Abstracts of Main Papers

Some Problems on Pedological Engineering and Engineering Pedology

Atsushi TADA

Volcanic Ash and Soil——A Commemorative Publication of the Retirement of Prof. Dr. Takashi Kurobe——, pp. 105～111 (1983)

1) Soils and farmlands receive many actions from outside system. For example, climate, topography, plants and animals; cultivation, irrigation, drainage and so on. Soils and farmlands also react to those actions. Whole actions and reactions in the fields are combined each other, are not independent, but specialists in soil science and pedological engineering are specialized and not well integrated. The urgent problem is an establishment of the research method on the relation between the actions and the reactions in the field soil in view of Pedology ane Pedological Engineering.

2) To solve this problem, the first step is to clarify the physical and engineering properties of typical genetically classified soil——this process is engineering pedology—— The second step is to find the engineering method based on the theory on the actions and the reactions in the soil and field——this process is Pedological Engineering.

3) One of the most typical soil in Japan is volcanic ash soil. Kanto Loam is one kind of component of volcanic ash soils in Japan, distributed in the Kanto Region, the central part.

i) Physical and engineering properties of Kanto Loam differs in accordance with the period of formation.

ii) Porosity is about 80% in A horizon of the soil as well as in B, C horizons. The humus content is about 10-20% in A horizon, 2～3% in B horizon.

iii) The subsoil has a large quantity of moisture content, which connected with particles by a force greater than the one equivalent to pF 4.2. We call it non-free water, and the one connected by a force lower than equivalent to pF 4.2 is called free water. Non-free water content of Kanto Loam changes irreversibly by air drying. Those characteristics depend on the clay mineral component in soil——main clay mineral is allophane——

On the other hand, the volume of larger size pore is also large, therefore, the permeability is high (about 10^{-2}cm/sec). However, through drought season, much water being supplied from the subsurface layer to the surface layer because of large quantity of moisture with high pF. The structure of the subsoil is massive but has many large pores and swelled particles. The top soil has crumbed structure.

iv) Those characteristics lead to the followings: By air-drying of subsoil, maximum dry density on compaction test increases and liquid limit of the soil and plasticity index decreases considerably. Those phenomena necessitate specific engineering method, for example, soil compaction works, banking, cutting works etc.

4) As mentioned above, a genetically classified soils have their own characteristic prop-

erties and problems. Those typical soils are peat soil, muck soil, gley clayey soil, volcanic ash soil, organic soil and so on.

5) Unsolved problems are as follows :

i) What are the optimum features arable fields (their physical, chemical, biological condition etc.) ?

ii) How are their objective indexes and their values ?

iii) Scale and time interval of research on Pedological Engineering and Engineering Pediology.

iv) Those problems must be solved on the viewpoint of properties and behavior of soil in soil layers and genetic reaction.

The Movement of Drainage Front and the Drainage Equation in a Single Layer for Glass Beads and Sand
——Study on the Drainage from Initially Saturated Porous Materials (I)——

Yukio TOYOMITSU and Atsushi TADA

Transactions of the Japanese Society of Irrigation, Drainage and Reclamation Engineering, **115**, pp. 17～24 (1985)

The vertical drainage from initially saturated porous materials is divided into two types of flow. The one is a saturated flow under the drainage front (the boundary between the saturated and unsaturated zone), and the other is an unsaturated flow above the drainage front.

In this paper, we researched the saturated flow in the vertical drainage from initially saturated porous materials. Before starting this research, we defined drainage front. Under this definition we have applied Darcy style equation on the drainage. The pressure of the water head on the drainage front were a negative value and we called this "drainage capillary force (h_{dc})".

The results were summarized as follows:

1. When negative h_o is equal to or smaller than the capillary fringe (h_c), then h_{dc} is constant. Therefore, negative h_{dc} is nearly equal to both capillary fringe and air entry value. Where h_o is the pressure of the water head on the bottom of the column.

2. When negative h_o is larger than h_c, then h_{dc} is not constant and this can be described by the follwing equation.

$$h_{dc}=\alpha Y+\beta$$

where α and β are constants: Y is the length from the bottom of the column to the drainage front. Experimentally, when L is a length of the colunm, α is nearly equal to the equation—$(h_c+h_o)/L$ and β is nearly equal to h_o.

3. The coefficient of water conductivity in the drainage (K_d) is equal to that in percolation and K_d is also constant in drainage.

4. The specific yield (f) is constant.

5. The drainage equation in which Darcy concept was applied, was in a good agreement with the experimental results.

The Relations between Difference of Soil Texture and Characteristics of Salt Concentration

Yukuo ABE

Transactions of the Japanese Society of Irrigation, Drainage and Reclamation Engineering, **94**, pp. 32~40 (1981)

In order to investigate characteristics of salt concentration due to difference of soil texture, four kinds of specimen were prepared cylindrically with respect to the mixing ratio of Kibushi Clay and Toyoura Standard Sand. These specimens were saturated with NaCl solution and placed in a constant temperature and humidity chamber to concentrate salt. At each step of the drying stages, the specimen was divided into four parts of the sample at 50mm height from the upper surface. Then, the soil solution contained in the divided sample was seperated by a centrifugal dehydrator at the primary wilting point of pF 3.8. Characteristics of salt concentration were determined in relationship to concentrations and weights of NaCl in both the extracted solution and soil suspension.

The following results were obtained from the study;

1) Concentration of extracted solution was increased in the frist upper layer and difference of increasing ratio of concentration was not recognized in all soil texture conditions. Increased clay contents, decreased the maximum concentration of the extracted solution. Therefore, probability of damage to crops is estimated to be decreased. On the other hand, changes of concentration of extracted solution could not be recognized in the lower layers from the second layer.

2) Concentration of soil suspension was increased in the first upper layer and there was no evidence of these tendencies in the lower layers except homogeneous soil texture with Toyoura Standard Sand. Increasing pattern of concentration of soil suspension in the first upper layer was similar in all soil conditions. But, since the concentration of the soil suspension was increased with increasing clay content, its tendency will be important in desalinization.

3) Weight of NaCl contained in extracted solution in the first upper layer resulted to increase with the increase of water evaporation ratio. And after reaching the maximum value, it showed to decrease gradually. However they decreased gradually in the lower layers. Weight of NaCl contatined in soil suspension showed the exponential increase in the first upper layer and almostly constant in the lower layers. Depending on these results, characteristics of NaCl-transportation were recognized.

Salt Accumulation Patterns in the Drying Process of Soil Specimens Saturated with NaCl Solution

Yukuo ABE

Transactions of the Japanese Society of Irrigation, Drainage and Reclamation Engineering, **106**, pp. 61～71 (1983)

The study was performed, in the second stage of the series, to determine the salt accumulation patterns in the drying process of soil specimens saturated with NaCl solution.

The soils were Toyoura Standard Sand and Sands mixed with Kibushi Clay at 10, 20, 30% weight ratios.

Concentrations of NaCl solution were employed at 0.05, 0.1 and 0.5%. Two hundreds cubic centimeters of soil were placed in a glass-column 5 cm in inner diameter, so that the depth of the specimen was 10cm. The specimens were saturated with NaCl solution and placed in the closed chamber at 40°C and 50% relative humidity. At each step of the drying process, the upper part of the specimen by 2.5cm deph from the surface was divided into five layers. On the other hand, the lower part of the specimen was divided into six layers of each 1.25cm thickness. Thirty mill-litters of H_2O were added to the upper layer's soil, and 75ml to the lower layers soil to obtain a soil suspension. The electric conductivity of each soil suspension was measured and expressed in terms of NaCl concentration.

The following results were obtained.

1) Following preparation of the soil suspension, measurement error was found to arise from difficulties in dividing into soil layers of equal thickness. A certain correction method was used to deal with this problem. Measurement error increased with dilution of the soil suspension concentration.

2) The depth of the accumulated layers was each 5.0cm in the case of Standard Sand saturated with 0.1% NaCl solution, and 6.25cm with 0.5% solution. With an increase in clay content, the depth of the accumulated layers decreased, i. e., 2.5cm at a 10% clay content, 2.0cm at 20% and 1.5cm at 30%.

3) The concentration gradients of the accumulated layers showed a tendency to increase with drying, and at a fixed stage of the drying process for specimens containing a large content of clay.

4) In upper-most layer (1 st layer), the concentration of salt in soil suspension (C') increased in proportion to the increase in evaporation of water from the soil surface (E). From point A to B, the salt concentration of C' still continued to increase with the higher proportional constant and then took on a constant value after point B. The increasing vatio of proportional constant at point A took on a maximum value in the case of the Standard Sand, ane decreased with an increase in clay content.

5) The difference in C' between each of the layer deeper than the 2nd layer and the layer which could hardly observed the salt accumulation increased in the progress of the drying process. In the extent of E where points A and B could be seen, the difference in C' decreased but increased after point B. Since NaCl accumulated in the 1st layer dispersed in the bottom layers, the indirect salt accumulation was considered to be dominant in the

layers beneath the 2nd layer.

6) At point *A*, the water present in each accumulated layer was recorded as about pF 1.9. No difference in water retentivity with respect to the soil texture of the specimens and concentration of NaCl solution could be found.

Minimum Requirements of Land Consolidation for Comparatively Large-scale Farming System——Land consolidation in paddy field for enlargement of farming scale (I) ——

Taiichi SAKUMA

Transactions of the Japanese Society of Irrigation, Drainage and Reclamation Engineering, **77**, pp. 1～5 (1978)

In Japan the standard size of a plot is very small because of small-scale farming. The object of this paper was to investigate the minimum requirements for a comparatively large-scale farming system which has been growing in the past ten years. The investigation clarified the necessity to widen farm roads in order to enlarge the farming scale.

Possible Land Consolidation for Comparatively Large-scale Farming System and the Relation between Land Consolidation and the Organization for Cultivation——Land cosolidation in paddyfield for enlargement of farming scale (II) ——

Taiichi SAKUMA

Transactions of the Japanese Society of Irrigation, Drainage and Reclamation Engineering, **81**, pp. 61～68 (1979)

The scale on which farming is carried out influences the form in paddyfield. In Japan the form of paddyfields corresponds to a small farming scale. But recently, there are an increasing number of comparatively large-scale farming systems. In this paper it was found that for enlargement of the farming scale, the new form for paddyfields is possible according to the methods and organization for cultivation.

Land Use Strategy in Tropical River Basin from the Viewpoint of Soil Conservation——Watershed Management in Lampung Province, Indonesia ——

Masahiko TOMITA, Masaru TOYOTA, Hajime TAKENAKA, Mitsukata SUZUKI, K. E. S. MANIK and B. ROSADI

Japan. J. Trop. Agr., **27** (4), pp. 244～258 (1983)

Significant development of Lampung agriculture have been caused by the artificial improvements of regiomal ecosystems due to the recent large-scale hydrological construction. But the agriculture at the region is so stable and sometimes suffers drastic damage because these artificial improvements have not yet been accustomed to the nature and human life of the region.

So, after some consideration on regional agro-ecosystem and present condition of watershed, a simulation model for watershed management was developed and adapted to the Seputih reive basin.

It is resulted that in order to maintain the stability of regional agriculture and hydro-facilities some improvement should be made as writen in Section 5.

The rivers flowing through lampung carry many suspended soil particles which eventually enter canals as sediment and close water passages. Rainfall is the first agent to produce soil erosion which makes river water turbid. Therefore, appropriate management of watershed is essential for the conservation or the improvement of regional agro-ecosystem.

Comparative Study on Water Management at the Farm Level in Paddy Fields

Mitsukata SUZUKI

Irrigation Engineering and Rural planning, **6**, pp. 4～19 (1984)

Water management at the farm level depends upon the maintenance of the equilibrium between water demand and supply. This paper deals with the management of supply of water and water depth at the farm level on a daily basis during the cropping season, in comparing results of studies carried out in Japan and Indonesia. Also, this report attempts to clarify the concept of evaluation of effective precipitation and stresses the importance of "lot-management water" in the cropping stages.

Theoretical Study of Block Type Classification in the Critical Block Method

Masayoshi SATOH and Masami OKAMOTO

Transactions of the Japanese Society of Irrigation, Drainage and Reclamation Engineering, **118**, pp. 17～22 (1985)

The Critical Block Method developed by Okamoto gives a convenient way of estimating design data for net diversion requirements in large scale paddy irrigation prejects where drained water is reused downstream. The classification of block types has been performed intuitively.

The authors present here a new systematic method for block type classification including some theoretical consideration of the characteristics of each block type.

1. "The C point" is defined as the point where the accumulated value of outflow (+) from a canal and inflow (−) into a canal is at a maximum.

2. A canal network can normally be divided into two parts. The first part ($\bar{U}$ section) consists of the places from where the diversion point can be reached or the places that can be reached from the diversion point without passing any C point. The second part ($\bar{D}$ section) consists of the places from where the main drain can be reached or the places that can be reached from the main drain whithout passing any C point.

3. An outflow from the $\bar{U}$ section increases the diversion requirement Q, and an inflow into the $\bar{U}$ section decreases Q depending on the outflow or inflow values. By contrast, an outflow and an inflow in the $\bar{D}$ section have no influence on Q.

4. Four block types are suggested in relation to their contribution to Q, by the combination of sections ($\bar{U}$ and $\bar{D}$) in which the intake and discharge points occur along the canal.

Analysis of Operation Rules and Procedures for Flood Control at Multipurpose Reservoirs in Japan —Releases in advance of flood at multipurpose reservoirs (I) —

Masayoshi SATOH

Transactions of the Japanese Society of Irrigation, Drainage and Reclamation Engineering, **76**, pp. 45～53 (1978)

Many unsuccessful flood control operation rules and procedures at multipurpose reservoirs in Japan were analyzed, and some dominant factors which affect flood control at those reservoirs were clarified. Once the discharge in excess of planned maximum outflow is forced to be released owing to the insufficiency of emptied capacity, then the author defines this case as "the failure of flood control".

20 unsuccessful flood control operation procedures were investigated by the author especially in view of the scale of flood and the actual operation procedures for release, then analyzed as follows.

1) In 11 cases the scale of flood was larger than planned one. In other 9 cases, only the defects of operation procedures caused the failures of flood control.

2) These defects of operation procedures at reservoirs are: one is that sufficient emptied capacity was not able to be secured in advace, and the other is the decrease of emptied capacity by storing flood harmless to lower reaches at the beginning of flood.

3) Thses defects, being the same in essence, result from the operation procedures which put importance on water supply sectors rather than the flood control sector. In Japan, release in advance of flood depend on the prediction of rainfall becase of the narrow basins of reservoirs. However, under the existing conditions of the unprecise prediction, it is difficult to satisfy the interests of these two kinds of sectors with the release in advance of flood.

4) This kind of difficulty should be taken into consideration for the establishment of flood control operation plans.

An Experimental Study on the Resistance Law of Rain Water Flow over a Slope Surface

Hironobu SUGIYAMA

Trans. JSIDRE., pp. 16～23 (1980)

An experimental study was made of the flow regimes of shallow water over the slope of a smooth surface, an uneven surface, an artificial turf and a gravel layer under a constant rate of rainfall or inflow. The results are summarized as follows:

1) The flow along a partial water path on a smooth surface is a laminar flow. However, if the water depth of the flow is evaluted by the equivalent depth all over the slope, the flow is regarded as a turbulent flow.

2) The flow over an uneven surface is also a laminar flow. But this flow may be regarded as a turbulent flow for the effective depth which is evaluated by subtraction of depression and/or wedge storage from the actual depth.

3) The high flow over a turf surface is a laminar flow, but the Darcy law is applicable to a low flow lower than the height of the turf and the Manning law to the exceeded flow over the top of the turf.

4) The flow in a gravel layer is also regarded as a Darcy flow.

5) The effect of depression and/or wedge storage must be taken in consideration for the analysis of runoff from a slope surface, except the case of a smooth surface.

Flow-State Parameters of Rainwater Flow over Natural Slope Surfaces

Hironobu SUGIUAMA and Mutsumi KADOYA

Trans. JSIDRE., (1984)

The equation, $h=kq^p$, is generally used in the kinematic runoff model to express the relation between depth, h, and dischare, q, of a two-dimensional overland flow. In this equation, exponent p is believed to be governed by a state of flow such as $p=1/3$ for laminar flow and $p=3/5$ for turbulent flow.

This paper points out that the two-dimensional overland flow is a hypothetical flow trasformed by the modeling of a slope in which rainwater flows along rills, and that the value of p is then changed inevitably beyond recognition.

First, the sectional characteristics of a rill are investigated in detail in a field plot over a natural slope. Next, how the depth-discharge relation changes is examined by transforming a shallow flow of laminar or turbulent state along a rill over a slope surface into the imaginal sheet plane flow over the full-width of the rill or the whole-width of the slope surface under a given rate of rainfall.

As a result, it was disclosed that the value of p changes outwardly to 0.40～0.53 for a laminar flow and to 0.67～0.75 for a turbulent flow, and that we may assume $p=0.5$～$0.7 \fallingdotseq 0.6$ from a practical engineering view point.

Study on the Shapes of Trees by Simulation Model

Akiyo SATSUKAWA and Hideshige TAKAHARA

Zōen-Zassi, **47** (5), (1984)

The aim of this sutudy is to discover a method of forecasting the shape trees will kake in ten or twenty years if they are left to grow up without artificial intervention. Eleven factors for determining the shapes of trees were selected and a tree-shape simulation model was created with the above-mentioned factors as its Parameters. Each factor was measured for each kind of tree, and the value obtained was input the computer. Then the image appearing on the graphic display was examined to see whether it resembled a real tree in shape. The above-mentioned eleven factors involved in the determination of the shapes of the trees are as follows.

(1) Height of trees
(2) Width of branches
(3) The number of points from which branches spread
(4) The number of branches originating
(5) The number of branches from same point
(6) Angle between trunk and branches
(7) Directions in which branches spread
(8) Curve of branches
(9) Distance between the ground and the lowest branches/Height of trees
(10) Distance between the each branch/Distance between the lowest branches and the ground
(11) Width of each branch/Width of the longest branch

We could not spend much time on this study. Therefore, we could not measure changes in the factors due to the passage of time, and consequently, changes in tree shape resulting from the passage of time was not measured. However, we consider that a basic method for forcasting changes resulting from the passage of time has been established.

Calculation on the Effectiveness of Green Belts against Radiant Heat

Hidesige TAKAHARA

Clty Planning Review, **119**, pp. 63～68 (1981)

Generated from petrochemical complex fire is related principally to the geometrical factor given by formula (1).

$$E = \varphi R_f \qquad (1)$$

E: Irradiance intensity
φ: Geometrical factor
R_f: Radiant emittance

To determine the geometrical factor (φ), Mc Guire formula is adapted. By studying the behavior of the geometricl factor, a formula is obtained for culculating the effectiveness of

spatial distance of the green belt, and also the effectiveness of shade is obtained.

Formula to determine the geometrical factor

$$\varphi=\frac{\cos\theta}{\pi}\left(\frac{1}{n}\tan^{-1}\frac{m}{\sqrt{n^2-1}}+\frac{mn}{\sqrt{(n^2-1)^2+m^2n^2}}\right.$$
$$\left.\tan^{-1}\frac{\sqrt{n^2-1}}{\sqrt{(n^2-1)^2+m^2n^2}}\right) \qquad (2)$$

m=H/R, n=L/R

H: height of cylinder (height of fire)

R: radius of cylinder (radius of fire)

(experimentally determind by H/R= 3)

L: distance from the cylinder axis to the heated surface

This geometrical factor formura is a function of m and n, that is, fire height H and the distnace to the heated surface L.

The question in whether the fire height H/R is always 3 or not, when the fire scale is enlarge. However, no inconsistencies were noted in the case a petrol tank fire during the Nigata eathquake, nor during experiments conducted in Wakayama, etc. .

Studies on Water Quality and Landslide in the Fractured Zone

Takaaki AMADA and Koichi KONDO

Shin-Sabō, **34** (4), pp. 12～19 (1982)

It is well-known that there is close relation between the chemical compositions of waters and weathering of rocks as one of indices to predict the landslide. The purpose of the study was to examine the relationship between landslide and weathering condition in stream basins regarding water quality. Water samples of ordinary water and flood waters have been collected twice from the 27 valleys in the Yoshino river basin, fractured zone, Shikoku. The authors have examined the relationships among the chemical species contents of waters.

In this report, qualitative properties of water in the fractured zone was clarified. Cations bicarbonate ions which had relations closely with the weathering were also explained. Finally the relation between the types of landslide and water quality was discussed.

Prediction of Sediment Discharge for Rivers with High Storage Effects in Mountainous Regions

Takaaki AMADA

Proceedings of the International Symposium on Erosion, Debris Flow and Disaster Prevention, 1985, Tsukuba, Japan, pp. 121～126 (1985)

This paper examines sediment runoff during torrential rains by describing the storage

effects of torrents and river channels in mountainous regions. The effects of topographical features and river structures such as sabo dams and weirs, upon sediment storage, is examined for two floods. The daily mean discharge, daily precipitation and the annual volume of sediment deposited at Amehata Dam is used to determine coefficients of the model equation and the lower limits of the dominant discharge and precipitation through simulation. The regression equation for estimating the volume of sediment deposited, was then derived. In addition, the relationship between the annual maximum discharge and the amount of sediment deposited, and correlation coefficients for volume of sediment deposited, sum of daily precipitation, and daily mean discharge up to the n-th level higher in each year were examined. It was concluded that the volume of sediment deposited is largely determined by large floods occurring within the relevant period.

The H-type (WY-type) Cable Crane System (I) Fundamental Solution and Computation Methods of Design Factors Giving Allowable Tension to the Track Cable

Masayuki, SUZUKI

J. Jap. For. Soc., **67** (2), pp. 39～50 (1985)

The H-type cable crane consists of a skidding cable on which a carriage runs, and guide cables connected with both ends of the skidding cable having V-shaped plane figures. The guide cables, in fixed length, change the direction of the skidding cable to the location of feiled timbers, and then the tension of the skidding cable will be adjusted by changing its length. This study, in its first part, develops a practical computation method which is based on the theory of a parabolic cable applied to a "semi-equivalent cable." The fundamental properties of the crane were clarified by an inverstigation of the results of calculations. The second part of the study focuses on the problem of an actual H-type cable crane system in which the skidding cable consists of a track cable and an endless operating line handling a hoisting carriage. Both a method of precise computation and a practical method for numerical values of the design factors are derived for the following two cases: a. where maximum tension of the track cable suspending the fixed load is equal to the allowable tension, and b. where maximum tension of the track cable with the fixed loaded deflection is equal to the allowable tension. The results of calculations showed that these methods are of use for investigating the problems of planning a cable.

Reduction of Energy Use in Forestry Operations

Masayuki SUZUKI

Reports of Special Project Research on Energy Under Grant in Aid of Scientific Research of the Ministry of Education Science and Culture, **11**, pp. 125～128 (1983)

Energy requirements for two major parts of forestry activeites, namely, logging operations as well as planting and tending operations are investigated. For the logging operations, data on the tools and fuel required by the machines used in the national forests are presented. From the analysis of the data it is estimatd that the energy requirements for logging are fairly large. For the planting and tending operations, however, in spite of the extent of the area involved a comparatively small quantity of energy input except for the portable machines is required. Generally, energy requirements for forestry operations are considerably lower compared with those for other industries. In the distribution of energy requirements, however, there is a marked difference between those for the logging opertions and those for the planting and tending operations and effective measures can be taken to decrease the amount of energy used in many respects.

The Movement and Deposition of Debris and the Vegetational Invasion on the Landslide Scars in the Upper Basin of the Oi River

Hideji MAITA

Shin-Sabō, **38** (4), pp. 16～24 (1985)

This report deals with the accumulative mechanism of the unstable debris and the vegetational invasion on the landslide scars in the upper basin of the Oi River.

The main results are as follows:

1) It is pointed out that rock fall, debris fall, dry fragments flow, debris avalanche and debris flow are main processes of the movement and deposition of rock fragments on the scars. The unstable debris on the scars are accumulated by these processes. Judging from the characteristics of each process, it is concluded that rock fall is the most important process.

2) Four vegetation types are recogniged on the scars, these are Fujiazami (*Cirsium purpuratum*) type, Kusakoakaso (*Boehmeria tricuspis var. unicuspis*) type, Susuki (*Miscanthus sinensis*) type and Woody plant type.

3) The relation shown in Fig. 9. between the movement and deposition of rock fargments and the vegetational invasion is obtained. It is clear form Fig. 9. that rock fall plays an important role for the vegetational invasion, and debris avalanche or debris flow plays an important role for the destruction of vegetation.