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A Study on the Optimum Design Flowrate for Tunnel-Type Small Hydro-Power Plants

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This study represents the methodology for feasibility analysis of small hydro power plants. Cumulative density function of Weibull distribution and Thiessen method were adopted to deside flow duration curve at candidate sites. The perfomance prediction model and construction cost estimation model for tunnel-type small hydro power plants were developed. Eight candidate sites existing on Han river selecrted and surveyed for actual sites reconnaissance. The performance characteristics and economical feasibility for these sites were analyzed by using developed models.

As a result, it was found that the optimum design flowrates with the lowest unit generation cost for tunnel-type small hydro power plants were the flowrate concerning with between 20% and 30% of time ratio on the flow duration curve. Additionally, primary design specifications such as design flowrate, effective head, capacity, annual average load factor, annual electricity production were estimated and discussed for surveyed sites.

An Analysis of Precision of Numerical Soultions by Using the Wave Saint-Venant Equations.

WOO, Hyo Seop, Senior Research Fellow, KICT/KIM, Hyeon Jun, Researcher, KICT.

The Saint-Venant equations of the continuity and momentum principles of one-dimensional, unsteady, open-channel flow are expressed in terms of the phase velocities of constant depth, velocity, and discharge, which results in unique relationships between these phase velocities and channel velocity. A case study shows that these unique relationships developed in this study can be used as an indicator of precision of numerical solutions of the Saint-Venant equations. Further physical interpreation of these relationships and utilization to the numerical analyses of the Saint-Venant equations are to be investigated.

Estimation of River Maintenance Water in the Geum River Watershed

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The purpose of this paper is to estimate river maintenance water of the main gauging stations in Geum river watershed.

The estimation methods of river maintenance water are classified into two categories; views of supply and demand. The definition of river main-tenance water in this paper, is the maximum value between mean drought flow and environmental conserving flow.

In order to estimate river maintenance water, the mean drought flow estimated at the upstream of the Daecheong Dam but the downstream of the Daecheong Dam estimated mean drought flow and water quality control flow use of QUAL2E Model.

In result, a mean drought flow showed large value at the Gong ju and Gyu am station as the downstream of the Daecheong Dam. The river maintenance water is 33.82㎥/sec at the Gong ju station, 51.51㎥/sec at the Gyu Am station.

Therefore, an estimation of the river maintenance water in the Geum River watershed concluded suitability which is detemined mean drought flow.

Peak Discharge Change by Different Design Rainfall on Small Watershed

JUN, Byong Ho, Prof., Korea Military Academy/JANG, Suk Hwan, Graduate Student, Seoul City Univ.

To design the minor structures in the small watersheds, it is required to calculate the peak discharge. For these calculations the simple peak flow prediction equations, the unit hydrograph method, the synthetic unit hydrograph methods or the runoff simulation models are adopted. To use these methods it is generally required to know the amount and the distributions, which are the uniform distribution, the triangular distribution, the trapezoidal distribution, or the design rainfall. In this study, the peak discharges are calculated by the different rainfall distribution and the values are compared.

Flow Charateristics and Transverse Bed Slope in Curved Alluvial Channels

CHA, Young Kee, Prof., Dankuk Univ./LEE, Dae Cheol, Dae Jeon Eng. College

This study is for simulating to the model which analyzes flow characteristics and transverse bed slopes in a coarse-streambed of the meandering alluvial channels.

Using the equations for conservation of mass, momentum, and for lateral stability of the streambed, a linear differential equation of transverse bed slope is dervied from the flow characteristics in curved channels. Its solutions are solved by the Sine-generated curve methoh(SCM) and compared with re-

sults of field measurements.

Lag distances by the maximum transverse bed slope and velocity profiles will predict risk sections of concave bank undere floods.

Numerical Analysis of Subsurface Flow in a Hillslope

CHOI, Eun Ho, Graduate Student, Dongkuk Univ./NAHM, Sun Woo, Prof., Dongkuk Univ.

The governing equation of flow in porous media is developed on the bases of the continuity equation of fluid for transient flow through a saturated-unsaturated zone, and substitution of Darcy's law. The numerical solutions are obtained by finite element method based on the Galerkin principles weighted residuals. The analysis are carried out by using the rainfall excess model in considering of the initial losses. The functional relationship between the hydraulic conductivity, capillary pressure head and volumetric water content are applied to the flow of water through unsaturated soil varied with changes of water content.

Estimation of Instream Flow in Han River

OH, Kyu Chang, Researcher, KICT/JEONG, Sang Man, Senior Researcher, KICT/PARK, Sang Jin, Senior Researcher, KICT/YOO, Young Suk, Researcher, KICT

This study was focused on establishing the concepts of the instream flow to prevent the problems for the conceptual ambiguity and the difference in the instream flow estimation methods.

The average drought flow is defined as the flow required to guarantee the minimum function of the river such as prevention of drying. The environmental control flow is defined as the flow required to control optimal river environment, the flow required for navigation, prevention of sea water-intrusion, protection of river management facilities, conservation of water quality, fishing, prevention of river mouth closure, control of groundwater level, protection of animals and plants, and landscape.

The average drought flow was obtained by flow duration analysis for the natural flows in the Han River at Indo-Bridge gaging station. When considering the 9 factors related to environment conservation, the conservation of water quality was proved to be most important. The pollutants for the river flows were estimated and the water qualities were forecatea. After comparing the water qualities in the future and water quality standards, there quired optimal dilution flow was estimated. The average drought flow and environmental control flow are all non-consumptive flows. Therefore larger flow between them, i. e., Max. (average drought flow, environmental control flow) can be the instream flow. The river management flow can be added to the flows for water utilization in the downstream.

The results from this study are expected to be very helpful in the systematic river management on the other main rivers in Korea.

A Study of the Runoff Simulation and the Urbanization Effect on Small Watersheds

JUN, Byong Ho, Prof., Korea Military Academy

To simulate the mechanism of runoffs on small watersheds, the ILLUDAS and the ILSD models are used in this study. The transfer ability of these models to Korean watersheds and significant factors that could affect their applicability were examined through the analyzation of the hydrographs generated from runoff simulations. The runoff hydrographs from the watersheds with different urbanization rates are also sumulated to investigate the degree of variation of the peak discharges, the runoff rates, the runoff volumes and other hydrological factors related with urban runoff.

Field Measurement and Analysis of Fluvial Sediment in the Cheongmi-Stream ( ) -Hydraulic and Sediment Characteristics-

YU, Kwonkyu, Researcher, KICT/WOO, Hyo Seop, Senior Research Fellow, KICT

Some selected hydraulic characteristics including the average velocity, geometry of the channel cross-section, and water temperature, and sediment-characteristics including suspended sediment concentration, and the size distributions of suspended and bed-sediments were collected at two measuring stations in the Cheongmi-Stream during a flood period. The river bed investigated for this study is composed completely of sands, and it can be considered a typical alluvial channel. The major results obtained from the analysis of the data collected are as follows : 1) Only during floods, a substantial sediment transport occurs in the river ; 2) The stage-discharge relations are changed frequently, especially for low flows ; 3) The friction in the flow increases with an increase in the flow dischagre ; 4) Silts and clays are dominant in suspended sediments during normal flows, while sands are dominant during floods ; 5) The vertical distributions of the flow velocity and suspended sediment concentration can be described, respectively, by Prandtl-von Karman's log-law and Rouse's exponential law. It is judged that the above results are commonly adapted for other alluvial rivers, although they were obtained from a limited number of data collected from a specific river reach.

Analytical Stydy on the Tide Propagation Characteristics in Tidal Rivers

LEE, Jae Hyung, Assoc. Prof., Jeonbuk Univ./KIM, Gyung Soo, Graduate Student, Jeonbuk Univ.

For investigation of the interaction of tide and river flow, the derived equations are solved analytically using the approximation method of perturbation. The convective inertia and nonlinear bottom friction terms are included in the derivations. The harmonic analysis is applied to decompose the complicated interaction of the freshwater discharge with various constituents of tide into its individual interaction with each constituent. In this study, four main constituents(M2, S2, K1, O1) are included. The

relations of dimensionless parameters of the tide, especially the dimensionless damping modulus, are then determined for each solution. The results show that analytical soultion of dimensionless damping modulus underestimates the measured value obtained from harmonic analysis. Results of water level obtained by applying the analytical model to a tidal reach of the Keum River in the years 1981 and 1982 show very good agreement with those obtained from the harmonic analysis.

Validity of Runoff Curve Number Method for Estimating of Effective Rainfall

YOON, Tae Hoon, Prof., Hanyang Univ.

A number of different curve numbers are estimated, and three of them are the basin or composite curve numbers(CN-Ⅱ and CN-Ⅲ) evaluated from hydrologic soil cover complex, the observed curve numbers computed from rainfall-runoff observations and the basin median curve numbers as a median of the observed curve numbers. Based on the observed runoff, CN-Ⅱ underestimates the effective rainfall meanwhile CN-Ⅲ overestimates. Hence, for the improvement in estimating effective rainfall, a modulating curve number may be defined as a value in between CN-Ⅱ and CN-Ⅲ. Basin median curve numbers produces the closest result to the observed runoff and therefore it can be adopted as a representative curve numner for gaged basin.

A Study of River-Bed Variation from Goan to Indogyo due to Flood in Han River

PARK, Jung Eung, Prof., Seoul National Polytechnic Univ./JEOUNG, Dae Seouk, Graduate Student, Kyunghee Univ.

The river-bed variation and the sediment transport in an alluvial stream are very complicated physical phenomena, especially in a stream where the dam construction prevents the supply of earth and sand from upper tributaries. Therefore, the mathematical modeling is needed to establish. The purpose of this study is to apply river-bed variation to the Han River downstream by the conception of gradually varied unsteady flow instead of that of steady flow in order to decrease errors. For the variation and forecast of river-bed, the numerical analysis has been made in this study by way of discharge variation and river-bed variation.

In conclusion, the numerical analysis shows that river-bed variation, sediment transport, and their forecast have similarity to natural phenomena and that river-bed variation is greatly affected in sediment transport by discharge variation and retention time(duration). Therefore, the errors of numerical analysis can be reduced by the application of flood data instead of continuous discharge data.

Field Measurement and Analysis of Fluvial Sediment in the Cheongmi-Stream ( )
- Mineralogical and Contaminative Characteristics of Sediment Particles

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As a second part of the study entitled "Field Measurement and Analysis of Fluvial Sediment in the Cheongmi-Stream", this study concerns mineralogical and contaminative characteristics of sediment particles collected at Wonbu-Gyo and Hanpyeong-Gyo in the Cheongmi-Stream. The mineralogical analysis of the bed sediment collected reveals that, in general, quarz is the most abundant mineral found in sands with feldspars and rock fragments in the next, which confirms what is known in the literature. The shape factor of sand particles is about 0.7, which also agrees to what is known in the foreign literature. The analysis also reveals that the clay particles collected are composed mainly of illite, kaolinite, and chlorite.

The analysis of contamination reveals that there is no substantial difference between the contents of organic material and heavy metals in the surface water and those in the pore water beneath the river bed. It is because the sampling for this analysis was conducted right after the September flood during which the fresh top soil from the upstream watershed replaced the old bed sediment and pore water that would probably be more contaminated. The contents of heavy metals in the bed sediment of sand particles do not exceed those in the soils adjacent to the river. For fine sediment such as clays, however, the contents of heavy metals, especially of mercury and zinc, far exceed those in the soils adjacent to the river. These fine sediments are transported downstream in the form of wash load and deposited in part on flood plains, which could be a new source of contaminants.

Hydrologic Time Series Model by Transfer Function

KANG, Kwan Won, Prof., Inha Univ./KIM, Ju Hwan, Graduate Student, Inha Univ.

The relationships between rainfall and runoff are analyzed statistically and modelled using discrete linear transfer function, which can be shown with the relations between input and output in hydrologic system. The procedures of identification, estimation and diagnostic checking of model are proposed, and the suitability of assumed model is determined by the statistics used in time series analysis.

A Multiple Regression Model for the Estimation of Monthly Runoff from Ungaged Watersheds

YOON, Yong Nam, Prof., Korea Univ./WONE, Seog Yeon, Graduate Student, Korea Univ.

Methods of predicting water resources availiability of a river basin can be classified as empirical

formula, water budget analysis and regression analysis. The purpose of this study is to develop a method to estimate the monthly runoff required for long-term water resources development project. Using the monthly runoff data series at gaging stations alternative multiple regression models were constructed and evaluated.

Monthly runoff volume along with the meteorological and physiographic parameters of 48 gaging stations are used, those of 43 stations to construct the model and the remaining 5 stations to verify the model. Regression models are named to be Model-1, Model-2, Model-3 and Model-4 developing on the way of data processing for the multiple regressions. From the verification, Model-2 is found to be the best-fit model. A comparison of the selected regression model with the Kajiyama's formula is made based on the predicted monthly and annual runoff of the 5 watersheds. The result showed that the present model is fairly resonable and convinient to apply in practice.

The On-Line Prediction of Water Levels using Kalman Filters

LEE, Jae Hyoung, Assoc. Prof., Jeonbuk Univ./HWANG, Man Ha, Graduate Student, Jeonbuk Univ.

In this paper a discrete extended Kalman filter for the tidal prediction has been developed. The filter is based on a set of difference equations derived from the one dimensional shallow water equations using the finite difference scheme proposed by Lax-Wendroff. The filter gives estimates of the water level and water velocity, together with the parameters in the model which essentially have a random character, e.g. bottom friction and wind stress. The estimates are propagated and updated by the filter when the physical circumstances change. The Kalman-filter is applied to field data gathered in the coastal area along the West Sea and it is shown that the filter gives satisfactory results in forecasting the waterlevels during storm surge periods.

Development of the Annual Runoff Estimation Model

KIM, Yang Su, Senior Researcher, KICT/JEONG, Sang Man, Senior Researcher, KICT/LEE, Youn Su, Namwon Eng. Co./SEOH, Byung Ha, Director, Water Resources Eng. Div., KICT

The study was focused on developing a new model to estimate annual runoff. This model can be used to estimate the available water resources for ungaged catchments for long-term water resources development planning. Data used in the model development were daily rainfall and daily runoff of the sample basin with record length from 1945 to 1988 years in Korea. The sample basin selected by consideration whether the flow is virgin and quality of discharge data is good. As a result, 46 stage gaging station were selected. Annual runoff was determined by sum of daily runoff calculated by daily state data of the sample basin. Also, the annual mean precipitation by using daily rainfall data was estimated and the annual runoff ratio for each sample basin was calculated, and the annual mean runoff ratio was estimated. The linear regression model was proposed and calibrated using annual mean precipitation values and geomorphological characteristics of the basins. To verify reasonableness of this model, the

regression model was applied to gaging stations which have historical data.

Vol. 24, No. 4

Numerical Simulation on Tidal Currents in a Bay Application to Gamag Bay

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This paper describes the characteristics of tidal currents in the Gamag Bay by using the two-dimensional nonlinear hydrodynamic equation. The basic equations are derived by Navier-Stokes momentum equation and continuity equation and its characteristics critically are reviewed, and they are analysed by the implicit finite defference method.The numerical model is constructed two-dimensional (depth-averaged) simple layer model.

This paper investigates the stability of solution and convergence of solution in application of the method to Gamag Bay, and the reproducibility of the simulation is also discussed in comparison with the results of field survey.

The following items are clarified through the numerical investigation; i) the reproduc-ibility of tidal range and currents are quite acceptable, comparing with the results of model tests and field data, and ii) tidal cycle for convergent solution is four tidal cycle. also, iii) bottom friction is successfully represented as $c=(1/n)\cdot h^{1/6}$.

Unsteady Flow Analysis in the Youngsan River Using Explicit and Implicit Finite Difference Methods

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Flood fouting in the Youngsan River was performed for the flood event of July, 1989 by two finite difference methods. The Saint Venant eq., a kind of hyperbolic partial differential equation is employed as governing equation and the explicit scheme (Leap Frog) and implicit scheme (Preissmann) are used to discretize the GE. As for the external boundary conditions, discharge and tidal elevation are upstream and downstream BC, respectively and estuary dam is included in internal BC. Lateral inflows and upstream discharges are the hourly results from storage function method. At Naju station, a relatively upstream points in this river, the outputs are interpreted as good ones by comparing two numerical results of FDMs with the observed data and the calibrated results by storage function method. And two computational results are compared at the other sites, from middle stream and downstream points, and thus are considered reliable. Therefore, we can conclude from this research that these numerical models are adaptable in simulating and forecasting the flood in natural channels in Korea as well as existing hydrologic models. And the study about optimal gate control at the flood time is expected as further study using these models.

A Comparative Study on the Multivariate ThomasFiering and Matalas Model

LEE, Joo Heon, Graduate Student, Kyunghee Univ./LEE, Eun Tae, Assoc. Prof., Kyunghee Univ.

The purpose of the synthetic generation of monthly river flows based on the short-term observed data by means of multivariate stochastic models is to provide abundunt input data to the water resources systems of which the system performance and operation policy are to be determined beforehand.

In this study, multivariate Thomas-Fiering and Matalas models for synthetic generation based on streamflows in neihboring basin were employed to check if it can be appllied in the modeling of monthly flows. Statistical parameters estimated by Method of Moment and Fourier Series Analysis respectively were reproduced for statistical features. For comparisons the statistical parameters of the generated monthly flows by each model were compared with those of the observed monthly flows.

Results of this study suggest that the application of Matalas model for synthetic generation of monthly river flows can be adapted

A Multivariate Model Development For Stream Flow Generation

JEONG, Sang Man/Senior Researcher, KICT

Various modeling approaches to study a long term behavior of streamflow or groundwater storage have been conducted. In this study, a Multivariate AR (1) Model has been applied to generate monthly flows of the one key station which has historical flows using monthly flows of the three subordinate stations. The Model performance was examined using statistical comparisons between the historical and generated monthly series such as mean, variance, skewness. Also, the correlation coefficients (lag-zero, and lag-one) between the two monthly flows were compared. The results showed that the modeled generated flows were statistically similar to the historical flows.

Planning Models for Detention Ponds with Consideration of the Urbanization Effects

LEE, Jong Tae, Prof., Kyongki Univ./YOON, Sei Eui, Prof., Kyungki Univ./LEE, Jae Joon, Prof., Keumoh Eng. College/YOON, Yong Nam, Prof., Korea Univ.

A number of planning models that are used for preliminary design of detention ponds in urban area were compared with consideration of urbanization effects. The characteristics of hydrological parameters α, γ which are used in planning models were analyzed. And a new planning model for detention ponds was suggested.The required storage volumes of the Sinjung I, Myunmock, and Hannam detention pond were calculated by the planning models with the catchment data. The applicability of planning models to estimate the required storage volume of detention pond was investigated. Mori and Rational model have the trend of overestimation of storage volumes of detention ponds, on the other hand Abt & Grigg and Kadoya model show the trend of underestimated values, and the rest of the planning models show the reasonable volumes.

A Study on the Application of Thomas Monthly Runoff Prediction Model for Ungauged Watersheds

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Young Bak, Prof., Korea Univ.

An effort was made to develop a monthly runoff prediction method based on the Thomas model. For the 20 watersheds selected the Thomas model was fitted, the parameters being determined by the Rosenbrock's rotating coordinate search method using the monthly rainfall and runoff data. The so determined parameters were correlated with the meteorologic, topographic and geologic characteristics of the watersheds. The model was tested by comparing the observed and simulated monthly runoff records from two test watersheds.

The result showed that the model developend in the present study could satisfactorily be applied to ungauged watersheds. It was noticed that the model had the tendency of slightly overestimating the runoff during winter period and underestimating during the spring period.