



ISSN (E): 2277-7695  
ISSN (P): 2349-8242  
NAAS Rating: 5.23  
TPI 2022; SP-11(5): 1857-1862  
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[www.thepharmajournal.com](http://www.thepharmajournal.com)  
Received: 14-03-2022  
Accepted: 18-04-2022

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## ICT system (C program) to computation of soil water relationships

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### Abstract

The use of technology and ICT tools are plays very important role in agriculture development, education and rural development. Thus it is possible to stay everything in-tuned with computers. In our country, largely within the town area unites varied on-line systems are getting used for varied functions i.e. everything is computerized to save lots of area unit time & efforts. Still In most laptop establishments they're not victimization the digital tool for reposting of knowledge. Hence, all the work associated with it's done manually i.e. through work or documentation. In the Agriculture field it is important to research in it and make easy and very fast calculations and for agricultural formulae etc. Information communication technology is highly increasable field to research in. due to use of ICT in agriculture, the farms are being developed and digitalization is takes placed. The paper deals with how we can make digitalize and make soil water relationship formulas easily with the help of computer programming language.

**Keywords:** Technology, ICT, agricultural, digitalization

### 1. Introduction

Soil is valuable resource that supports plant life, and water is an essential component of this system. The soil is composed of three major parts air, water and solids. The solid component forms the framework of the soil and consists of mineral and organic matter. The mineral fraction is made up of sand, silt and clay particles. All the physiological processes of plant are directly or indirectly influenced by water status of the plant. Water is reactant in many plant processes i.e. photosynthesis and hydraulic reactions.

There are generally three types of soil water such that gravity water, capillary water and hygroscopic water. The mineral and organic compounds of soil from a solid matrix, the interstices of which consist of irregularly shaped pores with a geometry defined by boundaries of matrix. The pore space is generally is filled partly with soil air and liquid vapour and partly with the liquid phase of soil water. Soil moisture, bulk density, water depth, saturation, voids ratio are important properties of soil.

Attempt has been made to simplify the calculation using C language with the project entitled, Calculation of soil water relationship using C language with the focus on following objectives:

1. To get acquainted with the software turbo C++, Version 3.0
2. To simplify the calculations to determine soil water relationship using C language.
3. To reduce the time required for determining soil water relationship.

### 2. Existing System

#### 2.1 Limitations in Present System

1. There are certain limitations in system, which areas follow.
2. There are various steps or formulae involved in Soil Mechanics, so it is difficult to handle manually.
3. Manually calculations are difficult to estimating various relationships with different values and also more time required.
4. For recording purpose it should be note down in some paper, thus chances of losing the data is increases.
5. Manually calculations include more errors with less accuracy.

#### 2.2 Proposed system

The proposed system is deals with calculations of soil water relationship formulas. To remove the complexities, errors and difficulties the proposed system is developed.

These difficulties can take place at the time of managing the jobs at institution. Today the digitalization is directly comes with computerization, so the students, researchers are coming under the one roof to learn about digitalization and computerization. Calculate the drop spillways formulas manually on the paper are very complex method to find the accurate value of the specific component. Since these works does manually thus it takes more time and there are chances of errors such as wrong details, wrong value at wrong place etc. So to reduce these faults “computer programming language” has been developed. The proposed system “ICT Application to computation of soil water relationships” deals with all the activities which are done by the agriculturist for measure the soil properties. This paper is all about how can information communication technology reduce the manual work load and give the accurate results of the proper formulas. The data will store sequentially in the database and we can access it whenever we need it.

### 2.3 Advantages of Proposed System

1. Calculations are done very fast and it saves the time.
2. It stores the old data, so data recovery is possible easily.
3. No need to data note down on the paper because it stores digitally in computer.
4. Modified the data as per requirement.
5. System includes the various security features.
6. System should be window based, user-friendly and efficient.

### 3. Material

1. Operating system- Microsoft Windows, Linux(alpha only)
2. License- GPL-2.0
3. Type-Integrated development environment
4. Written in - Delphi
5. Stable release- 6.3 January 30, 2021
6. Pen and Touch: No pen or Touch Input is available for this display
7. Bloodshed Software until 2005, orwell from 2011 to 2020, Embarcadero

### 4. System Requirement

#### 4.1 About the platform

1. Turbo C
2. Version 6.3

### 5. To determine soil water relationship following formulae calculated

#### 5.1 Voids ratio

The voids ratio of a mixture is the ratio of the volume of voids to volume of solids. It is a dimensionless quantity in materials science, and closely related to porosity. If the void ratio is high voids in a soil skeleton tend to minimize under loading-adjacent particles contract. The opposite situation i.e. when voids ratio is relatively small indicates that the volume of the soil is vulnerable to increase under loading-particles dilate as follows:

$$e = \frac{V_v}{V_s}$$

Where,

e is voids ratio

V<sub>v</sub> is volume of voids space

V<sub>s</sub> is the volume of solids

#### 5.2 Porosity

It is defined as the proportion of the volume of voids (air and water) in comparison with the total volume of soil. It is normally ranges from 0.2 to 0.6. one of the main reasons for measuring soil bulk density is that this value can be used to calculate soil porosity for the same particle density, lower the bulk density, the higher the porosity.

$$n = \frac{V_v}{V}$$

Where,

n is porosity

V<sub>v</sub> is the volume of voids space

V is the volume of soil

#### 5.3 Volumetric moisture content

It is defined as the ratio of volume of water to the volume of soil. It can be expressed as ratio, percentage or depth of water per depth of soil, such as inches of water per foot of soil.

$$W = \frac{V_w}{V}$$

Where,

W is the volumetric moisture content

V<sub>w</sub> is the volume of water

V is the volume of soil

#### 5.4 Saturation

It is defined as the ratio of volume of water to the volume of voids (or pore spaces). For a fully saturated soil sample soil sample volume of air is equal to zero.

$$S = \frac{V_w}{V_v}$$

Where,

S is the saturation

V<sub>w</sub> is the volume of water

V<sub>v</sub> is the volume of voids

#### 5.5 Dry weight moisture fraction

It is defined as the ratio of weight of water in a wet soil sample to the dry weight of sample, the Dry weight moisture fraction W is expressed as

$$W = \frac{W_w}{W_s}$$

Where,

W is the Dry weight moisture fraction

W<sub>w</sub> is the weight of water in a wet soil sample

W<sub>s</sub> is the dry weight of the sample

#### 5.6 Bulk density

It is defined as the ratio of mass of dry soil to the volume of soil sample. The typical value of Bulk 1.1 – 1.6 g/cm<sup>3</sup> density, it is also expressed as,

$$\rho_b = \frac{W_t}{V}$$

Where.

$\rho_b$  is the bulk density

$W_T$  is the total weight of the soil

V is the unit bulk volume

### 5.7 Particle density

It is defined as the ratio of mass of dry soil to the volume of solids. The typical value of particle density is 2.6-2.7g/cm<sup>3</sup>. It is also expressed by,

$$\rho_p = \frac{M_s}{V_s}$$

Where,

$\rho_p$  is the particle density

$M_s$  is the mass of dry soil

$V_s$  is the volume of solids

### 6. Source code for calculation of soil water relationships by using c language

```
#include<iostream>
#include<math.h>
#include<conio.h>
using namespace std;
int main()
{int choice;float a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,div;
charfav;cout<<"\t\t*****Department of Irrigation and
Drainage Engineering*****\n\n\t\t";
cout<<"\t\t*Soil Water Relationship*\n\n";
do
{cout<<"\n Press 1 to calculate Void Ratio ";
cout<<"\n Press 2 to calculate Porosity ";
cout<<"\n Press 3 to calculate area of Volumetric moisture
content ";
cout<<"\n Press 4 to calculate Saturation";
cout<<"\n Press 5 to calculate Dry Weight moisture fraction";
cout<<"\n Press 6 to calculate Bulk Density";
cout<<"\n Press 7 to calculate Particle density";
cout<<"\n Press 8 to **Exit** ";
cout<<"\n Enter your choice:";
cin>>choice;
switch(choice)
{case 1:
{cout<<"\n C program for Void Ratio";
cout<<"\n\nEnter Value of Vv: ";
cin>>a;
cout<<"\n\nEnter Value of Vs: ";
cin>>b;
div=a/b;
cout<<"\n\nValue of e = "<<div;
break;}
case 2:
{cout<<"\n C program for Porosity";
cout<<"\n\nEnter Value of Vv: ";
cin>>c;
cout<<"\n\nEnter Value of V: ";
cin>>d;
div=c/d;
cout<<"\n\nValue of n = "<<div;
break;}
case 3:
{cout<<"\n C program for Volumetric moisture content";
cout<<"\n\nEnter Value of Vm: ";
cin>>e;
```

```
cout<<"\n\nEnter Value of V: ";
cin>>f;
div=e/f;
cout<<"\n\nValue of w = "<<div;
break;}
case 4:
{cout<<"\n C program for Saturation";
cout<<"\n\nEnter Value of Vw: ";
cin>>g;
cout<<"\n\nEnter Value of Vv: ";
cin>>h;
div=g/h;
cout<<"\n\nValue of s = "<<div;
break;}
case 5:
{cout<<"\n C program for Dry Weight moisture fraction";
cout<<"\n\nEnter Value of Ww: ";
cin>>i;
cout<<"\n\nEnter Value of Ws: ";
cin>>j;
div=i/j;
cout<<"\n\nValue of W = "<<div;
break;}
case 6:
{cout<<"\n C program for Bulk Density";
cout<<"\n\nEnter Value of Ms: ";
cin>>k;
cout<<"\n\nEnter Value of Vb: ";
cin>>l;
div=k/l;
cout<<"\n\nValue of Row = "<<div;
break;}
case 7:
{cout<<"\n C program for Dry Particle density";
cout<<"\n\nEnter Value of Ms: ";
cin>>m;
cout<<"\n\nEnter Value of Vs: ";
cin>>n;
div=m/n;
cout<<"\n\nValue of Row = "<<div;
break;}
case 8:
{return 0;
default:
{cout<<"\n wrong choice";}}
cout<<"\n Do you want to continue?(y/n)\n";
cin>>fav;}}
while(fav=='y');
return 0;}
```

### 7. Results

1. Enter the option from 1 to 7 serially.
2. Give the input values.
3. After pressing enter key, output will be displayed.
4. Again press the enter key to switch over to the main page.
5. Follow the same procedure to design the different parameters.

```

*****Department of Irrigation and Drainage Engineering*****
*Soil Water Relationship*
Press 1 to calculate Void Ratio
Press 2 to calculate Porosity
Press 3 to calculate area of Volumetric moisture content
Press 4 to calculate Saturation
Press 5 to calculate Dry Weight moisture fraction
Press 6 to calculate Bulk Density
Press 7 to calculate Particle density
Press 8 to **Exit**
Enter your choice:
    
```

Fig 1: Output of main page

```

*Soil Water Relationship*
s 1 to calculate Void Ratio
s 2 to calculate Porosity
s 3 to calculate area of Volumetric moisture content
s 4 to calculate Saturation
s 5 to calculate Dry Weight moisture fraction
s 6 to calculate Bulk Density
s 7 to calculate Particle density
s 8 to **Exit**
r your choice:1
Program for Void Ratio
Value of Vv : 895
Value of Vs : 56
of e = 15.982142
Do you want to continue?(y/n)
    
```

Fig 2: Output to Voids ratio

```

Press 1 to calculate Void Ratio
Press 2 to calculate Porosity
Press 3 to calculate area of Volumetric moisture content
Press 4 to calculate Saturation
Press 5 to calculate Dry Weight moisture fraction
Press 6 to calculate Bulk Density
Press 7 to calculate Particle density
Press 8 to **Exit**
Enter your choice:2
C program for Porosity
Enter Value of Vv : 56
Enter Value of V : 23
Value of n = 2.434783
Do you want to continue?(y/n)
    
```

Fig 3: Output to Porosity

```

Press 1 to calculate Void Ratio
Press 2 to calculate Porosity
Press 3 to calculate area of Volumetric moisture content
Press 4 to calculate Saturation
Press 5 to calculate Dry Weight moisture fraction
Press 6 to calculate Bulk Density
Press 7 to calculate Particle density
Press 8 to **Exit**
Enter your choice:3
C program for Volumetric moisture content
Enter Value of Vm : 56
Enter Value of V : 12
Value of w = 4.666667
Do you want to continue?(y/n)
    
```

Fig 4: Output to Volumetric moisture content

```

Press 1 to calculate Void Ratio
Press 2 to calculate Porosity
Press 3 to calculate area of Volumetric moisture content
Press 4 to calculate Saturation
Press 5 to calculate Dry Weight moisture fraction
Press 6 to calculate Bulk Density
Press 7 to calculate Particle density
Press 8 to **Exit**
Enter your choice:4

C program for Saturation
Enter Value of Vv : 654
Enter Value of Vv : 32
Value of s = 20.437500
Do you want to continue?(y/n)
y
    
```

**Fig 5:** Output to saturation

```

y
Press 1 to calculate Void Ratio
Press 2 to calculate Porosity
Press 3 to calculate area of Volumetric moisture content
Press 4 to calculate Saturation
Press 5 to calculate Dry Weight moisture fraction
Press 6 to calculate Bulk Density
Press 7 to calculate Particle density
Press 8 to **Exit**
Enter your choice:5

C program for Dry Weight moisture fraction
Enter Value of Mw : 632
Enter Value of Ms : 32
Value of W = 19.750000
Do you want to continue?(y/n)
y
    
```

**Fig 6:** Output to Dry weight moisture fraction

```

Press 1 to calculate Void Ratio
Press 2 to calculate Porosity
Press 3 to calculate area of Volumetric moisture content
Press 4 to calculate Saturation
Press 5 to calculate Dry Weight moisture fraction
Press 6 to calculate Bulk Density
Press 7 to calculate Particle density
Press 8 to **Exit**
Enter your choice:6

C program for Bulk Density
Enter Value of Ms : 324
Enter Value of Vb : 2653
Value of Row = 0.122126
Do you want to continue?(y/n)
y
    
```

**Fig 7:** Output to Bulk Density

```

Press 1 to calculate Void Ratio
Press 2 to calculate Porosity
Press 3 to calculate area of Volumetric moisture content
Press 4 to calculate Saturation
Press 5 to calculate Dry Weight moisture fraction
Press 6 to calculate Bulk Density
Press 7 to calculate Particle density
Press 8 to **Exit**
Enter your choice:7

C program for Dry Particle density
Enter Value of Ms : 452
Enter Value of Vs : 32
Value of Row = 14.125000
Do you want to continue?(y/n)
y
    
```

**Fig 8:** Output to Dry Particle Density

**8. Conclusion**

This study deals with the calculation of soil water relation properties by using programming language. Calculation of formulas manually on the paper is time consuming method to find accurate value of specific parameter. By using c language

the calculation of different soil parameter are completed in very less time period. The complete design was done using c++ language with more accuracy. Turbo C++ Version 3.0 was used for this purpose.

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