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EDITORIAL BOARD

Seismic behavior of Cement-Sand-Gravel dam and the calculation method of its seismic loads

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Abstract: As a new type of dam with Symmetric trapezoidal cross section, Cement-Sand-Gravel (CSG) dam is built up with CSG material, so its seismic resistance and dynamic characteristics are unique. To study its seismic safety, time history analysis method is taken in this paper. Based on FEM, the dynamic characteristics and seismic response of CSG dam are analyzed. The effects of stiffness of dam and bedrock and height of dam on its seismic responses are studied. The results show that the seismic responses of this dam are evident low compared with concrete gravity dam, and the seismic stresses within dam are not large enough to endanger dam safety even during strong earthquake. This type of dam has different seismic response and dynamic characteristic with gravity dam, so the calculation method of seismic loads for gravity dam cannot deal with CSG dam well. Based upon FEM analysis results, the methods for estimating seismic distribution coefficient and the hydrodynamic pressure coefficient, which is suitable for this new type of dam, are proposed to calculate the seismic loads and hydrodynamic pressure on this dam. The conclusions of this paper can provide reference for aseismic design of CSG dam.

Key words: CSG dam; dynamic characteristics; seismic response; inertia force; hydrodynamic pressure; calculation method for seismic load

Three-dimensional numerical simulation and characteristic analysis of wavefield for earth-rock dam contain hidden troubles

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Abstract: Three dimensional wavefield characteristics analysis of the earth-rock dam with hidden troubles is the premise and foundation to identify the hidden troubles of the earth-rock dam by the use of wave test signals. In order to obtain the wavefield characteristics and the test signal distortion rule of various types of hidden troubles, the three dimensional wave-field characteristics of the earth-rock dam containing hidden troubles is simulated and analyzed based on the finite element numerical method in this paper. The analysis results show that the position of the hidden trouble body and the wave field information received by the dam surface are closely related, the phase of the time-distance curve above hidden troubles and the curve phase of other measuring points on measuring line has obvious difference, and scattered wave take-off time is around the measuring point in advance, the position of hidden body could be judgment along the survey line direction. To verify such wave field characteristics, the model test experiment of earth-rock dam with hidden troubles and leakage passage are carried out. The results show that there is only direct wave for dam without hidden troubles, and there is a distortion wave signal for dam containing the hidden trouble, due to scattering wave and direct wave superposition, and the measurement points of signal distortion and the top of set the actual hidden trouble corresponds exactly. Therefore, the numerical simulation results and test results have the same change rule on the characteristics of the test signal.

Key words: earth-rock dam; wavefield characteristics; numerical analysis; model experiment

Evaluation methodology of groundwater safeguard capacity on agricultural irrigation in the Huang-Huai-Hai Plain

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Abstract: Groundwater is an important source of water for agricultural irrigation in the main grain production region in North China, especially in the Huang-Huai-Hai Plain. The over exploitation situation of groundwater are closely related with the irrigation agriculture on the dependence level and the groundwater on agricultural irrigation water support capacity (such as the safeguard capacity) in this region. In the case of the Huang-Huai-Hai plain, through study of the relationship among the agricultural irrigation water and the precipitation and the crops planting intensity, and the dependence level of the agricultural irrigation on groundwater and influence characteristics on the over exploitation situation of groundwater, the corresponding concepts and methods for its evaluation is proposed. The results of the application of the evaluation methodology indicate that (1) the regional characteristics, the situation and the causes of the irrigation agriculture on the dependence level and the safeguard capacity can be objectively clarified by using the evaluation methodology, including the dependence level of irrigation water on groundwater, the supply level of the groundwater to irrigation water, and the safeguard capacity; (2) The groundwater safeguard capacity on agricultural irrigation is poor in the northwest area of the Huang-Huai-Hai Plain, especially the safeguard capacity has been in "difficult" or "cannot safeguard" state in the Hebei Plain, and the safeguard capacity is stronger in the south area of the plain.

Key words: groundwater; agriculture; water for agricultural irrigation; safeguard capacity; Huang-Huai-Hai Plain

Evaluation of salt discharge by subsurface pipes in the cotton field with film mulched drip irrigation in Xinjiang, China Ⅱ: Application of the calibrated models and parameters

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Abstract: Efficiency of salt removal using subsurface pipes (SSPs) located in the unsaturated zone of agricultural soils is very low due to a limited effective flow collecting area (S_{ef}). In this study, the dynamics of soil water movement and salt transport were simulated using the calibrated models and parameters for HYDRUS-2D/3D in order to investigate two possible methods for improvement of ameliorating saline soils in cases where drainage pipes are located well above the groundwater table. The first improvement method attempted to enlarge S_{ef} by laying seepage-proof material (SPM) underneath the SSPs. The effect of SPM width (L_f) and distance between SSPs was evaluated. Simulations continued until the salinity of the 0~40 and 40~60 cm soil layers was less than 3.0 and 6.0 g/kg, respectively, levels believed to allow successful cotton cultivation. Compared to the treatment without SPM, the salt discharge ratio (SDR) and the water use efficiency for salt discharge (WUESD) were enhanced from 11.9% and 1.86 kg/m^3 to a maximum of 32.1% and 3.15 kg/m^3, respectively, when a SPM was present. While, in general, increasing L_f enhanced WUESD, considerations of installation costs suggest an optimal practical L_f of between 20 and 100 cm. The SDR and WUESD were further enhanced by decreasing the space interval between pipes from 500 cm, typically found in commercial fields, to 200 cm. In additional simulations, the SSP was used to both supply water and discharge leachate, eliminating the need for wetting of the entire profile and potentially enhancing salt discharge efficiency. Results showed that the approach had limited practical value as very little salt could be discharged through the SSP, and the maximum WUESD was not more than 0.6 kg/m^3 even when a SPM was laid beneath SSP and the space interval between pipes was narrowed to 200 cm. The modeling approach presented should be useful in evaluation of further approaches using SSP to improve reclamation of saline agricultural soils where drainage of saturated zones is unpractical.

Key words: salt discharge; subsurface pipe; numerical simulation; HYDRUS 2D/3D; cotton field under film mulched drip irrigation

Definition of environmental flow components for *Leiocassis Longirostris* in the Huai River considering habitat change and hydrological change

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Abstract: *Leiocassis longirostris* (Chinese Longsnout Catfish) is classified by IUCN as data deficient, but population declines have been reported in China. Protection of the migration and overwintering habitats of *L. longirostris* was selected as the key environmental flow objectives for the main stream channel of the Huai River. First a conceptual model of the relationship between the ecological requirements of *L. longirostris* and the flow regime was established. Then the FLOWS method was extended by modelling the change in preferred physical habitat over time. Finally flow components suitable for survival and reproduction of this species were defined. Results of the analysis of environmental flows showed that high flow pulse occurred more frequently and with longer duration prior before the hydrological change, while the frequency of flooding increased after the change, so the environmental flows before change was more suitable for *L. longirostris*. Results of the analysis of satisfied degree of the assumed critical hydraulic parameters showed that the flow regime in the period prior to the hydrological change was more suitable for *L. longirostris*. So the mean water year before the change (1970 Year) was selected to characterize suitable environmental flow components. The suitable flow range for the spawning period was 545~1212 m^3/s, the minimum flow for larvae feeding period was 1750 m^3/s, and the minimum flow over the overwintering period was 74 m^3/s. These research findings can assist in the protection of rare species and maintenance of ecosystem integrity in the Huai River.

Key words: *Leiocassis longirostris*; FLOWS method; hydrological change; environmental flow; hydraulic parameters; flow component

Research on water quality transformation mechanism in Sluice-controlled river reaches Ⅱ. Identification of the major reaction mechanism

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Abstract: According to the multi-phase transformation model of water quality proposed in the preceding paper, different scheduling scenarios of sluice were set to further develop the water quality concentration numerical simulation. Then the concept of "contribution rate" was introduced, which can quantitatively evaluate the effect of sluice scheduling in the process of multi-phase transformation of water quality, and analyze the driver effect of different scheduling schemes on various reaction mechanisms and identify the leading reaction mechanism. The results show that contribution rate of sluice scheduling for multi-phase transformation of water quality changes with sluice scheduling methods changing, and water quality transformation showed different leading reaction mechanisms. When the sluice gate is in a small opening, the dominant role of adsorption and sedimentation will be significantly enhanced. On the contrary, the leading role of desorption and resuspension will be enhanced when the sluice gate in a large opening. And the leading role of different reaction changes alternately with sluice scheduling methods changing.

Key words: sluice-controlled river reaches; water quality transform; contribution rate; leading reaction mechanism

Laboratory investigations on the mechanical properties degradation of sandstone under the combined action between water chemical corrosion and freezing and thawing cycles

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Abstract: The degradation and damage mechanism and mechanical characteristics of sandstone specimens eroded in different chemical solutions under freeze thaw cycle were studied through freeze thaw test method. The variation of mechanical properties of sandstone under uniaxial compression and triaxial compression after being soaked in different chemical solutions under different freeze thaw cycles is analyzed. The damage mechanism of sandstone subjected to coupling effect of chemical corrosion and the freeze-thaw cycle is preliminarily analyzed. At the same time, the damage variable was defined to analyze quantitatively damage degree of sandstone. The test results show that for 0.1mol/L(H_2SO_4), 0.1mol/L(NaOH) and pH=7.0 distilled water, with the increase of freeze thaw cycles, the peak strength and elastic modulus of sandstone specimens decrease by exponential function, but the peak axial strain of it increase by exponential function. With the increase of freeze-thaw cycles, the damage of sandstone increases. The degradation and damage of sandstone soaked in H_2SO_4 solution is bigger than that in NaOH solution and pH=7.0 distilled water. H_2SO_4 solution increased the freezing and thawing degradation and damage of sandstone by freeze thaw, but there is a certain inhibition effect on the freezing and thawing damage of sandstone samples soaked in 0.1mol/L (NaOH) solution. Under coupling effect of chemical corrosion and the freeze-thaw cycle, although the chemical solution can relieve the damage caused by freezing and thawing cycles to a certain extent, but also the corrosion of water chemical solution is the same, but meanwhile the chemical damage produced by chemical solution, the coupling effect together with freeze-thaw cycle can give mutual effect on the degradation and damage of sandstone.

Key words: sandstone; chemical erosion; freeze-thaw cycle; coupling effect; mechanical property; degradation mechanism; damage variable

Verification of the seismic performance of Shapai Arch Dam during Wenchuan Earthquake

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Abstract: The study focuses on the seismic performance of Shapai Arch Dam during Wenchuan Earthquake. We try to make the calculation conditions close to the actual situation of Wenchuan earthquake for Shapai Arch Dam by two ways: one is ascertaining the real earthquake wave at the site of Shapai Dam; the other is to determine the actual strength of the dam concrete through material test on large dynamic universal testing machine. The study inquiries into the real strength of the joints in the arch dam by comparing the calculating results of the joints opening to the actual opening of the joints during the earthquake. Calculation analysis and actual seismic performance has verified that Shapai arch dam-foundation system has a rather satisfying seismic capacity. Through the analysis of the main source of the potential seismic capacity for high arch dam system, the study indicates that high arch dam foundation system designed and constructed according to Chinese seismic code for hydraulic structures has a large potential seismic capacity.

Key words: Arch dam; earthquake performance; seismic wave; tensile strength; potential seismic capacity

An empirical analysis on influencing factors of the reservoir resettlement satisfaction

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Abstract: This paper explains in detail data and sample composition by interview survey and questionnaire investigation of 1031 immigrant households in Danjiangkou reservoir (which supplies water primarily), 697 immigrant households in Centianhe reservoir (which irrigates primarily), 683 immigrant households in Tingzikou reservoir (which prevents flood primarily). This paper formulates the Logistic model with reservoir resettlement satisfaction as dependent variable, and with immigrants´ characteristics, family income and disbursement, production conditions, living conditions, social conditions, resources conditions, environmental conditions as independent variables. This paper uses the Logistic model to analyze the factors which may affect reservoir resettlement satisfaction, and innovatively presents some evaluation index such as children´s dependency ratio, old-age dependency ratio, household business income, salary income, transfer income etc. This paper more fully reveals the key influence factors and the differences on reservoir resettlement satisfaction in different types of reservoir resettlement. The study confirmed that variables of immigrants' family income such as "per capita net income", immigrants' production conditions such as "quality of cultivated land", immigrants' living conditions such as "infrastructure" and immigrants' social conditions such as "the implementation of immigration policy" in the three reservoir models are the most important factors that affect the immigrant satisfaction. Considering the practical implications of this research, identifying factors determining immigrant satisfaction with reservoir resettlement relocation experience could be useful for policy-makers designing immigration programmes.

Key words: reservoir resettlement satisfaction; influencing factors; logistic model; empirical analysis

Experimental study on chloride transport in concrete under environmental and loading coupling conditions

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Abstract: Chloride transport process and service life of concrete structures are affected by surrounding environment and loading conditions. Sustained bending load of 28%, 22%, 16% and 10% of ultimate bending load was applied on 8 reinforced concrete beams by a spring loading system, respectively. Meanwhile, the local strains on the mid-span height of RC beams were measured. Immersion tests were conducted on 4 beams while drying-wetting tests were on the other 4 beams in an artificial climate chamber under the condition of chloride solution of 5%, environment temperature of 50℃ and RH of 60%. An automatic drying-wetting device was used to simulate the ocean tide. After 60 days, to determine the chloride ions concentration, the concrete specimens were drilled at tension zone and compression zone in the mid-span of the RC beam. Compared with the chloride transport process in unstressed concrete, chloride transport process was accelerated by tensile stress and suppressed by compression stress. The chloride diffusivity in concrete with tension strain of 526$\mu\varepsilon$ is about 2.4 times faster than that in unstressed concrete, and the chloride diffusivity of concrete with compression strain of 90$\mu\varepsilon$ is the same as the unstressed concrete, but the chloride diffusivity of concrete with the compression strain of 175$\mu\varepsilon$ is 0.4 times slower than the unstressed concrete. And the chloride transport in RC beams under drying-wetting condition is faster than the ones under immersion condition. Among the different loading and environmental condition couplings, tension stress and drying-wetting coupling is the most serious condition for chloride transport. It can be found that the local strain of concrete is in good correlation with chloride ion diffusion coefficient, which can reflect the effect of loading on chloride transport. Within a range of strain in concrete, chloride diffusion coefficient increases with the increasing ensile strain, and decreases with the increasing compressive strain.

Key words: concrete; loading effect; environmental condition; chloride ions; diffusivity

Prisoner dilemma in transboundary river cooperation and the way towards evolution of cooperation

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Abstract: In the context of population growth and climate change, the scarcity of water resources has being more prominent, making development and utilization of transboundary river an internationally and regionally sensitive and intractable problem. The competition over transboundary river water resources is a "Prisoner Dilemma" situation. This paper explored the way of applying reciprocity theory on untacking Prisoner Dilemma in transboundary river cooperation, and discussed its feasibility and prerequisites. The case of Nile River in Africa was studied to analyze the challenges in transboundary river cooperation, and then the way towards evolution of cooperation was proposed. The Columbia River in North America was taken to exemplify the way towards evolution of cooperation on transboundary river cooperation. The results show that reasonable exploitation of transboundary river could not only increase common benefit of upstream and downstream states, but also promote the evolution of international cooperation in political and economic areas. Successful practice of reciprocity theory provides reference for cooperation policy making in water resources area between China and neighboring countries.

Key words: transboundary river; reciprocal cooperation; prisoner dilemma; evolution of cooperation

Experimental study of ice jam accumulation during freezing period

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Abstract: Ice jam is a common problem for rivers in cold regions. The ice jam thickness is an important indicator for ice jam prediction. However, the mechanism of ice jam evolution in the freezing period is still not clear. By conducting a series of flume experiments, this phenomenon was studied. Different flow and ice conditions were selected to study the frazil ice jam accumulation. Two different accumulation processes were shown from the study, which corresponding to the two flow conditions. Hydraulic thickening and mechanically thickening process were discussed separately in the passage, which can support the further research on the ice jam evolution.

Key words: ice jam; accumulation process; hydraulic thickening; mechanical thickening; experimental study

Study on the stable cross-sectional area of air-cushion surge chambers

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Abstract: Based on the rigid water column theory and considering the water inertia of penstock and characteristics of turbine and governor, a detailed formula for critical stable cross-sectional area of air-cushion surge chambers was derived. The parameter values in this formula calculated for the largest stable cross-sectional area were discussed in this paper. According to the data of ten different national diversion hydropower stations in recent years, the parameters in this detailed formula were statistically analyzed. The results show that the detailed formula for air-cushion surge chambers is consists of three parts: one is corresponded to the diversion tunnel term of F_{th1}, penstock term of F_{th2} and governor term of F_{th3}, which are formally consistent with the regular surge chamber, only except with the coefficient of $(1+m\times p_0/l_0)$. The largest stable cross-sectional area is dependent on the water head between design and maximum head, which can meet both a larger value of $(1+m\times p_0/l_0)$ and $e>1$. The value of $(1+m\times p_0/l_0)$ linearly increases with the increase of design head. The application of air-cushion surge chambers should be further demonstrated in details based on the scale of power plant engineering, rather than assumptions that it suit for any high-head hydropower stations.

Key words: air-cushion surge chambers; stable cross-sectional area; governor characteristics; statistical analysis

Simulation of rainfall runoff on permeable slope based on Nash instantaneous unit hydrograph

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Abstract: Based on Nash instantaneous unit hydrograph, Horton infiltration equation and rainfall interception models, a math model for simulating the rainfall runoff on permeable slope is established. The time-area relation of basin is a concentrated expression of geomorphic characteristics. Based on the time-area relation and isochrones of watersheds, a determination method of parameters n and K for Nash instantaneous unit hydrograph is derived in rectangular basin. The value of parameter n is equal to1.0, and the value of K is equal to the routing time. Finally, the model is applied and examined in simulation of rainfall-runoff on forested permeable slope in Miyun Reservoir watershed area in Beijing. The result shows that the trends of the calculated and measured values are consistent well.

Key words: permeable slope; Nash instantaneous unit hydrograph; model parameters; simulation of rainfall runoff