum R^2 were 2.74 g/kg and 0.93, respectively. Numerical simulations show that most (77.5%) of the salt in 0~60 cm soil layer was leached downwards, however, limited by the factors such as deep groundwater table and small surface area of the pipe for collecting flow from nearby domain, only about 11.7% of the salt in the 0~60 cm soil layer was discharged via the SSPs. The numerical models and the calibrated soil hydraulic parameters should be useful for further analyzing the dynamics of soil water and salt under the drainage condition of SSPs located in unsaturated soil, and for evaluation of alternative methods for salt leaching and discharge.

Key words: salt discharge; subsurface pipe; cotton field under film mulched drip irrigation; secondary salinization; numerical simulation

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Preliminary study on the characteristics and origin of barrier river reach in the Middle and Lower Yangtze River

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Abstract：Analysis of long temporal and spatial riverbed evolution data shows that the adjustment of river regime in the Middle and Lower Yangtze River（MLYR）trends to pass downstream，but it's obstructed by some kind of reaches which is called barrier river reach（BRR for short）. Statistics indicates that barrier reach is generally a single-thread bend with strong resistance at the concave bank. There is no node deflecting flow in the upper and middle reaches. In addition，BRR has narrow and deep cross-section and the change rate of river width with the water level is less than 45. Further analysis shows that the root reason of the barrier property lies in the ability to stabilize the mainstream planimetric positions of different flow levels. No matter how the upper river regime changes，the mainstream position of outflow basically remained stable，which provides relatively stable inflow conditions for the lower reaches. In the river regulation process，the good opportunity should be seized to shape BRR. The long river reaches without BRR should be planned and regulated systematically. The bank collapse and sandbar shrinking dramatically should be controlled timely to prevent barrier property from losing.

Key words：the Middle and Lower Yangtze River；river regime；barrier river reach

Optimal control of drought limit water level
for multi-year regulating storage reservoir

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Abstract：Based on analysis of functions of multi-year regulating storage reservoir, the concept and connotation of the drought limit water level is proposed. Taking the maximum benefit of river basin water supply as goal during the dry year, the optimal control model of drought limit water level is established to realize the maximum benefit of multi-year water replenishment and optimum the water discharge process by introducing of artificial fish swarm algorithm on the basis of optimizing control theory and adaptive technology, which has the characteristics of identification online and automatic optimization. The continuous dry year period in the 1990s in the Yellow River Basin is taken as an example to integrate the optimal control strategies of drought limit water level for Longyangxia reservoir. The results show that the available water during the dry years can be increased through implementation the multi-year water replenishment and storage water during high flow years to discharge water during low flow years by means of optimal control of drought limit water level, and then the loss of drought in the Yellow River basin can be reduced to some extent.

Key words：multi-year regulating storage reservoir; drought limit water level; optimal control; adaptive technology; artificial fish swarm algorithm

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Strain separation and thermal coefficient calculation of early age concrete based on thermal stress test

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Abstract: Thermal coefficient of concrete at early age is difficult to be measured by standard test method and thermal strain and autogenous strain are hard to be separated from total strain. In order to solve these problems, the advantage of the characters of thermal stress test was taken in this paper and some results can be concluded. Age at which first zero stress has been reached ($t_{z,1}$) was introduced as the starting point for effective strain. Based on concept of equivalent age, numerical model for autogenous strain under practical temperature history was established and the separation of thermal deformation and autogenous strain were achieved. Thermal coefficient should be concerned at heating stage and cooling stage separately, and concrete thermal coefficient is constant at specific stage.

Key words: thermal strain; autogenous strain; thermal coefficient; early age; thermal stress test

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Simulation of wind speed in the traffic cave of surge tank of underground hydropower station in transient process

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Abstract: This paper presents a mathematical model established for the simulation of gas movement in the traffic cave of surge tank on the basis of considering the compressibility of gas, and proposes a wind speed simulation method and simulation program according to the characteristics line method of the gas transient flow in the pipe. The applicability and rationality of the proposed method and program has been verified by comparing with the experimental results. Then the influences of traffic cave size (length, area, angle) on the development, distribution and wave process of wind speed are analyzed, and the mechanism of these factors are revealed from the point of wave superposition. The results show that it is essential to take the compressibility of the gas into consideration on the simulation of wind speed in the traffic cave of surge tank of underground hydropower station in transient process. The wind speed fluctuation is superimposed by the low frequency mass wave (fundamental wave) and the high frequency elastic wave (harmonic wave). The length of traffic cave mainly effect amplitude and cycle of harmonic wave, the sectional area of traffic cave affect the amplitudes of fundamental wave and harmonic wave while the dip angle only influences the amplitude of harmonic wave.

Key words: underground hydropower station; traffic cave of surge tank; transient process; wind speed; gas compressibility; wave superposition; numerical simulation

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A predictive model of effective elastic modulus
of concrete under influence of aggregate gradation

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Abstract: At a mesoscopic level, a multiphase mixture inclusion model is presented to predict the elastic modulus of concrete considering the influence of aggregate gradation. Densely graded aggregates are divided into some aggregate size ranges, and then the average aggregate sizes of every aggregate size range are obtained. Subsequently, the Generalized Self Consistent Method (GSCM) and a multiphase formula derived from Mori-Tanaka method are adopted to establish the aggregate gradation model of concrete, which is composed of different size of aggregate. The predicted model is compared with the single aggregate size model and Li's model through the Stock's experiment. The comparative results demonstrate that the aggregate gradation and the interaction among aggregate have a significant influence on the elastic modulus of concrete, and its impact is more evident with an increase in the aggregate volume fraction. Even if the aggregate volume fraction is larger, the aggregate gradation model also can get good prediction accuracy. The elastic modulus of concrete increases with the increase of the parameter of aggregate gradation curve, yet it decreases with the increase of the thickness of interface transition zone.

Key words: mesomechanics; elastic modulus; aggregate gradation; Mori-Tanaka; interfacial transition zone

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Identification of nitrate sources in groundwater
in the Yongding River alluvial fan with isotope technology

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Abstract: Nitrate (NO_3^-) is one of the main contaminants in groundwater in Beijing. In this study, the characteristics of hydrochemistry, nitrogen isotope ($^{15}N-NO_3^-$) and oxygen isotope ($^{18}O-NO_3^-$) in different parts of the quaternary groundwater are analyzed in the Yongding River alluvial fan. The contaminant sources of NO_3^- in the groundwater are identified, and the contributions of these different contaminant sources to the NO_3^- are evaluated quantitatively. The concentrations of NO_3^--N in the groundwater range from 1.32 mg/L to 37.44 mg/L, The concentrations of NO_3^--N in 80% of the groundwater samples exceeded the drinking water standarnd of 20 mg/L. The values of $^{15}N-NO_3^-$ in groundwater range from +9.38‰ to +16.96‰ and the mean value is +12.87‰. The values of $^{18}O-NO_3^-$ in groundwater range from +3.13‰ to +21.18‰ and the mean value is +10.39‰. Combined with the identification of denitrification in groundwater, NO_3^- mainly come from manure and partly come from chemical fertilizer and precipitation. Quantitative evaluation with isotope techniques and material balance model shows that manure contributes 58%~81% to the concentration of NO_3^- in groundwater. On the basis of this study, the suggestion about how to protect and improve groundwater quality is recommended.

Key words: groundwater; nitrate; isotope technique; contaminant source

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