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Application of C programming language to determine soil phase relationship

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Abstract

Soil mass is generally a three phase system. It consists of solid particles, liquid and gas. For all Practical purposes, the liquid may be considered to be water (although in some cases, the water may Contain some dissolved salts) and the gas as air. The phase system may be expressed in SI units either in terms of mass-volume or weight-volume relationships. The inter relationships of the Different phases are important since they help to define the condition or the physical make-up of the Soil. Thus, by using C languages, the calculations are completed in a very short span of Time as the formulae are pre-defined in the software. The complete design was done using C language in a very less time and with accuracy. Turbo C++, version 3.0 was used for this purpose. It contains the main page where, the formulae are given. By entering the values of each value, the calculation of formulae for Soil phase relationship. The results obtained were verified with the manual calculation and it was found that the results were accurate. Thus, this software programme is very efficient for calculating formula for Soil phase relationship.

Keywords: C language, technology, agriculture, computerized, soil phase relationship

Introduction

The word 'soil' has different meanings for different professions. To the agriculturist, soil is the top thin layer of earth within which organic forces are predominant and which is responsible for the support of plant life. To the geologist, soil is the material in the top thin zone within which roots occur. From the point of view of an engineer, soil includes all earth materials, organic and inorganic, occurring in the zone overlying the rock crust.

Soil mass is generally a three phase system. It consists of solid particles, liquid and gas. For all Practical purposes, the liquid may be considered to be water (although in some cases, the water may Contain some dissolved salts) and the gas as air. The phase system may be expressed in SI units either in terms of mass-volume or weight-volume relationships. The inter relationships of the Different phases are important since they help to define the condition or the physical make-up of the Soil.

Attempt has been made to simplify the calculation using C language with the project entitled, Application of C Programming Language to Determine Soil Phase Relationship.

Existing System

The Existing system is completely manual. The soil phase relationship calculation contains different formulas calculate the various values of soil. These formulas are very complex to calculate with the use of calculators. It is purely paper based to store the records of the onetime calculated values of those formulas. The calculations are done with calculator by entering the each value of formula manually in the calculator.

Limitations in Present System

There are certain limitations in system, which areas follow

1. There are various steps or formulae involved in determination of soil phase relationship, so it is difficult to handle manually.
2. Manually calculations are difficult to estimating various parameters in this soil phase relationship and also more time required.
3. For recording purpose it should be note down in some paper, thus chances of losing the data is increases.
4. It is difficult to search the old record of data.
5. Manually calculations include more errors with less accuracy.

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- To require the man power for calculation on the field and make it secure.

Proposed system

The proposed system is deals with the functionality of calculations of soil phase relationship. To remove the complexities, errors and difficulties the proposed system is developed. These difficulties can takes 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 soil phase relationship 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 “Application of C Programming Language to Determine Soil Phase Relationship” has been developed. The proposed system “Application of C Programming Language to Determine Soil Phase Relationship” deals with all the activities which are done by

the agriculturist for calculation of soil phase relationship. This paper is all about how can information communication technology reduce the manual work load and give the accurate results of the proper formulas.

Advantages of Proposed System

- Calculations are done very fast and it saves the time.
- No need to data note down on the paper because it stores digitally in computer.
- Modified the data as per requirement.
- System should be window based, user-friendly and efficient.
- Accuracy can be maintained.

Material

This chapter deals with the methodology used to calculate soil phase relationship using C language. It includes different formulae and theoretical considerations those are used for calculation. It also encapsulates the configuration of the system and information to design the system. Three phases of soil element are shown Fig. 1.

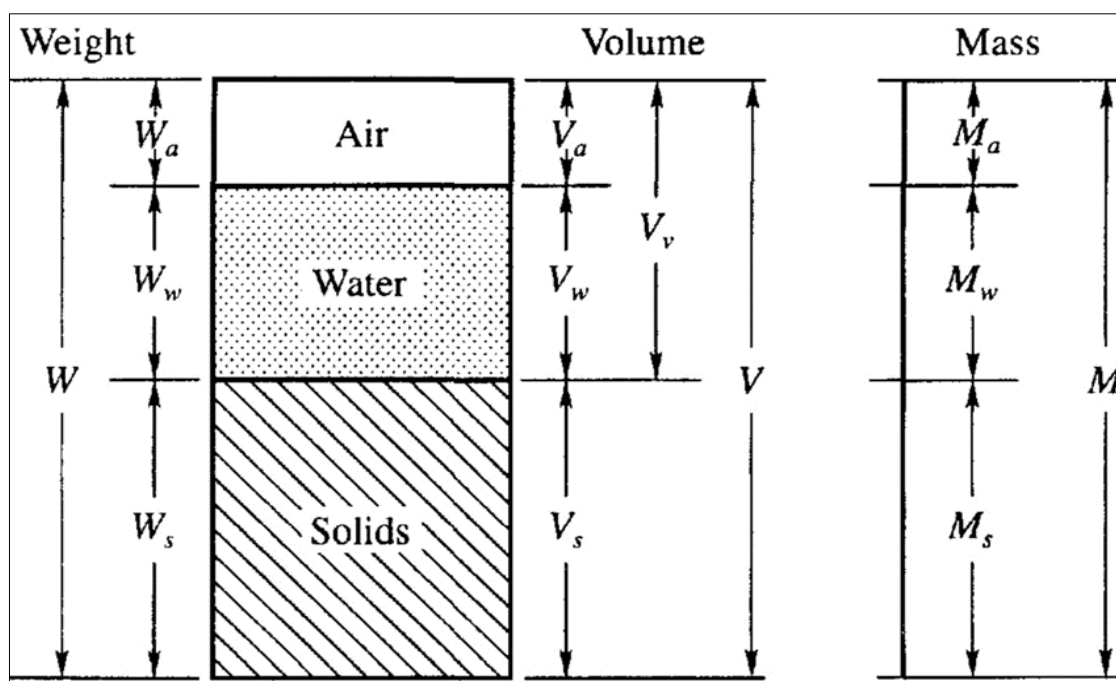


Fig 1: Block diagram- three phases of a soil element

System Requirements

- Windows 7 ultimate
- Installed memory (RAM): 4.00 GB (3.39 GB usable)
- System type: 32 – bit Operating System

About the platform

- Turbo C++ Version 3.0
- Copyright (c) 1990, 1992 by Borland International, Inc.

Calculation of soil phase relationship using different formulae

Mass-Volume Relationship

Volumetric Ratios

There are three volumetric ratios that are very useful in geotechnical engineering and these can be determined directly from the phase diagram, soil phase relationship, index properties and soil classification

1. The void ratio, e , is defined as

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

Where, V_v = volume of voids, V_s = volume of the solids. The void ratio e is always expressed as a decimal.

2. The porosity n is defined as

$$n = \frac{V_v}{V} \times 100\%$$

Where, V - total volume of the soil sample. The *porosity* n is always expressed as a percentage.

3. The degree of saturation S is defined as

$$S = \frac{V_w}{V_v} \times 100\%$$

Where, V_w = volume of water

It is always expressed as a percentage. When $s=0\%$, the soil is completely dry, when $s=100\%$, the soil is fully saturated.

4. Water content, w

The water content, w , of a soil mass is defined as the ratio of the mass of water, M_w , in the voids to the mass of solids, M_s , as

$$w = \frac{M_w}{M_s} \times 100$$

The water content, which is usually expressed as a percentage, can range from zero (dry soil) to several hundred percent. The natural water content for most soils is well under 100%, but for the soils of volcanic origin (for example bentonite) it can range up to 500% or more.

6. Density ρ

$$\rho = \frac{M_s}{V}$$

Where, M_s = mass of solid.

Weight-Volume Relationship

Unit weight or weight per unit volume is still the common measurement in geotechnical engineering practice. The density ρ , may be converted to unit weight, γ by using the relationship

$$\gamma = \rho g$$

The 'standard' value of g is 9.807 m/s^2 ($= 9.81 \text{ m/s}^2$ for all practical purposes).

1. Total unit weight for $S < 100$

$$\gamma_t = \frac{G_s \gamma_w (1 + w)}{1 + e}$$

Where, γ_w = unit weight of water, w = water content G_s = specific gravity of solid, e = void ratio.

2. Dry unit weight γ_d

$$\gamma_d = \frac{\gamma_w G_s}{1 + e}$$

G_s = specific gravity of solid, e = void ratio.

3. Saturated unit weight γ_{sat}

$$\gamma_{sat} = \frac{\gamma_w (G_s + e)}{1 + e}$$

Where, γ_{sat} = Saturated unit weight, γ_w = unit weight of water, G_s = specific gravity of solid, e = void ratio.

1. Source code for calculation of soil phase relationship

```
#include<iostream>
#include<conio.h>
#include<math.h>
using namespace std;

int main ()
{float s, Vw, Vv, sat, vol of Voids, vol of Solids, vol of
Voids,          vol          of          Soil,
porosity, WaterContent, WeightOfWetSample, WeightOfDrySa
mple, MassOfSolid, density, mass,
volume, satUnitWeight, UnitWeightOfWater, SpecificGravityO
fSolid, Voidratio, dryunitweight, Totalunitweight,
specific gravity of solid, unit weight of water, water content,
void ratio;
int x;
cout<<"\n\t\t*Department of Irrigation and Drainage
Engineering*\n\n\t\t";
cout<<"\t Soil Phase Relationships \n\n";
cout<<"1. Degree of saturation \n";
cout<<"2. Void Ratio \n";
cout<<"3. Porosity \n";
cout<<"4. Water Content \n";
cout<<"5. Density \n";
cout<<"6. Total unit weight \n";
cout<<"7. saturated unit weight \n";
cout<<"8. Dry unit weight \n";
cout<<"9.EXIT \n";
cout<<"Please enter a numeric value between 1 to 9 ";
cin>>x;
switch(x)
{case 1:{
cout<<"\n\t\t** Department of Irrigation and Drainage
Engineering ** \n\n\t\t";
cout<<"\n\n\t\t*** 1.Degree of saturation \n";
cout<<"enter value of Vw ";
cin>>Vw;
cout<<"enter value of Vv";
cin>>Vv;
s=Vw/Vv;
s=s*100;
cout<<"\n percentage of degree of saturation is="<<s;
break;}
case 2:
{cout<<"\n\t\t** Department of Irrigation and Drainage
Engineering ** \n\n\t\t";
cout<<"\n\n\t\t*** 2.Void Ratio \n";
cout<<"Enter values of volume of voids \n";
cin>>volOfVoids;
cout<<"\n Enter values of volume of solids \n";
cin>>volOfSolids;
sat = volOfVoids/volOfSolids;
cout<<"Void ratio is ="<<sat;
break;}
case 3:
{cout<<"\n\t\t** Department of Irrigation and Drainage
Engineering ** \n\n\t\t";
cout<<"\n\n\t\t*** 3. Porosity \n";
cout<<"Enter values of volume of voids \n";
cin>>volofVoids;
```

```

cout<<"\n Enter values of total volume of soil \n";
cin>>volofSoil;
porosity = volofVoids/volofSoil;
porosity=porosity*100;
cout<<"percentage of porosity is ="<<porosity;
break;}
case 4:
{cout<<"\n\t** Department of Irrigation and Drainage
Engineering ** \n\n\t";
cout<<"\n\n\t*** 4. Water Content \n";
cout<<"Enter value of Weight Of Wet Sample: \n \n";
cin>>WeightOfWetSample;
cout<<"Enter value of Weight Of Dry Sample: \n \n";
cin>>WeightOfDrySample;
WaterContent=Weight Of Wet Sample/Weight Of Dry
Sample;cout<<"\n Enter value of Mass Of Solid OR
Volume";cin>>MassOfSolid;
WaterContent=WaterContent/MassOfSolid;
WaterContent=WaterContent*100;
cout<<"Percentage of Water content in a given soil sample is
="<<WaterContent;
break;}
case 5:
{cout<<"\n\t** Department of Irrigation and Drainage
Engineering ** \n\n\t";
cout<<"\n\n\t*** 5. Density \n";
cout<<"enter value of mass";
cin>>mass;
cout<<"\n enter valu of volume";
cin>>volume;
density=mass/volume;
cout<<"\n density is = KG/m3"<<density;
break;}
case 6:
{cout<<"\n\t** Department of Irrigation and Drainage
Engineering ** \n\n\t";
cout<<"\n\n\t*** 6. total unit weight \n";
cout<<"\n Enter value of specific gravity of solid";
cin>>specificgravityofsolid;
cout<<"\n Enter value of unit weight of Water";
cin>>unitweightofwater;
cout<<"\n Enter value of Water content";
cin>>watercontent;
cout<<"\n Enter value of void ratio";
cin>>voidratio;
Totalunitweight=specificgravityofsolid*unitweightofwater;
Totalunitweight=Totalunitweight*++watercontent;
Totalunitweight=Totalunitweight/++voidratio;
cout<<"\n Total unit weight is=KN/m3"<<Totalunitweight;
break;}

```

```

case 7:
{cout<<"\n\t** Department of Irrigation and Drainage
Engineering ** \n\n\t";
cout<<"\n\n\t*** 7. saturated Unit Weight \n";
cout<<"\n enter value of Specific Gravity of solid";
cin>>SpecificGravityOfSolid;
cout<<"\n enter value of void ratio";
cin>>Voidratio;
satUnitWeight=SpecificGravityOfSolid + Voidratio;
cout<<"\n enter value of Unit weight of water";
cin>>UnitWeightOfWater;
satUnitWeight=UnitWeightOfWater*satUnitWeight;
satUnitWeight=satUnitWeight/++Voidratio;
cout<<"\n saturated Unit Weight of soil is
=lb/ft3"<<satUnitWeight;
break;}
case 8:
{cout<<"\n\t** Department of Irrigation and Drainage
Engineering ** \n\n\t";
cout<<"\n\n\t*** 8. Dry Unit Weight \n";
cout<<"\n Enter value of unit weight of water";
cin>>unitweightofwater;
cout<<"\n Enter value of specific gravity of solid";
cin>>specificgravityofsolid;
cout<<"\n Enter value of void ratio";
cin>>voidratio;
dry unit weight=unit weight of water*specific gravity of solid;
dryunitweight=dryunitweight/++voidratio;
cout<<"\n Dry unit weight is= KN/m3"<<dryunitweight;
break;
default:
cout<<"Sorry! Entered Invalid Choice.\nPlease select Valid
Choice.";
break;}}

```

Results and Discussion

This chapter deals with the results obtained by calculation of the Irrigation and Drainage formulae using C programming. The programme is prepared in the C++ language, Version 3.0 Turbo C++.

Steps to be followed

1. Enter the option from 1 to 9 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 Phase Relationships

1. Degree of saturation
2. Void Ratio
3. Porosity
4. Water Content
5. Density
6. Total unit weight
7. saturated unit weight
8. Dry unit weight
9.EXIT
Please enter a numeric value between 1 to 9

```

Fig 2: Output for main page


```

** Department of Irrigation and Drainage Engineering **

*** 1.Degree of saturation
enter valu of Vw 0.01643
enter value of Vv0.01942

percentage of degree of saturation is= 84.603500

...Program finished with exit code 0
Press ENTER to exit console.

```

Fig 3: Output for degree of saturation

```

** Department of Irrigation and Drainage Engineering **

*** 2.Void Ratio
Enter values of volume of voids
0.01942

Enter values of volume of solids
0.04058
Void ratio is = : 0.478561

...Program finished with exit code 0
Press ENTER to exit console.

```

Fig 4: Output for Void Ratio

```

** Department of Irrigation and Drainage Engineering **

*** 3. Porosity
Enter values of volume of voids
0.01942

Enter values of total volume of soil
0.06
percentage of porosity is = : 32.366665

...Program finished with exit code 0
Press ENTER to exit console.

```

Fig 5: Output for Porosity

```

** Department of Irrigation and Drainage Engineering **

*** 4. Water Content
Enter value of Weight Of Wet Sample:
3.36
Enter value of Weight Of Dry Sample :
2.32

Enter value of Mass Of Solid OR Volume2.32
Percentage of Water content in a given soil sample is = : 44.827587

...Program finished with exit code 0
Press ENTER to exit console.

```

Fig 6: Output for Water Content

```

** Department of Irrigation and Drainage Engineering **

*** 5. Density
enter value of mass109.57

enter valu of volume0.06

density is = 1826.166748 KG/m³

...Program finished with exit code 0
Press ENTER to exit console.

```

Fig 7: Output for Density

```

** Department of Irrigation and Drainage Engineering **

*** 6. total unit weight

Enter value of specific gravity of solid2.69
Enter value of unit weight of Water9.81
Enter value of Water content0.325
Enter value of void ratio0.874

Total unit weight is= 18.658108 KN/m³

...Program finished with exit code 0
Press ENTER to exit console.

```

Fig 8: Output for Total Unit Weight

```

** Department of Irrigation and Drainage Engineering **

*** 6. saturated Unit Weight

enter value of Specific Gravity of solid2.7
enter value of void ratio1.215
enter value of Unit weight of water62.4

saturated Unit Weight of soil is = 110.291641 lb/ft³

...Program finished with exit code 0
Press ENTER to exit console.

```

Fig 9: Output for Saturated unit weight

```

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*** 8. Dry Unit Weight

Enter value of unit weight of water9.81
Enter value of specific gravity of solid2.7
Enter value of void ratio0.84

Dry unit weight is= 14.395110 KN/m³

...Program finished with exit code 0
Press ENTER to exit console.

```

Fig 10: Output for Dry Unit Weight

Conclusions

The soil phase relationship such as void ratio, porosity, degree of saturation, water content, density, total unit weight, saturated unit weight and dry unit weight were accurately determined. Thus, this is time consuming. So by using the software Turbo C++, version 3; project work was done accurately and in very less time. Thus software found to be beneficial for determining soil phase relationship.

The calculations were done accurately using C language.

It is user friendly.

It is time efficient.

This is boon for determining soil phase relationship.

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