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Deterministic Water Quality Analysis in the Midstream of the Nakdong River

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Water quality analysis in the midstream of the Nakdong river is studied. Deterministic model RQ1 which contains two code, RQ1-1 for hydrologic and hydraulic analysis and RQ1-2 for water quality analysis are developed. Monthly mean and minimum discharges in the basin (from Waegwan to Jindong) are estimated. A varied flow analysis is performed based on the geometric data of channel and RQ1-1 model. The maximum concentration of BOD and minimum concentration of DO are occurred at the confluence of Keumho river and immediate downstream of Hyunpoong, respectively. The computed concentrations of BOD at several points have good agreements with observed data. Maximum allowable BOD loads from the Keumho River are provided to attain the goal of water quality in the basin.

Acute Toxicity on Daphnia Magna and Photobacterium Phosphoreum for Synthetic Detergents

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As the standard of living improves, the amount of synthetic detergent consumption greatly increas-

* The institution has changed its name from "Korean Association of Hydrosciences (KAHS)" to the present "Korea Water Resources Association (KWRA)" since February 1995.

es. Detergents which are not treated in the sewer treatment processes, flow into rivers or waterstreams and accelerate the pollution of the surface water resources. Detergents contain lots of toxicants. And it is difficult to evaluate gross toxicity of each toxicant in the receiving water. In this study, the acute toxicity of the synthetic detergents for home laundering and kitchen use were monitored with daphnia magna and photobacterium phosphoreum. Seven kinds of detergents were tested to evaluate the acute toxicity. The mean 24hr, 48hr-LC50 of the synthetic detergent for home laundering were 4.25%, 2.5% and those for kitchen use were 2.01%, 1.36% respectively. And the mean 5min, 15min-EC50 of the synthetic detergent for home laundering were 1.83%, 1.02%.

An Analysis of Groundwater Flow at Bugok Area using MODFLOW

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This study was conducted to analyse groundwater flow in the Bugok hot spring area using the MODFLOW model which can simulate three-dimensional groundwater flow both in confined and unconfined aquifers. Based on this study the following conclusions were obtained:

1) The hydraulic conductivity and the specific storage of the aquifer were 0.0135 m/day and 0.020, respectively, and the model-predicted groundwater elevation agreed well with the observed one.

2) Simulation results showed that the groundwater level declines at the end of the one-year simulation period when the annual recharge rate is small and the annual pumping rate high, which is the worst combination. Except that combination, the groundwater level does not decline at the end of one-year simulation period indicating the pumping rates used were allowable.

3) The safe yield depends upon the magnitudes of the recharge and pumping rates. The pumping rate should not produce excess decline of grouhdwater level around April when the water level is the lowest in a year.

Real-Time Flood Forecasting Using Rainfall-Runoff Model(I) : Theory and Modeling

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Flood forecasting in Korea has been based on the off-line parameter estimation method. But recent flood forecasting studies explore on-line recursive parameter estimation algorithms. In this study, a simultaneous adaptive estimation of system states and parameters for rainfall-runoff model is investigated for on-line real-time flood forecasting and parameter estimation. The proposed flood routing system is composed of ϕ-index in the assessment of effective rainfall and the cascade of nonlinear

reservoirs accounting for translation effect in flood routing. To combine the flood routing model with a parameter estimation model, system states and parameters are treated with the extended state-space formulation. Generalized least squares and maximum a posterior estimation algorithms are comparatively examined as estimation techniques for the state-space model. The sensitivity analysis is to investigate the identifiability of the parameters. The index of sensitivity used in this study is the covariance matrix of the estimated parameters.

Study on Vortex Characteristics and Estimation of Vortex Erosion at Downstream Part of Hydraulic Structure

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Characteristics of the vortex structure and the secondary scour at downstream part of the hydraulic structure such as drainage sluice or spillway were studied. Mean shear velocity in the scour hole could be derived by the theory of energy conservation and the amount of a vortex erosion could be obtained using entrainment equation for given value of a shear velocity. Comparison of erosion rates with others showed a large value at low shear velocity due to the continuous and strong upward flow of the macroturbulence different from the conventional vortex formed in the lee-side of a sand ripple. For a design purpose, if the flow depth at the end of an apron and the properties of bed material are given, the amount of vortex erosion can be known.

Optimal Allocation of Water Resources based on the Network Model

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The purpose of this paper is to construct a network model for the optimal allocation of limited water resources to the nodal system with given priorities. The solution technique for the model is based on the out-of-kilter algorithm(OKA). For the verification and application of the theoretical methodology and computer programs, the Geum river system is selected. Using release of Daecheong dam and water demand in Geum river basin, optimal allocation of water resources is accomplished for 4 cases (case 1 - case 4) which consider priority numbers in the demand nodes. The results of the application show that the model can reasonably represent the physical system, and water shortage at the demand nodes with high priority numbers is reduced. Its system solution was verified with that by the revised simplex algorithm.

Prediction of Ultimate Scour Potentials in a Shallow Plunge Pool

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A plunge pool is often employed as an energy-dissipating device at the end of a spillway or a pipe culvert. A jet from spillways or pipes frequently generates a scour hole which threatens the stability of the hydraulic structure. Existing scour prediction formulas of plunge pool of spillways or pipe culverts give a wide range of scour depths, and it is, therefore, difficult to accurately predict those scour depths. In this study, a new experimental method and new scour prediction formulas under submerged circular jet for large bed materials with shallow tailwater depths were developed. A major variable, which was not used in previous scour prediction equations, was the ratio of jet size to bed material size. In this study, jet momentum acting on a bed particle and jet diffustion theory were employed to derive scour prediction formulas. Four theoretical formulas were suggested for the two regions of jet diffusion, i.e., the region of flow establishment and the region of established flow. The semi-theoretically developed scour prediction formulas showed close agreement with laboratory experiments performed on a movable bed made of large spherical particles.

Derivation of the Critical Minimum Values of the Multiple Correlation Coefficient for Augmenting Hydrologic Samples

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The augmenting hydrologic data using a correlation procedue has been used to improve the estimates of the mean and variance at the site of interest with short record when one or more nearby sites with longer records are available. The variance of the unbiased maximum likelihood estimator of σ_y^2 derived by Moran based on the multivariate normal distribution is modified into the form of Matalas and Jacobs for the bivariate normal distribution to get the critical minimum values of the multiple correlation coefficient which give the improvement for estimating the variance at the site of interest. Those values are tabulated for various lengths of records and the number of sites.

Channel Routing Model for Streamflow Forecasting

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The purpose of this study is develop the algorithm of channel routing model which can be used for flood forecasting. In routing model, the hydraulic technique of the implicit scheme in the dynamic equation is chosen to route the unsteady varied flow. The channel routing model is connected with conceptual watershed model which is able to compute the flood hydrograph from each subbasin. The comparative study that the conceptual model can simulate the watershed runoff accurately. As a result of investigating the channel routing model, the optimal weighting factor θ which fixes two

points between time line is selected. And also, the optimal error tolerance which satisfies computing time and convergence of solution is chosen.

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Study on Hydraulic Characteristics for Upstream Migration of Fish in a Pool-and-Weir Fishway

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In this study, hydraulic characteristics for upstream migration of fish in a pool-and-weir fishway were analyzed through experiment. The results showed that streaming flow was preferable to plunging flow for upstream migration of fish and it was not good to make an orifice beneath the septum since it generates turbulent jet and eddies. Protrusions on the side wall of fishway were preferable to grooves since they decelerate flow velocity and make upstream migration easy. A vertically movable septum was necessary for a flushing of deposited bed material, and net installing over fishway was also needed for birds not to approach the fishway and eat fish.

Analysis of the Hydraulic Behaviour in the Nearshore Zone by a Numerical Model

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The unproper development of the nearshore zone can enhance the diffusion of pollutant in the nearshore zone resulting in unbalanced sediment budget of beach which causes alteration of beach topography. Therefore, it is required to predict the effects of the environmental change quantitatively. In this paper, the depth-averaged and time-averaged energy balance equation is selected to acount for the wave transformation such as refraction, shoaling effect, the surf zone energy dissipation, wave breaking index and bore, due to wave breaking in the shore region. Numerical solutions are obtained by a finite difference method, ADI and Upwind. For the calculation of the wave-induced current, the unsteady nonlinear depth-averaged and time-averaged governing equation is derived based on the continuity and momentum equation for imcompressible fluid. Numerical solutions are obtained by finite difference method considering influences of factors such as lateral mixing coefficient, bed shear stress, wave direction angle, wave steepness, wave period and bottom slope. The model is applied to the computation of

wave transformation, wave-induced current and variation of mean water level on a uniformly sloping beach.

Unsteady Flow Analysis through the Subcritical-Supercritical Transition Region

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Numerical instability of Preissmann scheme is studied for unsteady flow analysis in a natural river. The solution strategies to overcome the instability problems are presented in this paper. The main causes of numerical instability of Preissmann scheme are transition flow, abrupt change in cross section, inappropriate roughness coefficients, time step and distance step, rapidly rising hydrograph, dry bed and so on. Transition flow model is proposed for the analysis of the transition flow which changes from subcritical to supercritical or conversely. The subcritical and supercritical reaches are grouped in the channel, then appropriate boundary conditions are introduced for each reach. The transition flow analysis produces stable solutions in calculating through the various transition conditions. Verification with an actual river system is necessary in the future.

Comparative Analysis of Existing Synthetic Unit Hydrograph in Korea

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Parameters for the Synthetic Unit Hydrograph(SUH) using SCS and Nakayasu methods(including modified type) are derived by regression analysis of the Representative Unit Hydrograph(RUH) of 22 basins in Korea. These derived SUH's were compared with the RUH's and those of Snyder and HYMO given by the Korea Institute of Construction Technology (KICT) for selected 4 basins. In SCS method, when correlated with the lag time of SUH's based on the whole basin rather than on the riverwise basins the peak discharge(excluding Bocheng stream)is close to that of RUH. But the peak time given by riverwise basins agrees closer to the RUH than by the whole basins. The modified Nakayasu type SUH(excluding Wi stream) associated with lag time based on riverwise basins gives better agreements to the RUH than that of Nakayasu method. And the modified Nakayasu type SUH gives much better agreement to the RUH than that of Nakayasu method for the case of both whole and riverwise basins.

Pier Scour Prediction in Pressure Flow

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In this experimental research, the maximum scour depth at pier was studied. The model of the pier of San Gye bridge in the Bocheong stream was set for experimental pier scour studies. Several model verification processes were conducted through the roughness comparisons between model and prototype, pursuring scour depth variations with time depending upon channel bed variation, the comparison of the ratio between falling velocities and shear velocities in the model and prototype, and the comparison of pier scour between experimental data and field measuring data. The experiments were conducted in the free flow conditions and pressure flow conditions. The maximum scour depth at piers in the pressure flow conditions is twice as much as compared to the free flow conditions. Also, the maximum scour depth variations are indicated in the figures based on the Froude numbers, opening ratios, water depths and approaching angles in the free surface flow conditions.

Experimental Study of Flow Characteristics and Sediment Behaviors at the Step Down

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Reduced trend of surface velocity, length of the separated drop area and width of potential core have been verified through experimental study of flow characteristics at the step down. To investigate sediment behaviors, experimental study which involved accumulated sediment transport reducing water velocity in the separated drop area was performed. From the experimental results, surface velocity, length of the separated drop area and width of potential core were formulated, and calculated output was corroborated by experimental outcome. Furthermore, an examination of the parameter which is defined by q_{sf}/q_{uo} was performed by detecting sediment in the separated drop area. Therefore, these experiments can express the phenomena of flow characteristics and sediment behaviors at the step down.

Analysis of Mean Transition Time and Its Uncertainty between the Stable Modes of Water Balance Model

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The surface hydrology of large land areas is susceptible to several preferred stable states with

transiitions between stable states induced by stochastic fluctuation. This comes about due to the close coupling of land surface and atmospheric interaction. An interesting and important issue is the duration of residence in each mode. Mean transition times between the stable modes are analyzed for different model parameters or climatic types. In an example situation of this differential equation exhibits a bimodal probability distribution of soil moisture states. Uncertainty analysis regarding the model parameters is performed using a Monte-Carlo simulation method. The method developed in this research may reveal some important characteristics of soil moisture or precipitation over a large area, in particular, those relating to abrupt changes in soil moisture or precipitation having extremely variable duration.

Effect of the Simplification and Composition in Sewer Networks

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Simplified sewer networks have been used to simulate runoff hydrographs for urban watersheds since configurations of sewer networks in urban area are commonly so complex that it is too cumbersome to simulate them as what they are. If they were to be simulated without any simplification, it is not likely that satisfactory results are obtained due to accumulation of numerous little errors. Even for the well-known models widely used in everyday practices it is not appropriate to simulate everything in the watershed as what they are. In resolving these problems, it is common practice to simplify network configurations so as to be fitted to the models for runoff hydrograph simulation. In case of network simplification, hydraulic and hydrologic characteristics of the watersheds should be carefully taken into consideration to derive meaningful results. On the basis of these considerations, this study analyzes simulation outputs using simplified networks and compares them, as well as investigates the methods to make hydraulically sound simplification of sewer networks.

Prediction and Analysis of Debris Flow with Hydraulic Method

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The occurrence condition of debris fiow due to rainfall is given by solving the equations for flow on a slope. The solution shows that a debris flow will occur on a slope when the accumulated rainfall within the time of concentration exceeds a certain value determined by the properties of the slope. To estimate this critical value, the system analysis technique would be commendable. In this study, a

procedure to find the critical rainfall from the rainfall data with and without debris flows is proposed. Reliability of this method is verified by applying to the debris flows in Unzen Volcano which recently began to erupt. Discharge of debris flow in a stream is obtained by solving the equation of continuity using the kinematic wave theory and assuming the cross-sectional area to be a function of discharge. The computed hydrographs agree well with the ones observed at the rivers in Sakurajima and Unzen Volcanos. It is found from the derived equation that the runoff intensity of debris flow is in proportion to the rainfall intensity and accumulated rainfall, jointly. This gives a theoretical basis to the conventional method which has been widely used.

Numerical Modeling of One-Dimensional Longitudinal Dispersion Equation using Eulerian-Lagrangian Method

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Various Eulerian-Lagrangian numerical models for the one-dimensional longitudinal dispersion equation are studied comparatively. In the models studied, the transport equation is decoupled into two component parts by the operator-splitting approach ; one part governing advection and the other dispersion. The advection equation has been solved using the method of characteristics following fluid particles along the characteristic line and the results are interpolated onto an Eulerian grid on which the dispersion equation is solved by Crank-Nicholson type finite difference method. In solving the advection equation, various interpolation schemes are tested. Among those, Hermite interpolation polynomials are superior to Lagrange interpolation polynomials in reducing dissipation and dispersion errors in the simulation.

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Prediction of Scour Potential Distributions in a Shallow Plunge Pool

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Because a failure to provide enough plunge pool depth can create a risk to the structural stability of the spillways or dams, many researchers have proposed experimental formulas for calculating ultimate scour depth under jet issued from spillways and pipe culverts. For the design purposes of a plunge pool, scour potential distribution is important as much as the ultimate scour depth is. In this study scour potential distributions near the jet impinging point on a porous plane which can simulate a real cohesionless movable flat bed has been measured. Experimental results showed that scour potential distributions are geometrically similar to each other

provided the angle of jet impact was the same. Statistical analysis of experimental results showed that scour potential distributions for the design purposes of a plunge pool could be expressed by a single equation within a range of this experiment. The proposed formula for the prediction of scour potential distributions agrees well with experimental measurements.

Chaotic Analysis of Water Balance Equation

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Basic theory of fractal dimension is introduced and performed for the generated time series using the water balance model. The water balance equation over a large area is analyzed at seasonal time scales. In the generation and modification of mesoscale circulation local recycling of precipitation and dynamic effects of soil moisture are explicitly included. Time delay is incorporated in the analysis. Depending on the parameter values, the system showed different senarios in the evolution such as fixed point, limit cycle, and chaotic types of behavior. The stochastic behavior of the generated time series is due to deterministic chaos which arises from a nonlinear dynamic system with a limited number of equations whose trajectories are highly sensitive to initial conditions. The presence of noise arose from the characterization of the incoming precipitation, destroys the organized structure of the attractor. The existence of the attractor although noise is present is very important to the short-term prediction of the evolution. The implications of this nonlinear dynamics are important for the interpretation and modeling of hydrologic records and phenomena.

The Flood Forecasting Model for the In-do Brdg. by the Multi -Regression Analysis between the Water-level and the Influence Parameters

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In order to enhance the short-term flood forecasting accuracy of the water level of the In-do Brdg., three statistical flood forecasting models are presented and the forecasting accuracies and stabilities of the models are studied. The presented statistical models are as follows: The multi-input model by the multi-regression analysis between the water level of the In-do Brdg. and the influence parameters(Model MM). The multi-level multi-parameter model by the multi-regression analysis(Model MMP). The two-level multi parameter model according to the water level tendency(Model 2MP). Among the three models, the Model MM showed the lowest fore-

casting accuracy, the model 2MP showed the highest forecasting accuracy, although this model sometimes became unstable and diverged. The model MMP forecasted the flood less accurately than model 2MP, but it gave more stable forecasting results.

An Analysis of Historical Precipitation Data for Water Resources Planning

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A statistical characteristics, relations of calendar and water year, and frequencies of precipitaion which are necessary for water resources planning were analyzed with long historical data(1905-1991 years). And the analysis of precipitation of the drought periods in 1967-1968 years was carried out. The study basins are the five major rivers in Korea. As a results of this study, annual precipitation shows an increasing trend but its variation has no statistical significance. The relations of calendar and water year precipitation is presented, it shows that there is little difference of the total precipitation between them. The annual minimum series of total precipitation for the periods of 3, 6, 9, and 12 months by water year are constructed, and frequency precipitation for each periods using 2-parameter lognormal distribution is presented. The analysis of the precipitation in 1967-1968 years shows in a natural river basins that it would be a moderate drought, if dry seasons(Oct-May) or wet seasons(Jun-Sep) has 75 percents of historical mean precipitation of the same periods. And if it has less than 60 percents of historical mean precipitation, it would be a severe drought.

A Study on the Monthly River-Inflow Evaluation of the Keumgang Estuary Reservoir

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The major objective of this study is to analyze the water balance of the Keumgang Estuary Reservoir in the Keum River basin. This basin is one of the catchment area which water utilization is very complicated. For the study of this area, this paper is to evaluate the monthly river-inflow of the Keumgang Estuary Reservoir. Here, two approach methods are proposed

which can take care of the natural and the low flow. The results are as follows. The natural flow at the Keumgang Estuary Reservoir during the wet season was decreased to 8.4% and increased from 0.4% to 17.6% during the dry season by the effects of Deachung Reservoir at the upper basin. The monthly fluctuation of the low flow during May–June varies to a great extent, when large amounts of irrigation water are required.

Boundary Layer Flow under a Sluice Gate

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The boundary layer flow under a sluice gate is numerically solved by the random vortex sheet method combined with the vortex-in-cell method in a boundary-fitted coordinate system. The numerical solution shows that the boundary layer developed along the vertical sluice gate wall is the primary cause for the discrepancy in the contraction ratio between the laboratory experiments and inviscid theory; the bottom boundary layer plays much a smaller role in the discrepancy. By dimensional analysis it is concluded that the discrepancy is inversely proportional to the 3/4th power of the gate opening, as analyzed by Benjamin (1956). The results of the numerical simulation and dimensional analysis show a good agreement with experimental results obtained by Benjamin (1956).

Estimation of Hydraulic Properties in Porous Media

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The analysis of Richards equation requires data of the soil water retention function and the unsaturated hydraulic conductivity. The soil water retention function was measured through the use of the developed apparatus and the saturated hydraulic conductivity was measured by the constant head method for each soil sample corresponding to the A, B, C types of SCS. In order to obtain one water retention function and one unsaturated hydraulic conductivity which represent each soil group, van Genuchten's equation and Mualem's pore-structure model was chosen, respectively. Parameters of van Genuchten's equation are estimated for each soil group using data obtained in the experiments, and estimated values give a basis to analyze the unsaturated flow in the non-measured region efficiently.

Fractal Dimension of Simulated Sediments

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Cohesive sediment movement in estuarine systems is strongly affected by the phenomena of aggregation and flocculation. Aggregation is the process where primary particles are clustered together in tightly-packed formations; flocculation is the process where aggregates and single particles are bonded together to form large particle groups of very low specific density. The size, shape and strength of the flocculants control the rate of deposition and the processes of pollutant exchange between suspended sediments and ambient water. In estuarine waters, suspended sediments above the lutocline form the mobile suspension zone while below the lutocline they form the stationary suspension zone. Suspended particles in the mobile zone are generally in a dispersed state and the controlling forces are the Brownian motion and the turbulent flow fluctuations. In the stationary suspension zone, the driving force is the gravity. This paper discusses the settling and particle flocculation characteristics under quiescient flow conditions. Particles are entering the study domain randomly. Particles in the mobile suspension zone are simulated by using the Smoluchowski's model. Flocs created in the mobile suspension zone are moving into the stationary suspension zone where viscosity and drag effects are important. Utilizing the concepts of the maximum Feret's diameter and the Minkowski's sausage logic, the fractal dimension of the flocs within the stationary suspension is estimated and then compared with results obtained by other studies.

Effect of Length of Outfall Structure on Reattachment of Thermal Discharge

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The reattachment of buoyant effluent to shore in a crossflow is investigated experimentally. The effluent is produced by discharging warm water through projecting side channel into a confined crossflow of the same depth. In the projecting effluent, the size of recirculating region, which is formed by deflected thermal plume on the lee of the effluent, tends to increase, but the maximum temperature decreases in the direction of the crossflow and it has more even transverse spreading compared to non-projecting type. The heat flux across the crossflow is found to be independant of the projected length of the side channel under relatively low buoyancy flux on the contrary to high buoyancy flux. The reattachment of the effluent can be specified by both velocity ratio and densimetric Froude number, whereas only the velocity ratio is governing factor to the reattachment of the effluent in the case of non-projecting type.

Optimal Design of Dendritic Water Distribution Systems Using Linear Programming

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This paper presents a model for the optimal design of dendritic water distribution systems using linear programming technique. The optimization model was formulated and applied to a coastal region reclamation project site located in Hae-Nam, Jun-Nam province. The water distribution systems in the region had aleady been designed using a hydraulic simulator (BRANCH). The optimization model developed in this research utilized the data given in the report of the project. The comparison between the systems designed by the simulator and by the optimization model shows that the optimization model provides better results and can be utilized more efficiently in the design of dendritic water distribution systems.

The Development of an Event Rainfall-Runoff Model in Small Watersheds

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The linear reservoir rainfall-runoff system was developed as a rainfall-runoff event simulation model. It was achieved from large modification of runoff function method. There are six parameters in the model. Hydrologic losses consist of some quantity of initial loss and some ratio of rainfall intensity followed by initial loss. The model has analytical routing equations. Hooke and Jeeves algorithm was used to model calibration. Parameters were estimated for flood events from '84 to '89 at Seomyeon and Munmak stream gauges, and the trends of major parameters were analyzed. Using the trends, verifications were performed for '90 flood event. Because antecedent rainfalls affect initial loss, future researches are required on such effects. The estimation method of major parameters should also be studied for real-time forecasting.

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Estimation of Kinetic Constant in Moving Media Complete Mixing Activated Sludge Reactor

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This study was carried out to obtain kinetic constant of Moving Media Complete Mixing Activated Sludge (MMCMAS) for the wastewater treatment. A laboratory MMCMAS reactor was operated at the organic loading rate of 2.5~48 $gBOD_5/m^3/d$. Kinetic constant of MMCMAS reactor was estimated as follows:

Items	Low Organic Loading Rate	High Organic Loading Rate
K_m(/hr)	3.75~8	8.57~12.5
K_e(/hr)	0.007~0.03	0.09
K_s(/hr)	1.73~3.68	3.84~5.75
Y(VSS/BOD_5)	0.46	0.46

A Study on the Pipe Network System Design Using Non-Linear Programming

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The objective of this study is to develop a method which can design an optimal pipe network system using nonlinear programming(NLP) technique. The method finds the minimum-cost pipe network while satisfying all the design constraints including hydraulic constraints. The method developed in this study was applied to the Goyang distribution area in Goyang, Kyoungi-do. It has been found in the application and the comparison between the original design and the optimal design of this study that the optimal design method developed in this study does not require the trial-and-error procedure while satisfying the discharge and pressure requirements at the demanding nodes. Therefore, the optimal design method using NLP could be effectively utilized in the practical design considering economic aspect of the pipe network system at the same time.

A Study on the Real-Time Reservoir Operation by Optimization Model Considering Deviation Losses

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The aim of this paper is suggest how to control the real time reservoir operation for the optimal operation of reservoir during the drought and the rainy season. The release and the storage lead to the achievement or the deviation losses, higher or lower than the target level. Considering this deviation as one of the losses, putting the penalty on the losses, the way of optimal reservoir operation is discussed in order to minimize the penalty losses. This study draws the deviation losses' curve depending on the operation objective for the Daechung Dam, and applies the optimal operation to the Dam by the linear programing technique, using the slope of the deviation curve as the losses coefficience for the objective function. Conclusively, in this paper we can combine the opposing subjects – the release and the storage – as one objective function by the deviation curve, and also show how to decide the criterion related to the real-time reservoir operation by analysing to what extent and how easily the objectives can be achieved, subject to the inflows.

A Sensitivity Analysis of Model Parameters Involved in Clark Method on the Magnitude of Design Flood for Urban Watersheds

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A Sensitivity analysis on the model parameters involved in the Clark watershed routing method is made to demonstrate the effect of each parameter on the magnitude of 50-year design flood for small urban streams. As for the rainfall parameter the time distribution pattern of design storm was selected. For short duration storms Huff, Yen & Chow and Japanese Central type distributions were selected and the Mononobe distribution of 24-hour design storm was also selected and tested for Clark method application. The effect of SCS runoff curve number for effective rainfall and the methods of subbasin division for time-area curve were also tested. The routing parameter, i.e. the storage constant(K), was found to be the dominating parameter once design storm is selected. A multiple regression formula for K correlated with the drainage

area and main channel slope of the basin is proposed for the use in urban stream practice for the determination of design flood by Clark method.

Floodwave Propagation in Sinuous Channel with Compound Cross Sections

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The sinuosity model has been developed to simulate the floodwave in meandering channels by solving the extended Saint-Venant equation with the Preissmann scheme. The suggested model is compared with three conventional floodplain routing methods in terms of governing equations, mass conservation error and floodwave analysis. The sinuosity model produces the mass conservation error of 1.5-1.8 %, however the separate channel model produces 9.1 % and 27.4 % for sinuosity of 1.5 and 2.0, respectively. The model has been used to simulate flow in an idealized meandering river with a floodplain. The attenuation ratio and the travel time ratio are found to increase as the floodplain roughness and width increase and as the sinuosity factor decreases. The model is expected to contribute the floodwave analysis in sinuous channel with compound cross sections.

A Flood Routing for the South Han River by Muskingum-Cunge Method

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As a submodel of a multi-reservoir operation system for flood control, Muskingum-Cunge method is significant in state-space formulation and accuracy. Through an application to real flood data, the practical applicability of Muskingum-Cunge method was analyzed. For the estimation of celerity in Muskingum-Cunge method, dynamic wave first was simulated by DWOPER. Two methods were adopted to the simulation from Chungju Dam downstream to P'aldang Dam with the flood data in Sep. 1990. While results were very accurate in Yeoju stage gauge, Muskingum-Cunge method showed larger errors than DWOPER in Yangp'yeong station. Errors stem from difficulties in accurate estimation of celerity in the region disturbed by hydraulic structures. If it requires efficient channel routing methods, it is possible for the proposed estimation method for celerity to increase practical applicability of Muskingum-Cunge method

A Study on the Stage-Discharge Relationship in the Lower Reach of the Sumjin River

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In tidal rivers, the water level is affected by a tidal wave. The latter creates higher flood stages that enlarge the flood plain areas and increase potential damages. In such rivers, the water level is not solely a function of the flow discharge but rather a joint function of both the discharge and tidal phenomena. This paper attempts at formulating a relation between tital water level and river flow discharge that can be used for the predictions of water level in coastal rivers. Numerical applications were performed on the HaDong and the SongJung Station in Sumjin river with satisfactory results. The correlation coefficients between the tide(M) and the water stage(Z) at the HaDong Station is 0.558, and SongJung is 0.016. From this result, the water level at HaDong Station is greatly affected by a tide, whereas SongJung is not.

Application Ranges of Finite Difference Models Using Simplifed Momentum Equation in Channel Flow Simulation

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The kinematic and diffusion models using simplified momentum equations of the full dynamic equation have been frequently used for numerical flow simulations, because they have several computational advantages compared to the full dynamic model. In this paper, the more generally acceptable application ranges of the kinematic and diffusion finite difference models were investigated based on three major parameters, which are channel bed slopes So, dimensionless depth increasing numbers Gw at upstream boundary and Froude numbers Fr. The applicable ranges were obtained by comparing the relative magnitudes of the local acceleration, convective acceleration, pressure, gravity and friction terms in the full dynamic equation. In the simulations, a Courant number of 0.5 was used and the channel bed slopes were changed from 0.00001 to 0.05. Also, Froude numbers of 0.1, 0.5 and 0.9 were employed. In this paper, it is indicated that the applicable ranges of kinematic models are increased with increasing of Froude numbers. However, the applicable ranges of diffusion models are decreased with increasing of Froude numbers. Finally, 9 figures were proposed as a guideline in the application of kinematic and diffusion finite difference models based upon the allowable deviation compared to the full dynamic model. With applying the proposed criteria, it is expected that the flow simulations in

the channels, streams or rivers are more efficiently achieved.

The Characteristics of the Urban Water Use Trend with Time for a Day

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The purpose of this study was to improve the understanding of the characteristics of the daily urban water use. The city of Kwangju at Korea was selected as a study area. The population of Kwangju at the end of 1993 was more than one million and two hundred thousand peoples. The average of daily water use in 1993 was about three hundred and fifty thousand tons a day. The variation of the urban water demand trend with time for a day was studied. One day was devided into 12 divisions with a 2 hour increment. The water use demand for the given time interval of a day was observed. The water use index was defind in percentage that indicates the ratio of the amount of water use for a time interval to the amount of water use for a day. The water use index was found to be useful to manage and to operate the water supply systems. In addition to this, the probability distribution of the water use demand for each time interval was tested using the K-S(Komogorov-Smirnov) method. The normal distribution type was found to be appropriate as the probability distribution type for the variation of water demand for the given time interval of a day.

A Dynamic Model for the Pollutant Transport Analysis in a River

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A dynamic model for the pollutant transport analysis in a river is developed by Preissmann scheme and Lagrangian method considering tidal effects. A generalized Lagranian model alleviate the numerical difficulties associated with the use of the Eulerian reference frame. Comparing the finite difference and finite element solutions of one-dimensional transport equation, Lagrangian model shows the most stable and accurate results. The flow model is calibrated using the recorded flood data in the downstream of the Han River. The particle paths-of-travel is computed by the model for the various low flow conditions. The model will provide operational informations useful for water quality management in the downstream of the Han River.

Transient Forces on Pipe Bends by the Propagation of Pressure Wave

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External forces acting on a pipe bend change when a transient pressure wave propagates through the bend. Analytical expressions are derived to compute the changes of these forces when the instantaneous pressure wave passes through the bends. This analysis reveals that these forces depend mainly on static pressure rather than fluid momentum. The analysis also reveals that the change of the vertical component of the force acting on a pipe bend with an angle larger than 90° may reverse in direction during the passage of a pressure wave through the bend.

An Optimal Design of Paddy Irrigation Water Distribution System

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The water distribution system problem consists of finding a minimum cost system design subject to hydraulic and operation constraints. The design of new branching network in a paddy irrigation system is presented here. The program based on the linear programming formulation is aimed at finding the optimal economical combination of two main factors: the capital cost of pipe network and the energy cost. Two loading conditions and booster pumps for design of pipe network are considered to obtain the least cost design.