DEVELOPMENT OF PROGRAMME FOR DETERMINATION OF BEARNG CAPACITY OF SHALLOW FOUNDATIONS

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Minor Project

Submitted in partial fulfilment of the requirement for the award of degree of

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In

CIVIL ENGINEERING

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CANDIDATE'S DECLARATION

We hereby declare that the work presented in this Minor report entitled **"DEVELOPMENT OF C++ PROGRAMME FOR DETERMINATION OF BEARING CAPACITY OF SHALLOW FOUNDATIONS"** submitted in partial fulfilment of the requirement for the award of degree of **"Bachelor of Technology"** in **"CIVIL ENGINEERING"**.

This is an authentic record of my work carried out under the guidance of **Dr. Rakesh Kumar, Associate Professor**, Civil Engineering Department, Maulana Azad National Institute of Technology, Bhopal. I have not plagiarized or submitted the same work for the award of other degree.

The matter embodied in this thesis has not been submitted to any other university or institute for the award of any other degree or diploma.

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CERTIFICATE

This is to certify that the work contained in this Minor report titled **"DEVELOPMENT OF PROGRAMME IN C++ FOR DETERMINATION OF BEARING CAPACITY OF SHALLOW FOUNDATIONS"** by YASHPAL SOLANKI (191111054), PRIYOM GUPTA (191111060), AMAN KUMAR (191111063) has been carried out under my supervision and the content presented is correct to the best of our knowledge.

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ABSTRACT

Shallow foundations are the common types of foundation designed for many important structures. In general, these foundations are subjected to a vertical load, moment and shear at the base, which induce the stresses and deformation in the supporting soil. A geotechnical engineer is required to calculate bearing capacity of soils for different types of loading conditions. These loads may be static or dynamic in nature.

The load carrying capacity of a foundation depends on many factors such as type of soil, type of loads and foundation material etc. Various researchers have developed different approaches to calculate the bearing capacity of a foundation under different soils and loading conditions Empirical curves and tables are developed, which take into consideration the factors affecting the bearing capacity of soil. This makes the estimation of bearing capacity of foundation a complex task. And hence it is felt necessary to develop comprehensive user-friendly software, to calculate bearing capacity of shallow foundations.

Three main approaches are commonly used for estimating the bearing capacity of soils as per BIS code recommendations.

These are:

(i) by shear strength parameters. and c from Shear tests [IS: 2720(Parts XI and XIII)]

(ii) Plate load test results [IS: 1888-19811] and

(iii) Static cone penetration resistance qc [IS: 4968(Part 111)-1976].

The developed program incorporates all of these methods.

CONTENTS

LIST OF NOTATIONS

- C :- Cohesion in KN/m2
- Phi :- angle of shearing resistance of soil in degrees
- B :- width of footing
- L :- Length of footing
- d :- depth of footing
- W :- Correction factor for location of water table
- Alpha :- inclination of the load to the vertical in degree
- Nc ,Nq, Ny :- Bearing capacity factors
- Sc, Sq, Sy:- shape factors
- Dc, Dq, Dy:- Depth factors
- qu :- ultimate bearing capacity of soil
- qs :- safe bearing capacity of soil
- Y :- bulk unit weight of soil in KN/M3

CHAPTER - I

INTRODUCTION

1.1 GENERAL

For most structures including building, bridges, earth fills, earth concrete dams, it is the earth that provides the ultimate support. The behaviour of the supporting ground must, therefore, affect the stability of the structure. The supporting ground is invariably a soil which is weaker than any construction material like wood, concrete, steel or masonry. Hence, compared to structural members made out of these materials, a large area or mass of soil is necessarily involved in carrying the load.

Structural foundations are the substructure element which transmits the structural load to the earth in such a way that the supporting soil is not overstressed and not undergo deformations that would cause excessive settlement of the structure. Hence the properties of supporting soil must be expected to affect the choice and the type of structural foundation suitable for structure.

Shallow foundations are the common type of foundations usually provided for various important structures resting on good soil. In general, these foundations are subjected to a vertical load, a moment and a horizontal load. The resultant of these becomes eccentric inclined load on the foundation. A foundation is that part of a structure which transmits the weight of the structure to the ground. The technological developments since the beginning of 20th century have thrown many challenging problems requiring structures to be founded on difficult soil and environmental conditions. A foundation is required for distributing the loads of the superstructure on a large area. For proportioning of such foundations safe bearing capacity, are the main criteria. Selection Of type of foundation depends mainly on bearing capacity of the supporting soil, location and type of structure, ground condition and durability. The safe bearing capacity of soil is determined through the result of various laboratory and field test data and settlement are estimated from the known soil parameters for different soil conditions. The computation of bearing capacity different approaches may be time consuming and laborious job. Hence here in, an attempt has been made to compile the available knowledge base and develop a comprehensive computer package in C++ to estimate safe bearing capacity of shallow foundation.

1.2 OBJECTIVES OF STUDY

The main objective of this study is to develop a computer program in C++ LANGUAGE for determination of bearing capacity of shallow foundation as per IS 6403- 1981.

1.3 SCOPE OF THE STUDY

The computer package developed will be of general use for Civil Engineers and Architects for determination of Bearing Capacity of shallow foundations as per Bureau of Indian standards.

Indian Standard mentions that wherever possible bearing capacity calculations should be made on the basis of shear strength parameters; and c from Shear tests [IS: 2720(Parts XI and XIII)

Thus, the program incorporates input of all the data obtained from above mentioned tests to estimate bearing capacity.

In this study foundation subjected to dynamic loads such earth quake intensity, seismic force is not considered. Further deep foundations are also not included.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

A brief review of the available literature pertaining to the bearing capacity and settlement of shallow foundation has been presented in this chapter.

The literature review has been discussed under the following headings.

1. Foundation
2. Location and Depth of Foundation
3. Bearing Capacity of Soils

2.2 FOUNDATION

A foundation is that part of superstructure which is in direct contact with the ground and which transmits the load of super structure to the soil over a larger area.

Broadly Foundation is classified into two types:

(i) Shallow Foundation

(ii) Deep Foundation.

2.2.1 Shallow Foundation

A shallow foundation transmits structural loads to the soil strata at a relatively small depth. According to **Terzaghi** (1943) shallow foundation is the one which is laid at a depth D_f not exceeding the width B of the foundation.

i.e., $$\frac{\mathbf{Df}}{\mathbf{B}} < \mathbf{1}$$

Shallow foundations- termed bases, footings, spread footings, or mats. The depth is generally D/B < 1 but may be somewhat more. Refer to Fig 2. 1

Foundation with Df/ B ratio greater than 1 but less than 15 are moderately deep and more than 15 are considered as deep. Shallow foundations are constructed in open excavations and the disturbance of the underlying soil is minimal.

TYPES OF SHALLOW FOUNDATION

- Isolated footing
- Combined footing
- Strap footing
- Grillage footing
- Mat or raft footing

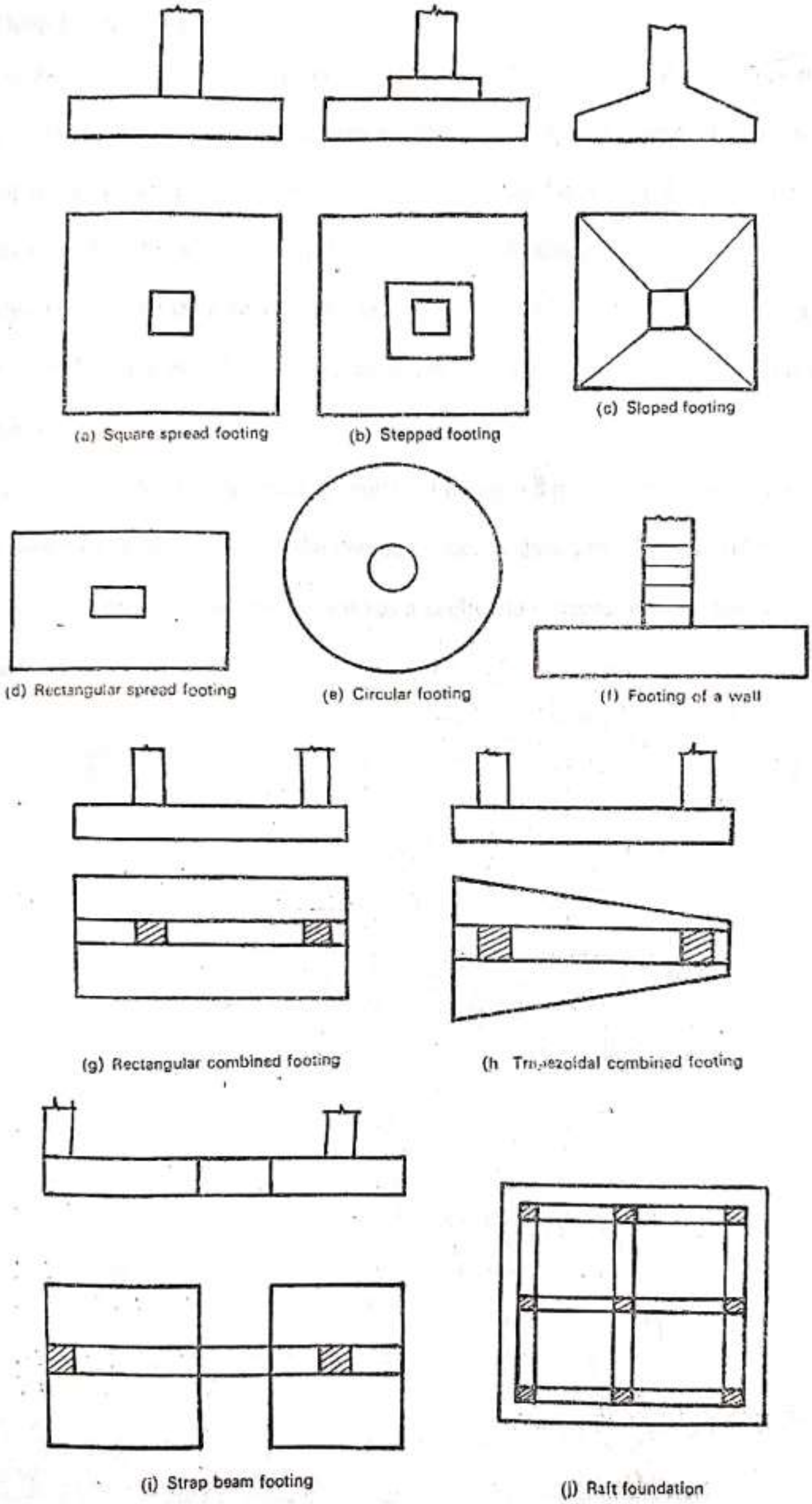

Fig 2.1(b): Various types of Shallow Foundations

2.2.4 SELECTION OF TYPE OF FOUNDATION:

Situation	Suitable Type of Foundation
The footing which supports the load bearing wall and when length is much grater than its width (L >> B).	Spread Footing (a)Strip Footing , (b) Stepped footing
To support individual columns of framed structures	Isolated Square or Rectangular footing
Footing which supports two or more columns and when columns carries unequal loads, and when columns are very near to each other so that their footings overlap or when bearing capacity of the soil is less and it requires more area under individual footing.	Combined Footing : (a) Rectangular combined footing (b) Trapezoidal combined footing
Type of foundation suitable in earthquake area and also to prevent differential settlement, the resultant of the column loads must pass through the centroid of the footing of plan.	Continuous Footing: In this single continuous R.C.C slab is provided as foundation.

GENERAL TERMS AND DEFINITIONS

- **Ultimate Bearing Capacity**

If the load at the base of footing is gradually increased, a stage will be reached when the load will cause a shear failure in the supporting soil. The maximum gross intensity of loading that the soil can support before it fails in shear is called the Ultimate Bearing Capacity que

- **Net Ultimate Bearing Capacity**

Net Ultimate bearing capacity is the maximum net intensity of loading at the base of the foundation that the soil can support before failing in shear.

It is given by:

$$q_{nu} = q_u - \gamma D_f$$

where;

γ = unit weight of soil above footing level and

D_f = Depth of footing.

- **Net Safe Bearing Capacity**

The Net safe bearing capacity is the maximum net intensity of loading that the soil can safely support without the risk of shear failure it is given by,

$$q_{nu} / F$$

where; F is the factor of safety (Generally taken as 3)

- **Gross Safe Bearing Capacity**

Gross safe bearing capacity is the maximum gross intensity of loading that the soil can carry safely without failing in shear it is given by,

$$q_g = q_n + \gamma D_f$$

- **Safe bearing pressure**

Safe bearing pressure is the maximum net intensity of loading that can be allowed on the soil Without the settlement exceeding the permissible value.

- **Allowable Bearing pressure**

Allowable bearing pressure is the maximum net intensity of loading that can be imposed on the soil with no possibility of shear failure or the possibility of excessive settlement. Hence, it is the of the net safe bearing capacity (shear failure criterion) and safe bearing pressure settlement criterion.

- **Net Pressure Intensity**

Net Loading Intensity difference between the gross pressure and the over burden pressure γD_f is known as net Determination of Bearing Capacity bearing capacity of the soil is needed for the dimensioning the foundation for any structure. Several methods are available for the determination of bearing capacity of shallow foundations.

Bureau of Indian Standard IS: 6403-1981 gives this method which is commonly the purpose are given below.

- Bearing Capacity based on Shear strength parameters.

The C++ program developed in the present work incorporates above method. Based on importance of the structure, judgment and experience of the investigator; final value of safe bearing capacity is recommended.

- ## Factors Affecting Bearing Capacity

The factors affecting bearing capacity (Static) are:

(i) The type of soil and its properties.

(ii) The contact pressure applied to the soil.

(iii) The form and size of the footing in plan.

(iv) The depth of footing below the ground surface.

(v) The position of the water table below ground surface.

(vi) The position of load application on footing.

- ## Basic Approaches for the Calculation of Bearing Capacity of Soils

The following approaches are widely discussed in literature.

Theoretical Methods:

(i) Terzaghi's Bearing Capacity
(ii) Meyerhof's Bearing Capacity Theory
(iii) Hansen's Bearing Capacity Theory
(iv) Vesics Bearing capacity Theory

Field Methods:

(i) Bearing Capacity from Plate Load Test.
(ii) Bearing Capacity Based on Standard Penetration

- ## Type of Bearing Capacity Failure

Three types of failure of soil support beneath the foundation have been recognized, depending upon the deformation associated with the load and the extent of development of failure surface.

(a) General shear failure
(b) Local shear failure
(c) Punching shear failure

General Shear Failure:

The failure pattern in general shear for a footing at the surface of ground is shown in Fig.2.3 Some of the important characteristics of general shear failure are:

(a) It has a well-defined failure pattern.

(b) Failure is sudden and catastrophic.

(c) Failure is accompanied by tilting of foundation.

There is a tendency for the soil adjacent to foundation to bulge

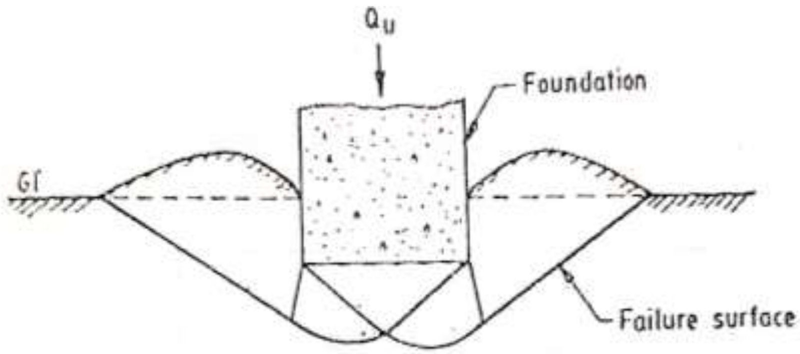

Fig. 2.3: Failure mechanism for general shear failure

Figure 2.3(a) shows the typical load vs. settlement diagram when general shear failure takes place. Ultimate or failure load of foundation is clearly evident.

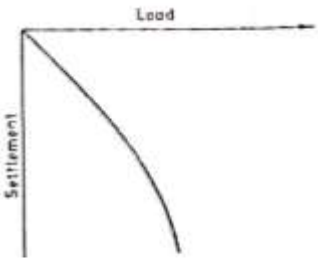

Fig. 2.3(a): Load settlement diagram for general shear failure

Local Shear Failure:

Figures 2.5 and 2.5(a) show failure mechanism and load-settlement curve respectively for Local shear failure. Characteristics of local shear failure are:

(a) Failure pattern is clearly defined only immediately below the foundation

(b) There is no catastrophic collapse or tilting of foundation.

(c) There is visible soil bulging on the sides of footing

(d) It is a transitional mode of failure retaining the characteristics of both general shear failure and punching shear failure.

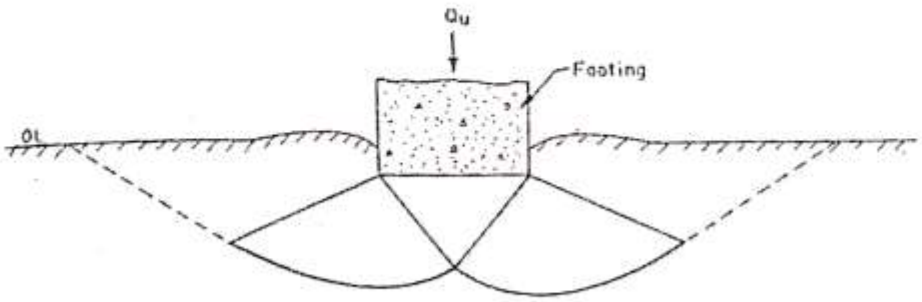

Fig. 2.5: Failure mechanism for local shear failure

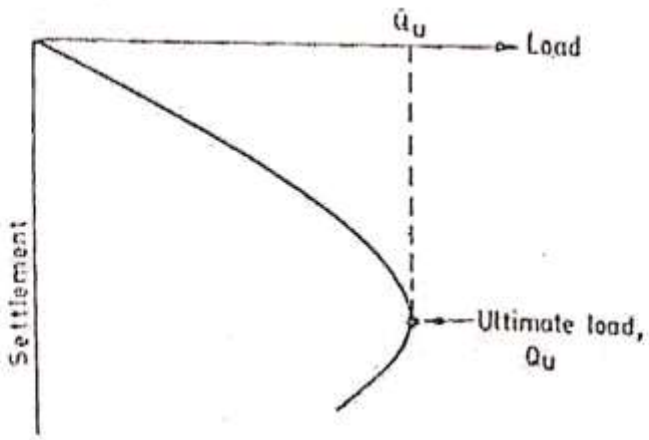

Fig. 2.5(a): Load settlement diagram for local shear failure

Punching Shear Failure

Fig.2.4 shown the failure mechanism for punching shear failure and Fig. 2.4(a) shows the corresponding load-settlement curve.

Characteristics of punching shear failure are as follows:

(a) Failure pattern is not easy to observe

(a) Soil outside the loaded area is not affected

(b) Horizontal and vertical equilibrium of footing are maintained

(c) There is a continuous increase is vertical load with the vertical movement of footing. This means that ultimate load is not clearly determinable, as can be observed from Fig.2.4(a)

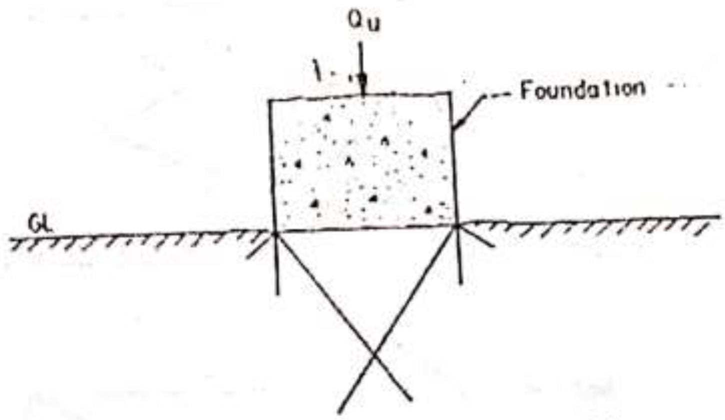

Fig. 2.4: Failure mechanism for Punching shear failure

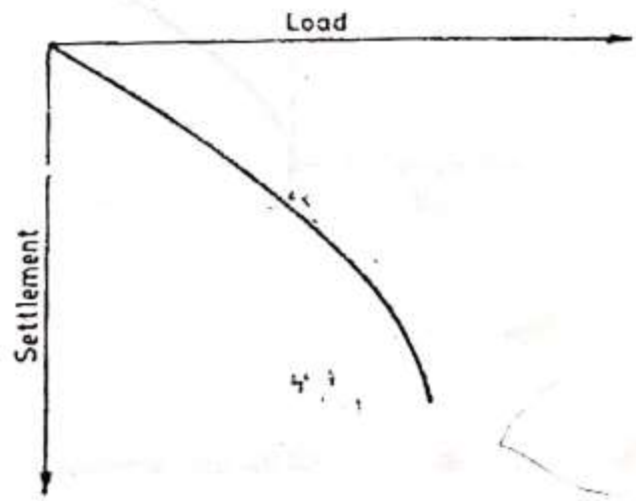

Fig.2.4 (a) Load Settlement diagram for punching shear failure

Table 2.2 Identification of Type of Failure

Type of failure	Relative density D, (%)	ϕ, (Deg)	Void ratio, (e)	Condition
1.General shear failure	>70	>360	<0.55	Dense
2.Local shear failure (as well as punching shear failure)	< 20	< 280	>0.75	Loose
3.Interpolate between dense and loose conditions	20 to 70	280to 360	0.55 to 0.75	Medium

2.4.10 Calculation of bearing capacity for soils with cohesion and Angle of shearing Resistance

The following formulae shall be used for calculating ultimate net bearing capacity in the case of strip footing;

(i) In case of general shear failure = $c\ N_C + q\ (Nq\ \text{-}l) + 1/2\ Bf\ N\ \gamma$

(ii) In case of local shear failure = $2/3\ \ N'\ c + q\ (N'q - l) + 1/2\ Bf\ N'\gamma$

The values of bearing capacity factor NC, Nq , N' c, N' q , and N'?. The program automatically selects the bearing capacity factors for given value of angle.

BEARING CAPACITY FACTORS

ϕ (Degrees)	N_c	N_q	$N\gamma$
0	5.14	1.00	0.00
5	6.49	1.57	0.45
10	8.35	2.47	1.22
15	10.98	3.94	2.65
20	14.83	6.40	5.39
25	20.72	10.66	10.88
30	30.14	18.40	22.40
35	46.12	33.30	48.03
40	75.31	64.20	109.41
45	138.88	134.88	271.76
50	266.89	319.07	762.89

SHAPE OF BASE	SHAPE FACTOR		
S.No	Sc	Sq	Sγ
1.Continous Strip	1.00	1.00	1.00
2. Rectangle	1+0.2B/L	1+0.2B/L	1-0.4B/L
3.Square	1.3	1.2	0.8
4. Circle	1.3	1.2	0.6

Use B as the diameter in the Bearing capacity formula.

Table 2.3

Summary of Bearing Capacity Equations as Suggested by Various Investigators

Table 2.2: Summary of Bearing Capacity Equations as Suggested by Various Investigators

Terzaghi's : 1943	Meyerhaof's: 1951, 1963	Hansen: 1957, 1970	Vesic : 1974	BIS Code Method : 6403 – 1981
$q_d = q(N_q-1)s_q d_q i_q + \frac{1}{2}B_\gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$	<u>Vertical Load:</u> $q_{nu}=cN_cS_cd_c+qN_qS_qd_q+0.5\gamma BN_\gamma S_\gamma d$ <u>Inclined Load:</u> $q_{nu}=cN_cd_ci_c+qN_qd_qi_q+0.5\gamma BN_\gamma d_\gamma i_\gamma$	$q_{nu}= cN_cS_cd_ci_cb_c+\gamma_1 D(N_q-1)S_qd_qi_qb_qr_w$ $+0.5\gamma_2 BN_\gamma S_\gamma d_\gamma i_\gamma b_\gamma r'_w$	$q_{nu}= cN_cS_cd_ci_c + qN_qS_qd_qi_q+0.5\gamma BN_\gamma S_\gamma d_\gamma i_\gamma$	$qd = q(N_q-1)s_q d_q i_q + \frac{1}{2}B_\gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$
$N_q = [e^{(0.75\pi-\phi/2)\tan\phi}]^2/2\cos^2(45+\phi/2)$	$N_q = e^{\pi\tan\phi}\tan^2\left(45+\frac{\phi}{2}\right)$	$N_q = e^{\pi\tan\phi}\tan^2\left(45+\frac{\phi}{2}\right)$	$N_q = e^{\pi\tan\phi}\tan^2\left(45+\frac{\phi}{2}\right)$	$N_q = e^{\pi\tan\phi}\tan^2\left(45+\frac{\phi}{2}\right)$
$N_c = (N_q-1)\cot\phi$	$N_c = (N_q-1)\cot\phi$	$N_c = (N_q-1)\cot\phi$	$N_c = (N_q-1)\cot\phi$	$N_c = (N_q-1)\cot\phi$
$N_\gamma = \tan\phi\,[(K_{p\gamma}/\cos^2\phi)-1]/2$	$N_\gamma = (N_q-1)\tan(1.4\phi)$	$N_\gamma = 1.5(N_q-1)\tan\phi$	$N_\gamma = 2(N_q+1)\tan\phi$	$N_\gamma = 2(N_q+1)\tan\phi$
<u>For: Strip Round Square</u> S_c = 1.0 1.3 1.3 S_γ = 1.0 0.6 0.8				

Chapter-3

DEVELOPMENT OF SOFTWARE

3.1 GENERAL

As per code of practice for determination of bearing capacity of shallow foundations the procedure used for analysis of bearing capacity of shallow foundation as discussed in detail have been adopted in a software package. This package has been devloped in C++ programming specially using its features and can be run on any personal computer. It is a user-friendly package, which provides necessary guidance on input data at every step.

3.2 CREATION AND EXECUTION OF C++ PROGRAMME:

For creating and executing a C++ program, one must follow four important steps:

(i) Creating Source code

Creating includes typing and editing the valid C++ code as per the rules followed by the C++ Compiler.

(ii) Saving source code with extension .cpp

After typing, the source code should be saved with the extension .cpp

(iii) Compilation

This is an important step in constructing a program. In compilation, compiler links the library files with the source code and verifies each and every line of code. If any mistake or error is found, it will inform you to make corrections. If there are no errors, it translates the source code into machine readable object file with an extension .obj

(iv) Execution

This is the final step of construction of a C++ Program. In this stage, the object file becomes an executable file with extension .exe. Once the program becomes an executable file, the program has an independent existence. This means, you can run your application without the help of any compiler or IDE.

C++ PROGRAMME

```
#include <iostream>

#include <cmath>

using namespace std;


int main() {


    double c,phi;

    cout<<"Input value of c: ";

    cin>>c;

    cout<<"Input value of phi: ";

    cin>>phi;

    double deg=M_PI/180;

    double phi_d=phi/2;

    phi=phi*deg;

    phi_d=deg*phi_d;

    double N_phi=tan(45*deg+ (phi_d));

    N_phi=N_phi*N_phi;

    double N_q=N_phi*exp(M_PI*tan(phi));

    cout<<"N_q "<<N_q<<endl;

    double N_gamma=2*(tan(phi))*(N_q +1);
```

```
    double N_c = (1/tan(phi))*(N_q -1);
    cout<<"N_c"<<N_c<<endl;
    cout<<"N_gamma"<<N_gamma<<endl;
    string s;
    cout<<"Input type of footing: ";
        cin>>s;

    double s_c,s_q,s_gamma;
    double b,gamma,w,d,alpha;
    cout<<"Input value of b:";
    cin>>b;

    cout<<"Input value of gamma:";
    cin>>gamma;

        cout<<"Input value of w:";
    cin>>w;

        cout<<"Input value of d:";
    cin>>d;

        cout<<"Input value of alpha:";
        cin>>alpha;
//    cin>>b>>gamma>>w>>d>>alpha;
    double q=gamma*d;
    double qu;
    if(s=="strip"){
      s_c=1.00;
      s_q=1.00;
```

```
    s_gamma=1.00;}
  else if(s=="rectangle"){
    double b,l;
    cout<<"Input value of b:";
    cin>>b;
    cout<<"Input value of l:";
    cin>>l;
            s_c=1+0.2*(double (b)/double (l));
    s_q=1+0.2*(double (b)/double (l));
    s_gamma=1-0.4*(double (b)/double (l));
  }
  else if(s=="square"){
    s_c=1.30;
    s_q=1.20;
    s_gamma=0.80;
  }
  else if(s=="circle"){
    s_c=1.30;
    s_q=1.20;
    s_gamma=0.60;
  }
//  cout<<s_c<<" "<<s_q<<" "<<s_gamma<<endl;
  double dc,ic,dq,iq,d_gamma,i_gamma;
  dc=(1+0.2*(d/b)*sqrt(N_phi));
  dq=(1+0.1*(d/b)*sqrt(N_phi));
  d_gamma=dq;
  ic=pow((1-(alpha/90)),2);
  iq=ic;
  i_gamma=pow((1-(alpha/(phi/deg))),2);
```

```
        cout<<dc<<" "<<dq<<" "<<d_gamma<<" "<<ic<<" "<<iq<<" "<<i_gamma<<endl;
    if(phi<28*deg){
      if(phi<10*deg){dq=1;d_gamma=1;}

    qu= ((c*N_c*s_c*dc*ic))+(q*(N_q-
1)*s_q*dq*iq)+(b*gamma*N_gamma*s_gamma*d_gamma*i_gamma*w/(2.0));
   }
    else if(phi>=28*deg and phi<36*deg){

              double qu_l = ((c*N_c*s_c*dc*ic))+(q*(N_q-
1)*s_q*dq*iq)+(b*gamma*N_gamma*s_gamma*d_gamma*i_gamma*w/(2.0));

              double qu_u =(c*N_c*s_c*dc*ic)+(q*(N_q-
1)*s_q*dq*iq)+(b*gamma*N_gamma*s_gamma*d_gamma*i_gamma*w/(2.0));

              qu= qu_l*((phi/deg -28)/(36-28)) + qu_u*((36-phi/deg)/(36-28));
    }
    else
    {
        qu=(c*N_c*s_c*dc*ic)+(q*(N_q-
1)*s_q*dq*iq)+(b*gamma*N_gamma*s_gamma*d_gamma*i_gamma*w/(2.0));
        }
     double f;
        cout<<"input value of f: ";
        cin>>f;
        double qs;

        qs = (qu/f) + (gamma*d)      ;
         cout<<"net ultimate bearing capacity of soil: "<<qu<<endl;
         cout<<"safe bearing capacity of soil: "<<qs<<endl;

        return 0;
```

FOLLOWING ARE THE ADVANTAGES OF C++ LANGUAGE

(i) C++ is a highly portable language and is often the language of selection for multi-device, multi-platform app development.

(ii) C++ is an object-oriented programming language and includes concepts like classes, inheritance, polymorphism, data abstraction, and encapsulation which allow code reusability and makes programs very maintainable.

(iii) C++ use multi-paradigm programming. The Paradigm means the style of programming. paradigm concerned about logics, structure, and procedure of the program. C++ is multi-paradigm means it follows three paradigm Generic, Imperative, Object Oriented.

(iv) It is useful for the low-level programming language and very efficient for general purpose.

(v) C++ gives the user complete control over memory management. This can be seen both as an advantage and a disadvantage as this increases the responsibility of the user to manage memory rather than it being managed by the Garbage collector.

USE OF PROGRAMME: -

To execute or run the software the user has to explore the CD **"DETERMINATION OF BEARING CAPACITY OF SHALLOW FOUNDATION"**.

Exploring the CD, the user has to go through below steps: -

1. First input the value of c and φ.
2. From the value of c and phi we determined the values of bearing capacity factors Nc, Nq, N γ in accordance with IS code.
3. Then we have determined shape factor(S), depth factor (D), inclination factor(i) on the basis of footing.
4. We have also introduced a water table correction factor (W).

At last we can find the value of bearing capacity of soil after input all the parameters.
With the help of this programme we can find value of Q at any C and φ.

Validation of the Software and Illustrative Examples:

Sample examples have been taken for calculation through software and the same are validated by manual calculation. The results are found satisfactory.

Below problem is taken from book by DEBASHIS MOITRA
page no. 635 .

16.13 The subsoil at a site consists of a stratum of silty clay having a unit weight of 17 kN/m^3. The shear strength parameters of the soil in the undrained condition are found to be:

$c = 30$ kN/m^2, $\phi = 10°$

A rectangular footing of 2.2 m × 3.5 m is to be founded in this soil at 1.2 m below GL. Determine the safe bearing capacity of the footing, with respect to a factor of safety of 3.0, as per IS: 6403–1981. Consider a general shear failure. [*Ans.* 145.82 kPa]

Q7- Calculate the net ultimate bearing capacity of a rectangular footing 2mX4m in plan , founded at a depth of 1.5 m below the ground surface. The load on the footing acts at an angle of 15^0 to the vertical and is eccentric in the direction of width by 15cm. The saturated unit weight of the soil is $18kN/m^3$. The rate of loading is slow and hence the effective stress shear strength parameters can be used in the analysis . $c'=15kN/m^2$ and $\varphi'=25^0$.Natural water table is at a depth of 2m below the ground surface. Use IS-Code recommendations.

Sol-

qv =c Nc Sc dc ic+q(Nq-1)sq dq iq+0.5 Y B Ny Sy dy iy W'

$C = c' = 15kN/m^2$

$\varphi = \varphi' = 25^0$,

Nc=20.7,Nq=10.7 and Ny=10.9

$Y = Ysat = 18kN/m^3$

$q=18x1.5 = 27\ kN/m^2$

For Dw' = 0.25 (Dw'=2-1.5=0.5m), W'=0.625

B

Sc = Sq = 1+0.2 B' =1+0.2x (1.7/4) = 1.025

L

Sy = 1- 0.4 B' = 1- 0.4 (1.7/4) = 0.83

L

$dc = 1+ 0.2\ (Df/B')\ \tan(45^0+ \varphi/2) = 1+0.2(1.5/1.7)\tan 57.5^0 =$ 1.28

$dq = dy = 1 +0.1\ (Df/B')\ \tan(45^0 + \varphi/2) = 1+0.1(1.5/1.7)\ \tan 57.5^0$ $= 1.14$

$ic = iq = (1-\alpha/\varphi)^2 = (1-15/90)^2 = 0.69$

$iy = (1-\alpha/\varphi)^2 = (1-15/25)^2 = 0.16$

Substituting these values ,

qnu = 15 X 20.7 X1.085 X 1.28 X 0.69 + 27 X9.7 X 1.085 X 1.14 X 0.69 + 0.5 X 18 X 1.7 X 10.9 X 0.83 X 1.14 X 0.16 X 0.625

=297.5+220.5+15.8

=533.8kN/m2

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CHAPTER 4

CONCLUSION

For important projects various field and laboratory investigation are carried out to determine the soil parameters. The analysis of test data for calculation of bearing capacity of soil of shallow foundation under varying condition requires references to various IS codes, graphs and tables. The work becomes tedious and consumes lot of time of Civil Engineers and Architects.

Hence there was a need to have compiled information for estimation of safe bearing capacity of shallow foundation to provide an effective as well as simple solution for reducing time by developing a computer program for the purpose. In present work, the computer program is developed in and C++ PROGRAMMING.

The software is user friendly, interactive and flexible enough to fulfil the need of the user. The software can be run on any system and does not require any environment / platform. From the value of c and φ, calculation of bearing capacity for strip, square, circular footing can be estimated. Sample example have been taken above for calculation through software and the same are validated by manual calculation. The results are found satisfactory.

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