This thesis is respectfully dedicated

to

my parents

BEARING CAPACITY
OF
SKIRTED CIRCULAR FOOTINGS ON SAND

A MAJOR PROJECT THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF DEGREE OF

MASTER OF ENGINEERING

IN

CIVIL ENGINEERING
[STRUCTURAL ENGINEERING]

WORK IS WORSHIP

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CANDIDATE DECLARATION & CERTIFICATE

This is certify that I, **SANJEEV KUMAR TYAGI** a student of final year M. E. (Structural Engineering), Delhi College of Engineering, Delhi, carried out my major project work on **"BEARING CAPACITY OF SKIRTED CIRCULAR FOOTINGS ON SAND"** under the guidance of **Prof. (Mrs.) P.R. Bose**, Principal, Government Engineering College Jaffarpur, Delhi and **Prof. A. Trivedi**, Professor, Department of Civil Engineering, Delhi College of Engineering, Delhi, for the partial fulfillment of the requirement for the degree of **Master of Engineering, Civil Engineering (Structural Engineering),** Delhi College of Engineering, Delhi.

This is certified that the matter embodied in this major project thesis has not been submitted elsewhere for the award of any other degree / diploma.

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This is to certify that above statement made by candidate is correct to the best of our knowledge.

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ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my project guides **Prof. (Mrs.) P.R. Bose**, Principal, Government Engineering College, Jaffarpur, Delhi and **Prof. A. Trivedi**, Professor, Department of Civil Engineering, Delhi College of Engineering, Delhi, for their constant inspiration, encouragement, guidance and constructive criticism and judicious evaluation that led to the completion of this major project work to achieved its present shape.

I also wish to express my sincere thanks to my elder brother Engineer Y. K. Tyagi, (C.P.W.D.), Engineer C. P. Sharma, Ex. Er. (R.E.S.) Bulandshahr, Engineer Sadanand Ojha, Computer Engineer Sudhir Tomar & Engineer Ashutosh Tyagi for extending all facilities & word of encouragement while working on this project work.

I would like to take this opportunity to thanks the staff of Civil Engineering Department & The Librarian of D.C.E. for making resources available to me.

Finally, I am obliged to all my batch mates who have given me precious and valuable suggestions from time to time and helped in the exercise of preparing the major project thesis.

Date: **(Sanjeev Kumar Tyagi)**

Place: D.C.E. **M.E. (Structural Engineering)**

ABSTRACT

This thesis presents the analysis results of bearing capacity of skirted circular footings on sand.

In fact this skirt provides the soil confinement. In this way I studied the influence of soil confinement which is provided by using a skirt of different height and diameter combination.

Initially, the response of non confined case was determined and then compared with that of confined soil, with different combination of height and diameter of the skirt.

The results indicates that the bearing capacity of circular footing can be appreciably increased by soil confinement. It was concluded that such reinforcement resists lateral displacement of soil underneath the footing, leading to a significant improvement in the response of the footing.

The analysis results give the clear indication that when we are increasing the diameter of the skirt, the bearing capacity is increased up to a certain limit of diameter. After increasing the diameter of the skirt above this optimize limit the bearing capacity will start decreasing. At every time of increasing the skirt height, the bearing capacity also increases. This is due to the enlargement in the surface area of the skirt-footing model.

In this thesis the recommended skirt heights and diameters that give the maximum bearing capacity improvement are being presented and discussed.

CONTENTS

NOMENCLATURE

B	=	Width of footing.
b_c, b_q, and b_γ	=	Tilting factor of footing.
BCR	=	Bearing capacity ratio, Q_u/q_u.
C	=	Cohesion of soil.
C_c	=	Coefficient of curvature.
C_{inc}	=	Increase of cohesion.
C_{ref}	=	Cohesion (constant) in plaxis.
C_u	=	Uniformity coefficient.
D	=	Diameter of footing.
d/D	=	Ratio of the diameter of cylindrical shell to the diameter of footing.
D_f	=	Depth of foundation.
dp	=	Differential reactive pressure on the element length ds of the failure surface.
d_q, d_γ, and d_c	=	Depth factor of footing.
D_r	=	Relative density.
E_{inc}	=	Increase of stiffness.
E_{init}	=	Initial void ratio.

E_{oed} = Oedometer modulus.

E_{ref} = Young's modulus (constant) in plaxis.

F = Resultant frictional resistant force.

g_c, g_q, and g_γ = Slope factor of footing.

G_{ref} = Shear modulus.

h = Height of cylindrical shell & skirt.

h/D = Ratio of the height of skirt to the diameter of footing.

H_d = Height over which the Rankine Passive force acts.

i_c, i_q, and i_γ = Inclination of footing.

K_a = Rankine and Coulomb active earth pressure coefficient.

K_p = Rankine and Coulomb passive earth pressure coefficient.

$K_{p\gamma}$ = Passive force coefficient.

K_x = Permeability in horizontal direction.

K_y = Permeability in vertical direction.

L = Length of continuous footing.

l_p, l_w, and l_R = lever arms.

$N_c^/$, $N_q^/$ and $N_\gamma^/$ = Modified bearing capacity factors (for local shear faliur).

N_q, N_c, and N_γ = Dimensionless bearing capacity factor providing the contribution of c, q, And γ.

P_p = Passive force.

$P_{p(1)}$, $P_{p(2)}$, and $P_{p(3)}$ = Rankine passive force.

P_{pq}, P_{pc}, and $P_{p\gamma}$ = Passive force with contribution of q, c, and g respectively.

Q = Surcharge.

q_c, q_q, and q_γ = The ultimate load per unit area of foundation for a soil with cohesion , friction and weight.

q_o = Average pressure over the footing contact area.

Q_u = Ultimate bearing capacity of footing with soil confinement.

q_u = Ultimate bearing capacity of footing.

R = Resultant reaction on failure surface.

r, r_1, and r_o = Radius of log-spiral.

R_{inter}. = Strength reduction factor.

s_γ, s_c, and s_q = Shape factor of footing.

t = thickness of skirt.

UPVC = Unplasticized polyvinyl chloride.

V = vertical load.

W = Weight of wedge.

α = Angle of inclination of sides of wedge to the horizontal surface of Foundation

β = Angle of inclination of the soil above the ground surface.

ϕ = Friction angle.

γ_{sat} = Soil unit weight below phreatic level.

γ_{unsat} = Soil unit weight above phreatic level.

γ = Unit weight of soil in KN/m^3.

φ	=	Dilatancy angle.
ν	=	Poisson ratio.
θ	=	Angle of log-spiral.
$\sigma^{/}$	=	Effective normal stress.
ζ_{γ}	=	Shape factor for circular footing.

CHAPTER – 1
INTRODUCTION

The soil must be capable of carrying the loads from any engineered structure placed upon it without a shear failure and with the resulting settlements being tolerable for that structure. This thesis is concerned with evaluation of the limiting shear resistance, or ultimate bearing capacity $q_{ult,}$ of the soil to foundation load.

A foundation is required for distributing the load of the superstructure on a large area. The foundation should be designed such that (1) the soil below does not fail in shear and (2) the settlement is within the safe limits. The pressure which the soil can safely withstand is known as the allowable bearing pressure.

1.1. BASIC DEFINITIONS :

1.1.1. ULTIMATE BEARING CAPACITY (q_u): The ultimate bearing capacity is the gross pressure at the base of the foundation at which the soil fails in shear.

1.1.2. NET ULTIMATE BEARING CAPACITY(q_{nu}): It is the net increase in pressure at the base of foundation that causes shear failure of the soil. It is equal to the gross pressure minus overburden pressure.

Thus $$q_{nu} = q_u - \gamma D_f \qquad (1.1)$$

Where q_u = ultimate bearing capacity (gross)

γ = unit weight of foundation soil.

And D_f = depth of foundation.

It may be noted that the overburden pressure equal to γD_f existed even before the construction of foundation.

1.1.3. NET SAFE BEARING CAPACITY (q_{ns}): It is the net soil pressure which can be safely applied to the soil considering shear failure. It is obtained by dividing the net ultimate bearing capacity by a suitable factor of safety. Thus

$$q_{ns} = q_{nu}/F.S. \qquad (1.2)$$

Where F.S. = Factor of safety, which is usually taken as 3.0

1.1.4. GROSS SAFE BEARING CAPACITY (q_s): It is the maximum gross pressure which the soil can carry safely without shear failure. It is equal to the net safe bearing capacity plus the original overburden pressure. Thus

$$q_s = q_{ns} + \gamma D_f$$

or $$q_s = q_{nu}/F.S. + \gamma D_f \tag{1.3}$$

Some authors define the gross safe bearing capacity (q_s) as the ultimate bearing capacity divided by a factor of safety (F.S.), that is,

$$q_s = q_u/F.S. = (q_{nu} + \gamma D_f)/F.S. = q_{nu}/F.S. + \gamma D_f/F.S. \tag{1.4}$$

As the added strength due to γD_f is available in full, it does not seem logical to apply a factor of safety to this term. It is, therefore, more rational to define the gross safe bearing capacity as indicated by Eq. 1.3.

1.1.5. NET SAFE SETTTLEMENT PRESSURE (q_{np}): It is the net pressure which the soil can carry without exceeding the allowable settlement. The maximum allowable settlement generally varies between 25 mm. and 40 mm. for individual footings.

The net safe settlement pressure is also known as unit soil pressure or safe bearing pressure.

1.1.6. NET ALLOWABLE BEARING PRESSURE (q_{na}): The net allowable bearing pressure is the net bearing pressure which can be used for the design of foundations.

As the requirements for the design of foundations are that there should be no shearing failure and the settlements should also be within the limits, the allowable bearing pressure is the smaller of the net safe bearing capacity (q_{ns}) and the net safe settlement pressure (q_{np}). Thus

$$q_{na} = q_{ns} \quad \text{if} \quad q_{np} > q_{ns} \tag{1.5}$$

or $$q_{na} = q_{np} \quad \text{if} \quad q_{ns} > q_{np} \tag{1.6}$$

1.2. TYPES OF FAILURE IN SOIL AT ULTIMATE LOAD:

1.2.1.GENERAL SHEAR FAILURE :

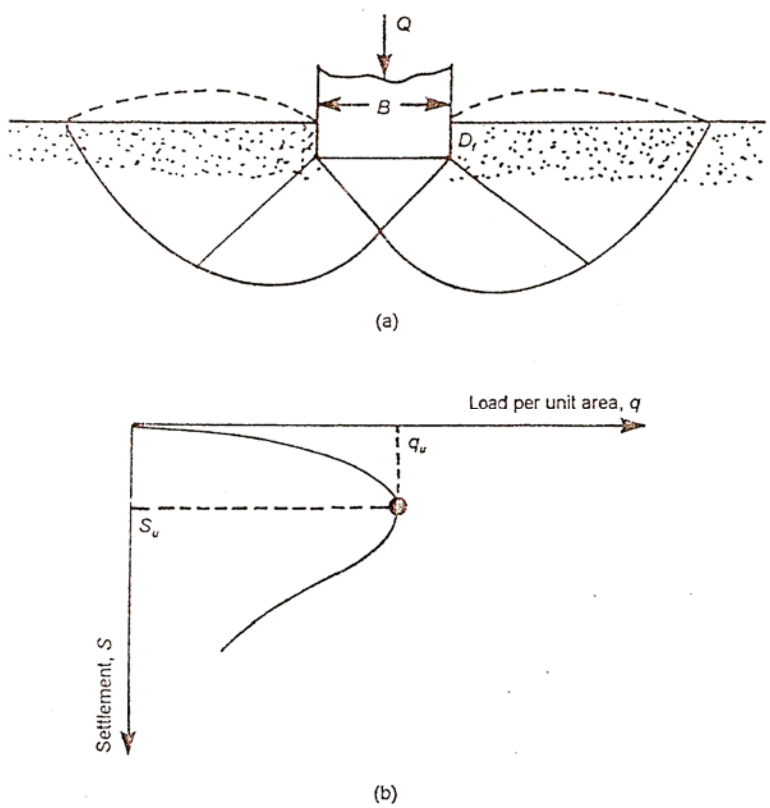


Fig. 1.1. General shear failure in soil

Fig. 1.1 shows a strip footing resting on the surface of a dense sand or a stiff clay. The figure also shows the load settlement curve, where q is the load per unit area and s is the settlement. At a certain load intensity equal to q_u, the settlement increases suddenly. A shear failure occurs in the soil and the failure surfaces extend to the ground surface. This type of failure is known as general shear failure. A heave on the sides is always observed in general shear failure.

1.2.2. LOCAL SHEAR FAILURE :

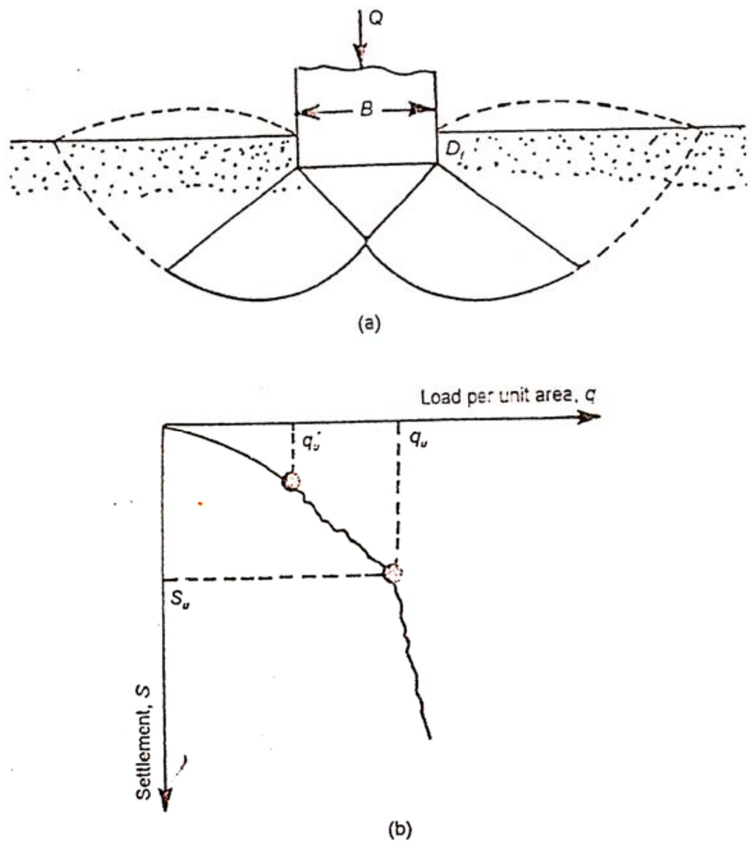


Fig. 1.2. Local shear failure in soil

Fig 1.2 shows a strip footing resting on a medium dense sand or on a clay of medium consistency. The figure also shows the load-settlement curve. When the load is equal to a certain value q_u', the foundation movement is accompanied by sudden jerks. The failure surfaces gradually extend outwards from the foundation, as shown in figure. However, a considerable movement of the foundation is required for the failure surfaces to extend to the ground surface. The load at which this happens is equal to q_u, Beyond this point, an increase of load is accompanied by a large increase in settlement. The failure is known as local shear failure. A heave is observed only when there is substantial vertical settlement.

1.2.3. PUNCHING SHEAR FAILURE :

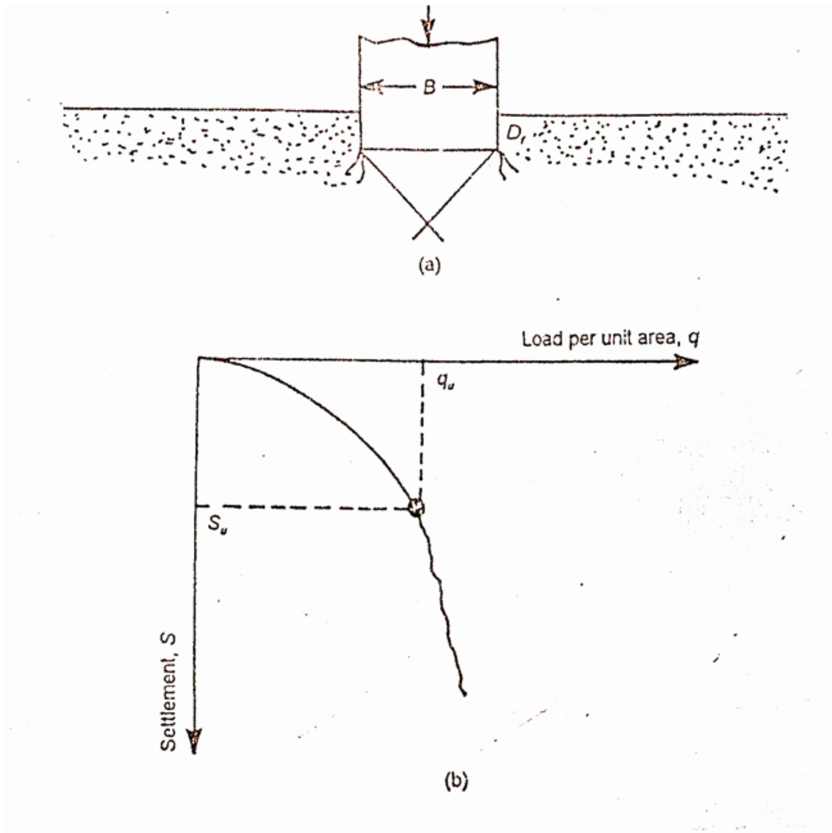


Fig. 1.3. Punching Shear Failure in soil

Figure 1.3 shows the same foundation located on a loose sand or soft clayey soil. For this case, the load-settlement curve will be like that shown in figure. A peak value of load per unit area, q, is never observed. The ultimate bearing capacity, q_u is defined as the point where $\Delta s/\Delta q$ becomes the largest and almost constant there after. This type of failure in soil is called punching shear failure. In this case, the failure surface never extends up to the ground surface. No heave is observed in punching shear failure. There is only vertical movement of footing.

The nature of failure in soil at ultimate load is a function of several factors such as the strength and the relative compressibility of soil, the depth of the foundation (D_f) in relation to the foundation width (B), and the width-to- length ratio (B/L) of the foundation. This was clearly explained by Vesic who conducted extensive laboratory model tests in sand.

The bearing capacity of shallow footing during the last fifty years has been extensively studied by several investigators [Prandtl ,1920; Reissner, 1926; Terzaghi, 1943; Meyerhof, 1951; Caquot and Kerisel, 1953; De Beer, 1963; Baki and Beik, 1970; Hansen, 1970; Vesic, 1973; Chen, 1975; Ingra and Baecher, 1983; Kumbhojkar, 1993; Zadroga, 1994; Dewaiker and Mohapatro, 1994; Frydman and Burd, 1997; Michalowki, 1997; Paolcci and Pecker, 1997; Soubra, 1999; Perkins and Madson, 2000 amongst others]. The bearing capacity solutions use the slip-line method, limit analysis method, finite element method, and limit equilibrium method. Limit equilibrium method, which is adopted by Terzaghi. Only numerical values of the bearing capacity factors differ accordingly to the specific assumption or approximation adopted in the solutions. Further more to account the original theory (e.g., footing shape; depth and tilts; rigidity and layering of solution of soil below a footing; inclination of applied loads.) a series of correction factors are applied to the N_c, N_q and N_γ terms. This trend of enhancing the accuracy of the bearing capacity calculation without altering the basic equation is a proof of overwhelming acceptance of Terzaghi's approach regardless of the concern about its theoretical correctness.

Raft foundations are widely used in supporting structures for many reasons such as weak soil conditions or heavy columns loads. In many cases, some problems arise such as the construction is adjacent to an old building or the foundation depth is so great that the excavation needs to be braced during foundation construction (e.g., basement excavation). One of the available solutions is to sheet piles to support the excavation sides during construction. Due to the difficulty of removing these piles, they become part of the permanent structure and two problems arise. The first problem deals with the structural analysis of the raft if the piles are used as end supports for the raft. The second problem is the effect of these piles on the lateral movement of the soil underneath the raft and the effect of this confinement on the bearing capacity of the soil. While there are several solutions for the first problem, such as isolating the raft from the piles, the confining effect of these piles on the raft behavior is not clearly understood. Looking to the problem in a smaller scale, it can be modeled as a circular footing supported on a soil, which is surrounded by a confining cylinder. The strength of confined sand was studied by Rajagopal et al. (1999). They carried out a large number of triaxial compression tests to study the influence of geocell confinement on the strength and stiffness behavior of granular soils. Geocells fabricated by hand using different geotextiles were used to investigate the effect of the stiffness of the geocell on the overall performance of geocell–soil composite.

Several investigators have reported significant effect of soil confinement by using horizontal soil reinforcement to increase the bearing capacity of supporting soils. This was achieved by placing layers of geogrid at different depths and widths under the footing. The soil reinforcement is not only placed horizontally but also can be placed vertically besides the footing to resist the lateral deformation of the soil. The use of vertical reinforcement along with horizontal reinforcement was investigated as well. The reinforcement consists of a series of interlocking cells, constructed from polymer geogrids, which contain and confine the soil within its pocket geogrid. Rea and Mitchell (1978) conducted a series of model plate loading tests on circular footing supported over sand-filled square-shaped paper grid cell to identify different modes of failure and arrive at optimum dimensions of the cell. Dash et al. (2001) performed an experimental study on the bearing capacity of a strip footing supported by a sand bed reinforced with a geocell mattress. Critical dimensions of reinforcement and depth of placement for mobilizing maximum bearing capacity improvement were presented.

The aim of this thesis is to investigate the influence on bearing capacity, of a skirted circular footing. The studied parameters include the skirt height and skirt diameter of the footing. In this way this thesis gives an idea of improving the footing response by using a confining skirt around individual footing.

CHAPTER -2
ULTIMATE BEARING CAPACITY THEORIES

During the last fifty years, several bearing capacity theories were proposed for estimating the ultimate bearing capacity of shallow foundations. This chapter summarizes some of the important works developed so far. The cases considered in this chapter assume that the soil supporting the foundation extends to a great depth and also that the foundation is subjected to centric vertical loading.

Foundations, like the structures or equipment they support, are usually designed to meet certain serviceability and strength criteria. Serviceability conditions dictate that the foundation should perform such that under normal operating loads the structure or equipment it supports may fulfill its design purpose. These serviceability limitations are typically described by settlement or other motion limitations. The strength criteria have the purpose of ensuring that the foundation has sufficient reser4ve strength to resist the occasionally large load that may be experienced due to extreme environmental forces or other sources. In most, but not all cases, the serviceability or settlement criteria and the strength criteria may be treated as unrelated design tasks. Serviceability is a typically a long-term consideration for the foundation that may depend on time-dependent consolidation characteristics. Foundation strength, or bearing capacity, may be a short-termed problem such as an embankment construction on an untrained clay foundation or a long-term problem in which the maximum foundation load may appear at some unknown time.

A shallow foundation may be defined as one in which the embedment depth of the foundation is less than its least characteristic dimension. Usually, the bearing capacity of a foundation is determines by limit equilibrium, limit analysis, or slip-line solutions. The Varity of solutions available for a particular problem may lead to some uncertainty about which is the more appropriate procedure. In the following, the basic of these solution procedures will be summarized and method for their use presented.

2.1. METHODS OF ANALYSIS:

At present time, the analysis of foundation can be made by employing one of the following four widely used methods:

1. Slip-line method
2. Limit equilibrium methods
3. Limit analysis methods
4. Finite-element methods

The first three methods are used in association with stability problems where the bearing capacity is sought. If, instead, the foundation settlement or stress distribution or stress distribution within the soil mass are of prime interest, then the fourth method must be used. Brief description of the first three procedures are given here.

The slip-line method involves construction of a family of shear or slip lines in the vicinity of footing load. These slip-lines, which represent the direction of maximum shear stress, form a network known as slip-line fields. The plastic slip-line fields are bounded by regions that are rigid. For plane equilibrium and one equation for the yield conditions available for solving for the three unknowns stresses. These equations are written with respect to curvilinear coordinates that coincide with slip-lines. If the foundation boundary conditions are given only in terms of stresses, these equations are sufficient to give the stress distribution without any references to the stress-strain relationship. However, if displacement or velocity are specified over part of the boundary, then the constitutive relation must be used to relate the stresses to the strain and the problem becomes much more complicated. Although solutions may be obtained analytically, numerical and graphical methods are often found necessary (see Sokolovskii, 1965; Brinch Hansen, 1961, 1970).

The method described in the well-known textbook by Terzaghi (1943) and by Taylor (1948), or the method developed by Meyerhof (1951) are all classified here as method of limit equilibrium. They can best be describing as approximate approach to constructing the slip-line fields. The solution requires that assumptions be made regarding the shape of the failure surface and the normal stress distribution along such a surface. The stress distribution usually satisfies the yield conditions and the equation of static equilibrium in an overall sense. By trial and error, it is possible to find a most critical location of the assumed slip surface from which the capacity of the footing can be calculated.

In addition to the yield condition, the limit analysis methods consider the soil stress-strain relationship in an idealized manner. This idealization, termed normality or the flow rule establishes the limit theorem on which limit analysis is based. The methods offer an upper and lower bound to the true solution. The upper-bond solution is calculated from a kinematically admissible velocity field that satisfies the velocity boundary conditions and is continuous except at certain discontinuity surface where the normal velocity must be continuous, but the tangential velocity may undergo a jump on crossing a boundary. Similarly, the lower-bond solution is determined from a statically admissible stress field that satisfy the stress boundary conditions, is in equilibrium, and nowhere violates the failure condition. If the two solutions coincide, then the method give the true answer for the problem considered. A good treatment of the subject is given by Chen (1975) and Chen and Liu (1990).

The method describe above are related in a manner. Most of the slip-line solution give kinematically admissible velocity fields and thus can be considered as an upper-bond solution provided that the velocity boundary conditions are satisfied. If the stress field within the plastic zone can be extended into the rigid region so that the equilibrium and yield conditions are satisfied, then the solutions may be the exact solutions. Shield (1995) has shown this for many cases. The extensive work that has been done on the stability analysis, including using the slip-line methods, is summarized in the book by Sokolovskii (1965).

Limit equilibrium method utilized the basic philosophy of the upper-bound rule, that is, a failure surface is assumed and the least answer is sought. However, it gives no consideration to soil kinematics and the equilibrium conditions are satisfied only in limited sense. Therefore, limit equilibrium solutions are not necessarily an upper bound or lower bound. However, any upper-bound solution from limit analysis will obviously be a limit equilibrium solution. Nevertheless, the method has been the most widely used owing to its simplicity and reasonably good accuracy.

The limit analysis method itself has many striking features that should appeal to researchers, as well as engineers. The problem formulation is generally simple and an analytically solution is always assured. In simple problems, it has been shown to yield reasonable answer when compared to limit equilibrium solutions. Its capability of providing a mean for bounding the true solution is noteworthy. Finally, the method is efficient and can be extended to solve more difficult footing problems for which other method is efficient and can be extended to solve more difficult footing problem for which other method have so far failed.

2.2. SOIL GOVERNING PARAMETERS:

The bearing capacity of footing depends not only on the mechanical properties of the soil (cohesion c and friction angle ϕ), but also on the physical characteristics of the footing (width B, depth D, length L, and roughness δ). For a coulomb material, Cox (1962) has shown that for a smooth surface footing bearing on a soil subjected to no surcharge, the fundamental dimensionless parameters associated with the stress characteristics equations are ϕ and $G = \gamma B/2c$, where γ is the unit weight of the soil. When G is small, the soil behaves essentially as a cohesive weightless medium. If G is large, soil weight rather than cohesion is a principal source of bearing strength. For most practical cases, one can expect that ϕ lies in the range of 0^o to 40^o and G will range from 0.1 to 1.0. These limits assume that c ranges from 500 to 1000 psf, and that the footing width ranges from 3 to 10 ft. the dimensionless bearing capacity q/c depends only on the angle of internal friction of the soil ϕ, the dimensionless soil weight parameter G, footing base friction angle δ, surcharge depth ratio D/B, and the base dimensions B and L.

For the most part, the bearing capacity of footing on soils have in the past been calculated by a superposition method, suggested by Terzaghi (1943) in which the contributions to the bearing capacity from different soil and loading parameters are summed. These contributions are represented by the expression, $q_o = c\ N_c + qN_q + \gamma BN_\gamma/2$, where q_o is the average pressure over the footing contact area A, q is the overburden or surcharge pressure at the foundation base and the bearing capacity factors Nc, Nq and Ng represents the effect due to soil cohesion, surface loading, and soil unit weight, respectively. Above equation is valid for strip footing subjected to vertical center loads. However, other geometries are common. The parameters N are all functions of the angle of internal friction ϕ. Terzaghi's quasiempirical method assumed that these effects are directly superposable, where the soil behavior in the plastic region is nonlinear and thus superposition does not hold for general soil bearing capacities. The reason for using the simplified (superposition) method is largely the mathematical difficulties encountered when using conventional equilibrium method.

2.3. TERZAGHI'S BEARING CAPACITY THEORY:

In 1948, Terzaghi proposed a well-conceived theory to determined the ultimate bearing capacity of shallow rough rigid continuous (strip) foundation supported by a homogeneous soil layer extending to a great depth. Terzaghi defined a shallow foundation as a foundation where the width, B, is equal to or less than its depth, D_f. The failure surface in soil at ultimate load (that is, q_u, per unit area of the foundation) assumed by Terzaghi is shown in Fig. 2.1. Referring to Fig. 2.1, the failure area in the soil under the foundation can be divided into three major zones. They are:

1. Zone abc. This is a triangular elastic zone located immediately below the bottom of the foundation. The inclination of sides ac and bc of the wedge with the horizontal is $\alpha = \phi$ (soil friction angle).
2. Zone bcf. This zone is the Prandtl's radial shear zone.
3. Zone bfg. This zone is the Rankine passive zone. This slip lines in this zone make angles of $\pm(45\text{-}\phi/2)$ with the horizontal.

Note that a Prandtl's radial shear zone and a Rankine passive zone are also located to the left of the elastic triangular zone abc; however, they are not shown in Fig. 2.2.

Line cf is an arc of a log spiral, defined by the equation

$$r = r_o \, e^{\theta \tan\phi} \tag{2.1}$$

Lines bf and fg are straight lines. Lines fg actually extends up to the ground surface. Terzaghi assumed that the soil located above the bottom of the foundation could be replaced by surcharge $q = \gamma D_f$.

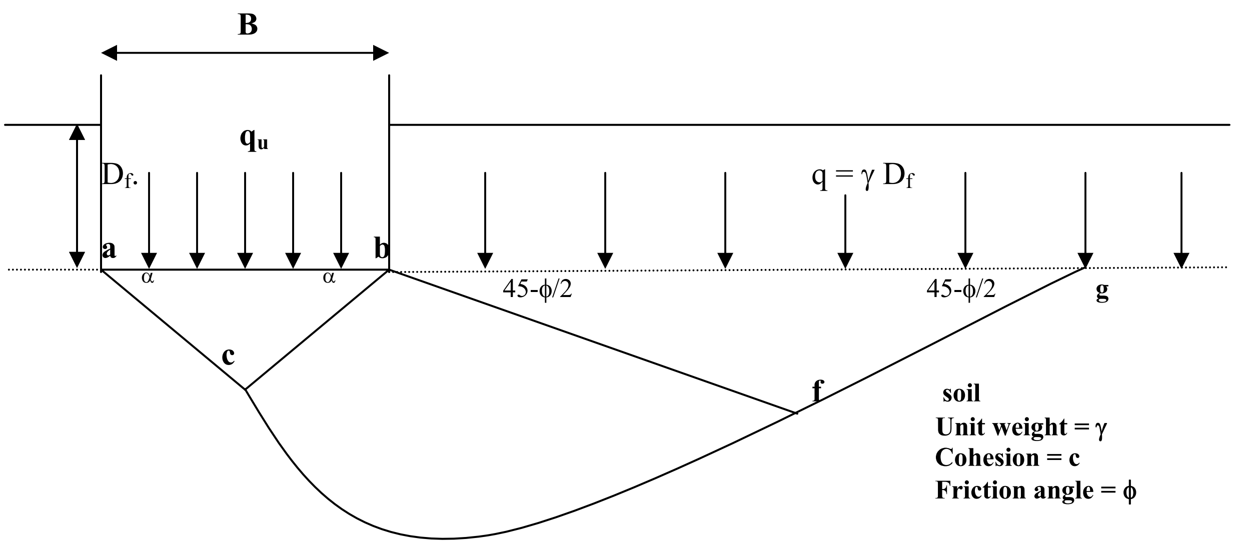


Fig. 2.1. failure surface in soil at ultimate load for a continuous rough rigid foundation as assumed by Terzaghi

The shear strength, s, of the soil can be given as

$$s = \sigma' \tan\phi + c \tag{2.2}$$

Where σ' = effective normal stress

c = cohesion

The ultimate bearing capacity, q_u, of the foundation can be determined if we considered faces ac and bc of the triangle wedge abc and obtained the passive force on each face requires to cause failure. Note that the passive force P_p will be a function of the surcharge $q = \gamma D_f$. Cohesion c, unit weight γ, and angle of friction of the soil ϕ. So, referring to Fig. 2.2.

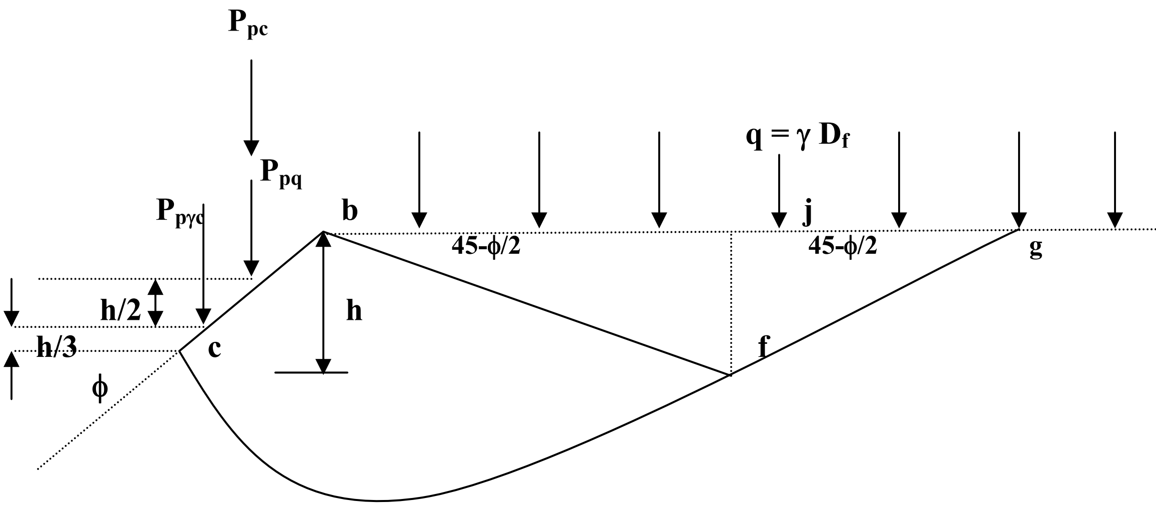


Fig. 2.2. Passive force on the face bc of wedge abc shown in figure 2.1

The passive force P_p on the face bc per unit length of the foundation at right to the cross section is

$$P_p = P_{pq} + P_{pc} + P_{p\gamma} \quad (2.3)$$

Where P_{pq}, P_{pc} and $P_{p\gamma}$ = passive force contributions of q, c and γ, respectively. It is important to note that the directions of P_{pq}, P_{pc} and $P_{p\gamma}$ are vertical, since the face bc makes an angle ϕ with the horizontal, and P_{pq}, P_{pc} and $P_{p\gamma}$ must make an angle ϕ to the normal to bc. In order to obtain P_{pq}, P_{pc} and $P_{p\gamma}$, the method of superposition can be used; however, it will not be an exact solution.

RELATIONSHIP FOR P_{pq} ($\phi \neq 0, \gamma = 0, q \neq 0, c = 0$):

Considered the free body diagram of the soil wedge bcfj shown in Fig.2.2 (also shown in Fig.2.3).

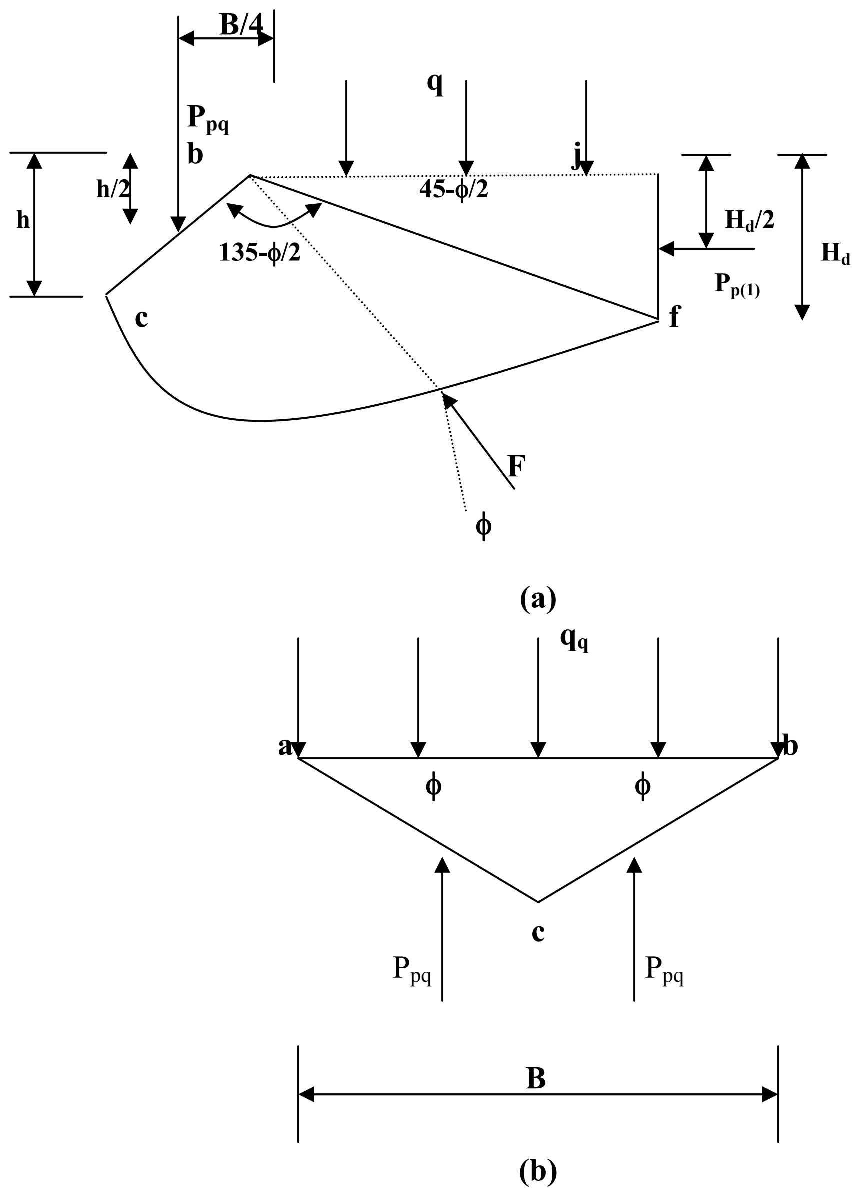


Fig. 2.3. Determination of P_{pq} ($\phi \neq 0, \gamma = 0, q \neq 0, c = 0$)

For this case the center of the log spiral, of which cf is an arc, will be at point b. the forces per unit length of the wedge bcfj due to the surcharge q only are shown in Fig2.3a, and they are:

1. P_{pq}
2. Surcharge, q
3. The Rankine passive force, $P_{p(1)}$
4. The frictional resistance force alone the arc cf, F

The Rankine passive force, $P_{p(1),}$ can be expressed as

$$\mathbf{P_{p(1)} = q\, K_p\, H_d = q\, H_d \tan^2 (45 + \phi/2)} \qquad \mathbf{(2.4)}$$

Where, $H_d = fj$

K_p = Rankine passive earth pressure coefficient = $\tan^2 (45 + \phi/2)$

According to the property of a log spiral defined by the equation $r = r_o\, e^{\theta \tan\phi}$, the radial line at any point makes an angle ϕ with the normal. Hence, the lines of action of the friction force F will pass through b, the center of the log spiral (as shown in Fig.2.3a). Taking the moment about point b

$$P_{pq}(B/4) = q(bj)\,(bj/2) + P_{p(1)}\, H_d/2 \qquad (2.5)$$

Let

$$bc = r_o = (b/2) \sec\phi \qquad (2.6)$$

$$bf = r_1 = r_o\, e^{(3\pi/4 - \phi/2)\tan\phi} \qquad (2.7)$$

So

$$bj = r_1 \cos (45 - \phi/2) \qquad (2.8)$$

And

$$H_d = r_1 \sin (45 - \phi/2) \qquad (2.9)$$

Combining Eqs. (2.4), (2.5), (2.8) and (2.9)

$$P_{pq}\, B/4 = q\, r_1^2 \cos^2 (45-\phi/2)/2 + q r_1^2 \sin^2 (45-\phi/2) \tan^2 (45+\phi/2)\, /2$$

Or

$$P_{pq} = 4\, [q\, r_1^2 \cos^2 (45-\phi/2)]\, /B \qquad (2.10)$$

Now combining Eqs. (2.6), (2.7), and (2.10)

$$P_{pq} = qB\, e^{2(3\pi/4 - \phi/2)\tan\phi} / \cos^2(45+\phi/2) \tag{2.11}$$

Considering the stability of the elastic wedge abc under the foundation as shown in Fig. 2.3b.

$$q_q\,(B \times 1) = 2\,P_{pq}$$

Where, q_q = load per unit area on the foundation, or

$$\mathbf{q_q = 2P_{pq}/B = q\,[e^{2(3\pi/4 - \phi/2)\tan\phi} / 2\cos^2(45+\phi/2)\,] = q\,N_q} \tag{2.12}$$

RELATIONSHIP FOR P_{pc} ($\phi \neq 0$, $\gamma = 0$, $q = 0$, $c \neq 0$):

Figure 2.4 shows the free body diagram for the wedge bcfj (also refer to Fig.2.2). As in the case of P_{pq}, the center of arc of the log spiral will be located at point b. the forces on the wedge which are due to cohesion c are also shown in Fig. 2.4, and they are

1. Passive force, P_{pc}
2. Cohesive force, $C = c(bc \times 1)$
3. Rankine passive force due to cohesion,

   $$P_{p(2)} = 2c\,(K_p)^{1/2}\,H_d = 2\,c\,H_d \tan(45+\phi/2)$$

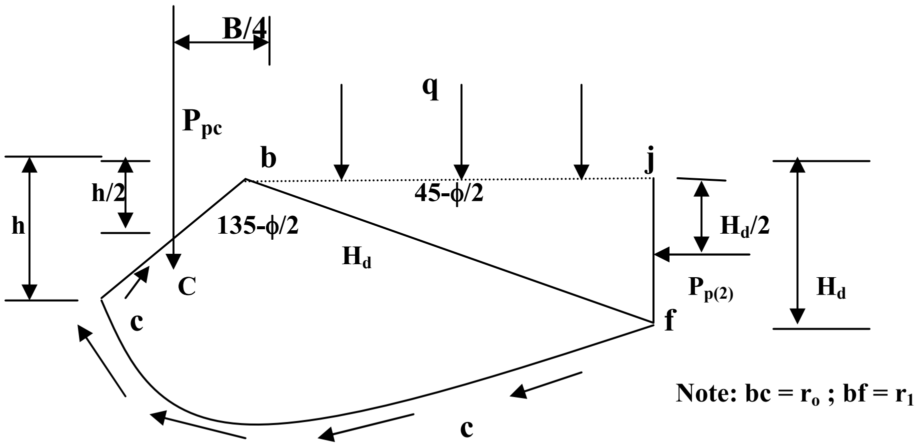
4. Cohesive force per unit area along arc cf, c.

Taking the moment of all the forces about point b

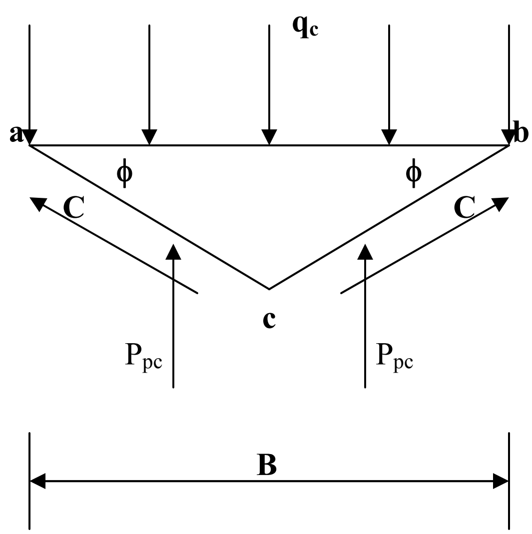
$$P_{pc}\,(B/4) = P_{p(2)}\,[\,r_1 \sin(45-\phi/2)/2] + Mc \tag{2.13}$$

Where Mc = moment due to cohesion c along arc cf

$$= c\,(r_1^2 - r_o^2) / 2\,\tan\phi \tag{2.14}$$



(a)



(b)

Fig. 2.4. Determination of P_{pc} ($\phi \neq 0, \gamma = 0, q = 0, c \neq 0$)

$$P_{pc}\,(B/4) = [2c\, H_d \tan(45+\phi/2)]\, [r_1 \sin(45-\phi/2)/2] + (c/2 \tan\phi)(r_1^2 - r_o^2) \qquad (2.15)$$

The relationship for H_d, r_o, and r_1 in terms of B and ϕ given in Eqs. (2.9), (2.6) and (2.7), respectively. Combining Eqs. (2.6), (2.7), (2.9), and (2.15), and noting that $\sin^2(45-\phi/2) \times \tan(45+\phi/2) = ½ \cos\phi$

$$P_{pc} = Bc(\sec^2\phi)\, [\{(e^{2(3\pi/4 - \phi/2)\tan\phi})(½ \cos\phi)\} + \{(e^{2(3\pi/4 - \alpha + \phi/2)\tan\phi} - 1) / 2 \tan\phi\}] \qquad (2.16)$$

Considering the equilibrium of the soil wedge abc (Fig.2.4b)

$$q_c(B \times 1) = 2\,C \sin\phi + 2P_{pc}$$

Or

$$q_c B = cB \sec\phi \sin\phi + 2P_{pc} \tag{2.17}$$

Where q_c = load per unit area of the foundation combining Eqs.(2.16) and (2.17)

$$q_c = c\sec\phi\, e^{2(3\pi/4 - \phi/2)\tan\phi} + c \sec^2\phi\, e^{2(3\pi/4 - \phi/2)\tan\phi} / \tan\phi - c[\sec^2\phi/ \tan\phi - \tan\phi] \tag{2.18}$$

$$q_c = ce^{2(3\pi/4 - \phi/2)\tan\phi}[\sec\phi + \sec^2\phi/ \tan\phi] - c[\sec^2\phi/ \tan\phi - \tan\phi] \tag{2.19}$$

However

$$\sec\phi + \sec^2\phi/ \tan\phi = \cot\phi[1/2\cos^2(45+\phi/2)] \tag{2.20}$$

Also

$$\sec^2\phi/ \tan\phi - \tan\phi = \cot\phi \tag{2.21}$$

From Eqs(2.20),(2.21)and(2.19)

$$\mathbf{q_c = c \cot\phi\, [\{(e^{2(3\pi/4 - \phi/2)\tan\phi} /2\cos^2(45+\phi/2)\} - 1] = cN_c = c \cot\phi\, (N_q - 1)} \tag{2.22}$$

RELATIONSHIP FOR $P_{p\gamma}$ ($\phi \neq 0, \gamma \neq 0, q = 0, c = 0$):

Figure2.5a shows the free body diagram of wedge bcfj. Unlike the free body diagram shown in Figs. 2.3 and 2.4, the center of the log spiral of which bf is an arc is at a point O along line bf and not at b. this is because the minimum value of $P_{p\gamma}$ has to be determined by several trials. Point O is only one trail center. The forces per unit length of the wedge that need to be considered are:

1. Passive force, $P_{p\gamma}$
2. The weight of wedge bcfj, W
3. The resultant of the frictional resistance force acting along arc cf, F
4. The Rankine passive force, $P_{p(3)}$

The Rankine passive force $P_{p(3)}$ can be given the relation

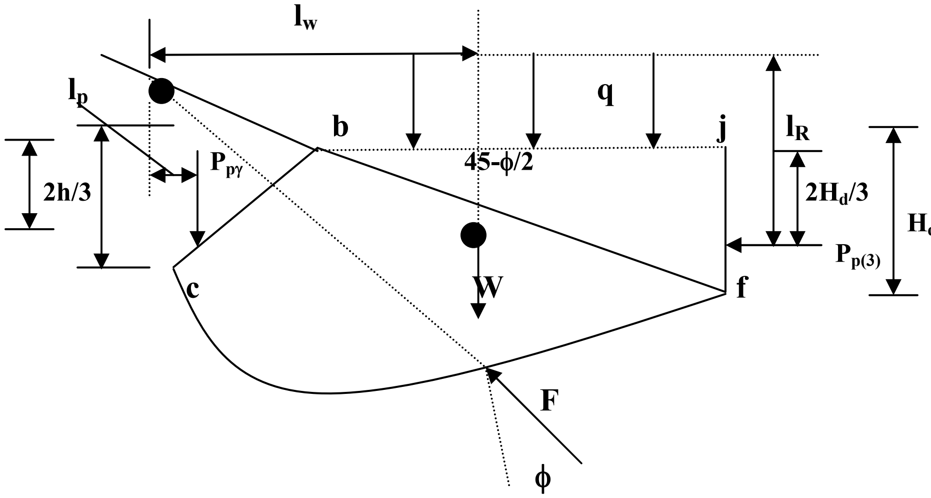
$$P_{p(3)} = \frac{1}{2} \gamma H_d^2 \tan^2(45+\phi/2) \tag{2.23}$$

Also note the line of action of force F will pass through O. taking the moment about O

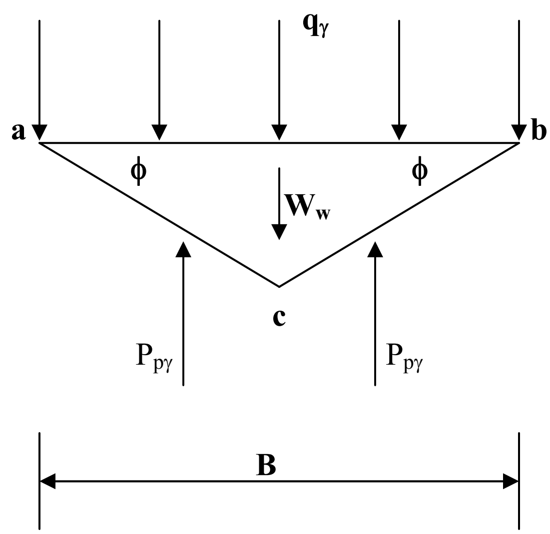
$$P_{p\gamma}\, l_p = W\, l_p + P_{p(3)}\, l_R$$

Or

$$P_{p\gamma} = [W\, l_w + P_{p(3)}\, l_R] / l_p \tag{2.24}$$



(a)



(b)

Fig.2.5. Determination of $P_{p\gamma}$ ($\phi \neq 0, \gamma \neq 0, q = 0, c = 0$)

If numbers of trail of this type are made by changing the location at the center of log spiral O along line bf, then the minimum value of $P_{p\gamma}$ can be determined.

Considered the stability of wedge abc as shown in Fig. 2.5, we can write that

$$q_{\gamma} B = 2 P_{p\gamma} - W_w \quad (2.25)$$

Where, q_γ = force per unit area of the foundation

W_w = weight of wedge abc

Howeve

$$W_w = B^2\gamma \tan\phi /4 \quad (2.26)$$

So

$$q_\gamma = 1/B\ (2\ P_{p\gamma} - B^2\gamma \tan\phi/4) \quad (2.27)$$

The passive force $P_{p\gamma}$ can be expressed in the form

$$P_{p\gamma} = ½\ \gamma\ h^2\ K_{p\gamma} = ½\ \gamma\ (B \tan\phi/2)^2\ K_{p\gamma} = 1/8\ \gamma\ B^2\ K_{p\gamma} \tan^2\phi \quad (2.28)$$

Where $K_{p\gamma}$ = passive earth pressure coefficient

Substituting Eq. (2.28) into Eq. (2.27)

$$q_\gamma = 1/B\ (\gamma\ B^2\ K_{p\gamma} \tan^2\phi/4 - B^2\gamma \tan\phi/4)$$

$$= ½\ \gamma\ B\ (½\ K_{p\gamma} \tan^2\phi - \tan\phi/2) = ½\ \gamma\ B\ N_\gamma \quad (2.29)$$

ULTIMATE BEARING CAPACITY:

The ultimate load per unit area of the foundation (that is,the ultimate bearing capacity q_u) for a soil with cohesion,friction and weight can now be given

$$q_u = q_q + q_c + q_\gamma \quad (2.30)$$

substituting the relationship for q_q,q_c and q_γ given by eqs.(2.12),(2.22) and (2.29) into eq. (2.30) yields

$$\mathbf{q_u = cN_c + qN_q + ½\ \gamma B N_\gamma} \quad \textbf{(strip foundation)} \quad \textbf{(2.31)}$$

Where,

c = cohesion of soil

γ = unit weight of soil

$q = \gamma\ D_f$

N_c, N_q and N_γ = bearing capacity factors that are Nondimensional and only function of the soil friction angle, ϕ

The bearing capacity factors, N_c, N_q and N_γ are defined by

$$N_q = e^{2(3\pi/4 - \phi/2)\tan\phi} / 2\cos^2(45+\phi/2) \quad (2.32)$$

$$N_c = \cot\phi\,(N_q - 1) \quad (2.33)$$

$$N_\gamma = \tfrac{1}{2} K_{p\gamma} \tan^2\phi - \tan\phi/2 \quad (2.34)$$

Where , $K_{p\gamma}$ = passive pressure coefficient

The variation of bearing capacity factors defined by Eqs. 2.32, 2.33 and 2.34 are given in Table-2.1

Table 2.1. Bearing-capacity factor for Terzaghi equations

Value of N_γ for f of 34 and 48^o are original Terzaghi value and used to back-compute $K_{p\gamma}$

ϕ, deg	N_c	N_q	N_γ	$K_{p\gamma}$
0	5.7	1.0	0.0	10.8
5	7.3	1.6	0.5	12.2
10	9.6	2.7	1.2	14.7
15	12.9	4.4	2.5	18.6
20	17.7	7.4	5.0	25.0
25	25.1	12.7	9.7	35.0
30	37.2	22.5	19.7	52.0
34	52.6	36.5	36.0	59.5
35	57.8	41.4	42.4	82.0
40	95.7	81.3	100.4	141.0
45	172.3	173.3	297.5	298.0
48	258.3	287.9	780.1	650.6
50	347.5	415.1	1153.2	800.0

For estimating the ultimate bearing capacity of square or circular foundation Eq. (2.31) may be modified as follows -

$$\mathbf{q_u = 1.3\ cN_c + q\ N_q + 0.4\ \gamma\ B\ N_\gamma}\quad \textbf{(square footing)} \qquad \textbf{(2.35)}$$

And

$$\mathbf{q_u = 1.3\ cN_c + q\ N_q + 0.3\ \gamma\ B\ N_\gamma}\quad \textbf{(circular footing)} \qquad \textbf{(2.36)}$$

In Eq.(2.35), B equals the dimensions of each side of the foundation; in Eq. (2.36), B equals the diameter of the foundation.

Since Terzaghi's founding work, numerous experimental studies to estimate the ultimate bearing capacity of shallow foundation have been conducted. Based on these studies, it appears that Terzaghi's assumption of the failure surface in soil at ultimate load is essentially correct. However, the angle α that the sides ac and bc of the wedge (Fig. 2.1) make with the horizontal is closer to $45 + \phi/2$ and not ϕ as assumed by Terzaghi. (In actual practice, α has been found to vary from $45 - \phi/2$ for perfectly smooth base to $45 + \phi/2$ for perfectly rough base. Since footings are normally rough, α has been found closer to $45 + \phi/2$ than to ϕ).

For foundations that the local shear failure mode in soil, Terzaghi suggested modifications to Eqs. (2.31), (2.35) and (2.36) as follows:

$$\mathbf{q_u = 2/3\ cN'_c + q\ N'_q + \tfrac{1}{2}\ \gamma\ B\ N'_\gamma}\quad \textbf{(strip foundation)} \qquad \textbf{(2.37)}$$

$$\mathbf{q_u = 0.867\ cN'_c + q\ N'_q + 0.4\ \gamma\ B\ N'_\gamma}\quad \textbf{(squar foundation)} \qquad \textbf{(2.38)}$$

$$\mathbf{q_u = 0.867\ cN'_c + q\ N'_q + 0.3\ \gamma\ B\ N'_\gamma}\quad \textbf{(circular footing)} \qquad \textbf{(2.39)}$$

N'_c, N'_q and N'_γ are the modified bearing capacity factors. They can be calculated by using the bearing capacity factor equations (for N'_c, N'_q and N'_γ) by replacing ϕ by

$\phi' = \tan^{-1} (2/3 \tan \phi)$.

Terzaghi's bearing capacity equation have now been modified to take into account the effects of the foundation shape (B/L), depth of embedment (D_f), and the load inclination. This is given in tables in coming pages. Many design engineers, however, still use Terzaghi's equation, which provides fairly good results considering the uncertainty of the soil conditions at various sites.

2.3.1. ASSUMPTION AND LIMITATIONS IN TERZAGHI'S ANALYSIS:

1. The soil is homogeneous and isotropic and its shear strength is represented by Coulomb's equation.
2. The strip footing has a rough base, and the problem is essentially two-dimensional.
3. The elastic zone has straight boundaries inclined at $\alpha = \phi$ to the horizontal, and the plastic zones fully develop.
4. Pp consists of three components, which can be calculated separately and added, although the critical surface for these components are not identical.
5. Failure zones do not extend the horizontal plane through the base of the footing, i.e. the shear resistance of soil above the base is neglected and the effect of soil around the footing is considered equivalent to a surcharge $\sigma = \gamma$ D.

LIMITATIONS :

1. As the soil compressed, ϕ changes; slight downward movement of footing may not develop fully the plastic zones.
2. Error due to assumption 4 is small and on the safe side.
3. Error due to assumption 5 increases with depth of foundation, and hence the theory is suitable for shallow foundation only.

2.4. MEYERHOF'S BEARING CAPACITY EQUATION:

Meyerhof (1951, 1963) proposed a bearing capacity equation similar to that of Terzaghi, but included a shape factor s_q for the depth term N_q. He also included depth factor d_i and inclination factor i_i for cases where the footing load is inclined from the vertical. This procedure equation of the general form shown on Table 2.1, with N factors in Table 2.4.

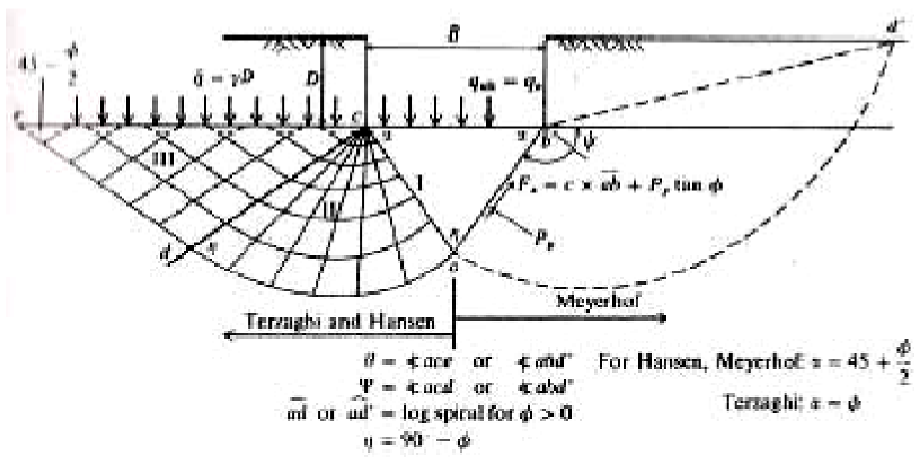


Fig. 2.6. General footing-soil interaction for bearing capacity equations for strip footing- left side Terzaghi(1943),Hansen(1970) and right sideMeyerhof(1951).

Meyerhof obtained his N factor by making trials of the zone abd' with arc ad', which includes an approximate for shear along cd of Fig 2.6. The shape, depth and inclination factors in Table 2.3 are from Meyerhof (1963) and are somehow different from his 1951 valued. The shape factors do not greatly differ from those given by Terzaghi except for the addition of sq. observing that the shear effect along cd of Fig. 2.6 was being somewhat ignored, Meyerhof proposed depth factor d_i.

He also proposed using inclination factors to reduce the bearing capacity when the load resultant was inclined from the vertical by the angle θ.

Up to about D = B of Fig. 2.6 Meyerhof's q_u is not greatly differ from the Terzaghi value. The difference is more pronounced at larger D/B ratios.

Table 2.2.Bearing capacity equations by several authors indicated

TERZAGHI :

$$q_u = cN_c + qN_q + 0.5\gamma BN_\gamma s_\gamma$$

$N_q = a^2 / 2\cos^2(45+\phi/2)$

$a = e^{(0.75\pi-\phi/2)\tan\phi}$

$N_c = (N_q - 1)\cot\phi$

$N_\gamma = \tan\phi/2\ (K_{p\gamma}/\cos^2\phi\ \ - 1)$

For:	strip	round	square
s_c =	1.0	1.3	1.3
s_γ =	1.0	0.6	0.8

MEYERHOF :

Vertical load : $q_u = cN_c s_c d_c + qN_q s_q d_q + 0.5\gamma BN_\gamma s_\gamma d_\gamma$

Inclined load: $q_u = cN_c d_c i_c + qN_q d_q i_q + 0.5\gamma BN_\gamma d_\gamma i_\gamma$

$N_q = e^{\pi\tan\phi}\tan^2(45+\phi/2)$

$N_c = (N_q - 1)\cot\phi$

$N_\gamma = (N_q - 1)\tan(1.4\phi)$

HANSEN :

General : $q_u = cN_c s_c d_c i_c g_c b_c + qN_q s_q d_q i_q g_q b_q + 0.5\gamma BN_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$

When $\phi = 0$

Use $q_u\ 5.14s_u(1 + s'_c + d'_c - I'_c - b'_c - g'_c) + q$

N_q = same as Meyerhof above

N_c = same as Meyerhof above

$N_\gamma = 1.5\ (N_q - 1)\tan\phi$

VESIC:

Use Hansen's equation above

N_q = same as Meyerhof above

N_c = same as Meyerhof above

$N_\gamma = 2(N_q + 1)\tan\phi$

Table 2.3. Shape, Depth and inclination factors for the Meyerhof bearing –capacity equation of Table –2.2

Factors	value	for
Shape :	$s_c = 1 + 0.2\ K_p\ B/L$	Any ϕ
	$s_q = s = 1 + 0.1\ K_p\ B/L$	$\phi > 10^o$
	$s_q = s_\gamma = 1$	$\phi = 0$
Depth:	$d_c = 1 + 0.2\ (K_p)^{1/2}\ D/B$	Any ϕ
	$d_q = d_\gamma = 1 + 0.1\ (K_p)^{1/2}\ D/B$	$\phi > 10$
	$d_q = d_\gamma = 1$	$\phi = 0$
Inclination:	$i_c = i_q = (1 - \theta^o/90^o)^2$	Any ϕ
	$i_\gamma = (1 - \theta^o/\phi^o)2$	$\phi>0$
	$i_\gamma = 0$	$\phi = 0$

$K_p = \tan^2(45 + \phi/2)$

θ = angle of resultant measured from vertical without a sign

2.5. HANSENE'S BEARING CAPACITY METHOD:

Hansen (1970) proposed the general bearing capacity case and N factor equation shown in Table 2.2. It can be readily seen that this equation is a further extension of the earlier Meyerhof (1951) work. Hansene's shape, depth, and other factors making up the general bearing capacity equation proposal in 1957 and 1961. The extension includes a factor for the footing being tilted from the horizontal b_i and for the possibility of the footing being on a slope g_i. Table 2.4 give selected N values for the Hansen equation together with the more difficult shape and depth factor aids.

Any of the equation not subscripted with a (V) may be used as appropriate (limitations and restriction are noted in the Table). When the value used in the inclination equation has the horizontal load component H parallel to B one should use B' with the N_γ term in the bearing capacity equation and if H is parallel to L use L' with N_γ. A further restriction is $i_i > 0$ since a value of $i_i \leq 0$ is an unstable footing that requires resizing before proceeding. For a footing on clay with $\phi = 0$ compute i_c using H parallel to B and/or L as appropriate and note it is a subtractive constant in the modified bearing capacity equation. We note that when the base is tilted V and H are perpendicular and parallel, respectively, to the base as compared with when it is horizontal.

For footing on a slope g_i factor are used to reduce the bearing capacity, however, these- as with the factor of Table 2.5 should be used cautiously as here is little experimental data available other than the work of Shields et. al. (1977) who used model footing on a sand box slope. It is difficult to see a field case where one would use a spread footing in a cohesionless soil slope unless the slope angle β is very and the footing depth D very large. In any case, since there are already shear stresses in the slop soil (holding the slop in place) one should not adjust any ϕ_{tr} to the large plane strain value and, additionally, one should use a large safety factor.

The Hansen equation implicitly allows ant D/B and thus can be used for both shallow (footing) and deep (piles, drill caisson) bases. Inspection of the qN_q term implies a great increase in q_{ult} with great depth. To place modest limits on this Hansen used

$$\left.\begin{aligned} d_c &= 1 + 0.4D/B \\ d_q &= 1 + 2\tan\phi(1 - \sin\phi)^2\, D/B \end{aligned}\right\} D/B \leq 1$$

$$\left.\begin{aligned} d_c &= 1 + 0.4 \tan^{-1} D/B \\ d_q &= 1 + 2\tan\phi(1 - \sin\phi)^2 \tan^{-1} D/B \end{aligned}\right\} D/B > 1$$

This gives a discontinuity at D/B = 1; however, note the use of ≤ and>. For f = 0, we have

D/B =	0	1	1.1	2	5	10	20	100
d_c' =	0	0.40	0.33	0.44	0.55	0.59	0.61	0.62

We can see that use of $\tan^{-1}$ D/B for D/B > 1 controls the increase in d_c and d_q in line with observation that q_{ult} appears to reach some limiting value at some depth ratio D/B where this value of D is often termed the critical depth.

2.6.VESIC'S BEARING CAPACITY EQUATIONS:

The Vesic (1973, 1974) procedure that is essentially the Hansen method will be briefly noted. Essentially differences in this method are in using a slight difference N_γ (see table 2.4) and a variation on some of Hansen's i_i, b_i, and g_i factor as noted with the subscript (V) in Table 2.5. Any of the factor not subscribed with an (H) can be used for a Vesic solution. Note that some of the Vesic factors are less conservative than those of Hansen and since none of the methods have been extensively verified with full-scale field test one should exercise caution in their use.

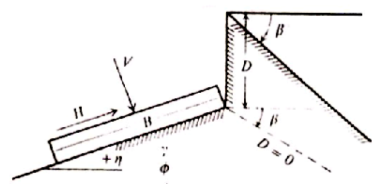
Table 2.4. Bearing-capacity factors for the Meyerhof, 1951; Hansen, 1970; and Vesic, 1973

Bearing-capacity equations

Note that N_c and N_q are same for all three methods; subscript identify auther for N_γ

ϕ	N_c	N_q	$N_{\gamma(H)}$	$N_{\gamma(M)}$	$N_{\gamma(V)}$
0	5.14	1.0	0.0	0.0	0.0
5	6.49	1.6	0.1	0.1	0.4
10	8.34	2.5	0.4	0.4	1.2
15	10.97	3.9	1.2	1.1	2.6
20	14.83	6.4	2.9	2.9	5.4
25	20.71	10.7	6.8	6.8	10.9
26	22.25	11.8	7.9	8.0	12.5
28	25.79	14.7	10.9	1.2	16.7
30	30.13	18.4	15.1	5.7	22.4
32	35.47	23.2	20.8	22.0	30.2
34	42.14	29.4	28.7	31.1	41.0
36	50.55	37.7	40.0	44.4	56.2
38	61.31	48.9	56.1	64.0	77.9
40	75.25	64.1	79.4	93.6	109.3
45	133.73	134.7	200.5	262.3	271.3
50	266.50	318.5	567.4	871.7	761.3

Table 2.5.Shape,depth,inclination,ground and base factors for use in either the Hansen(1970) or Vesic(1973) bearing capacity equations of table 2.2. Factors apply to either method unless subscribed with (H) or (V). used primed factors when $\phi = 0$

Shape factors	Depth factors	Inclination factors	Ground factors (base on slope)
$s'_c = 0.2 \cdot \frac{B}{L}$ $s_c = 1 + \frac{N_q}{N_c} \cdot \frac{B}{L}$ $s_c = 1$ for strip	$d'_c = 0.4k$ $d_c = 1 + 0.4k$	$i'_{c(H)} = 0.5 - 0.5\sqrt{1 - \frac{H}{A_f c_a}}$ $i'_{c(V)} = 1 - \frac{mH}{A_f c_a N_c}$ $i_c = i_q - \frac{1 - i_q}{N_q - 1}$ (Hansen and Vesić)	$g'_c = \frac{\beta^\circ}{147^\circ}$ for Vesić use $N_\gamma = -2 \sin \beta$ for $\phi = 0$ $g_c = 1 - \frac{\beta^\circ}{147^\circ}$
$s_q = 1 + \frac{B}{L} \tan \phi$	$d_q = 1 + 2 \tan \phi (1 - \sin \phi) k$		$g_{q(H)} = g_{\gamma(H)} = (1 - 0.5 \tan \beta)^5$
$s_\gamma = 1 - 0.4 \cdot \frac{B}{L}$	$d_\gamma = 1.00$ for all ϕ	$i_{q(H)} = \left(1 - \frac{0.5H}{V + A_f c_a \cot \phi}\right)^5$	$g_{q(V)} = g_{\gamma(V)} = (1 - \tan \beta)^2$ **Base factors (tilted base)**
	$k = \frac{D}{B}$ for $\frac{D}{B} \leq 1$ $k = \tan^{-1} \frac{D}{B}$ for $\frac{D}{B} > 1$ (rad)	$i_{q(V)} = \left(1 - \frac{H}{V + A_f c_a \cot \phi}\right)^m$	$b'_c = \frac{\eta^\circ}{147^\circ}$ $b_c = 1 - \frac{\eta^\circ}{147^\circ}$
Where A_f = effective footing area $B' \times L'$ (see Fig. 4-4) c_a = adhesion to base = cohesion or a reduced value D = depth of footing in ground (used with B and not B') e_B, e_L = eccentricity of load with respect to center of footing area H = horizontal component of footing load with $H \leq V \tan \delta + c_a A_f$ V = total vertical load on footing β = slope of ground away from base with downward = (+) δ = friction angle between base and soil—usually $\delta = \phi$ for concrete on soil η = tilt angle of base from horizontal with (+) upward as usual case		$i_{\gamma(H)} = \left(1 - \frac{0.7H}{V + A_f c_a \cot \phi}\right)^5$ $(\eta = 0)$ $i_{\gamma(H)} = \left(1 - \frac{(0.7 - \eta^\circ/450)H}{V + A_f c_a \cot \phi}\right)^5$ $(\eta > 0)$ $i_{\gamma(V)} = \left(1 - \frac{H}{V + A_f c_a \cot \phi}\right)^{m+1}$	$b_{q(H)} = \exp(-2\eta \tan \phi)$ $b_{\gamma(H)} = \exp(-2.7\eta \tan \phi)$ $b_{q(V)} = b_{\gamma(V)} = (1 - \eta \tan \phi)^2$ *Notes:* $\beta + \eta \leq 90^\circ$ $\beta \leq \phi$
General: 1. Do not use s_i in combination with i_i. 2. Can use s_i in combination with d_i, g_i, and b_i. 3. For $L/B \leq 2$ use ϕ_{tr} For $L/B > 2$ use $\phi_{ps} = 1.5\phi_{tr} - 17$ For $\phi \leq 34^\circ$ use $\phi_{ps} = \phi_{tr}$		$m = m_B = \frac{2 + B/L}{1 + B/L}$ H parallel to B $m = m_L = \frac{2 + L/B}{1 + L/B}$ H parallel to L *Note:* $i_q, i_\gamma > 0$	

2.7. NUMERICAL EVALUATION OF TERZAGHI'S N_γ:

While developing the solution, Eq. $\mathbf{q_u = cN_c + qN_q + ½ \gamma BN_\gamma}$ and Fig.2.7, Terzaghi (1943) makes a series of assumptions (e.g., replacement of the soil located above the base of the footing by a uniform surcharge, limit equilibrium), separates contributions of c, q, and γ, and calculates q, by superposition. Key details of his procedure relevant to the present paper are briefly summarized here. Fig. 2.8(a) (after Terzaghi 1943) shows a shallow, strip footing with rough base resting on a horizontal surface. The soil below the footing is in a state of plastic equilibrium under general shear failure. Terzaghi uses Prandtl's mechanism to divide the body of soil *iecdh* into an elastic zone *abc*, I, and symmetric radial shear, II, and passive Rankine zones, III, and assumes that the radial shear zone is bounded by a log-spiral, $r = r_o e^{\theta \tan\phi}$ (*cd* in Fig. 2.8) failure surface. While calculating Arc and N_q, the log spiral is unique.

It is centered at the footing edge (point a in Fig. 2.8) and spans between *ac* and *ad,* which, respectively, make angles ϕ and 45 - ϕ/2 with the horizontal. Closed-form expressions for N_c and N_q are therefore easily obtained by taking moments of the forces acting on the block *acdf* about a. This log spiral proves unsatisfactory for calculating N_γ. Terzaghi therefore assumes that the center of the unknown failure surface spanning between *ac* and *ad* lies on *ad.* From the family of log spirals, he finds the critical failure surface, one which yields minimum passive pressure P_γ on the wedge *acdf,* Fig. 2.8(c), graphically by trial and error for a series of ϕ values, and provides a ϕ versus N_γ (Fig. 2.7) relation. The procedure, although tedious, is logical, since mathematical expression for obtaining the critical surface and its solution become formidable. Modifications to the original solution that enhance accuracy of (2.31) in many respects, still use the trial-and-error procedure for calculating N_γ. Graphical procedures in general have inherent limitations regarding accuracy and, the extent of accuracy of Terzaghi's solution is not known. The objective of this technical note is to present explicit analytical expressions for calculating N_γ, to provide results of their numerical solution and compare them with those of the graphical method.

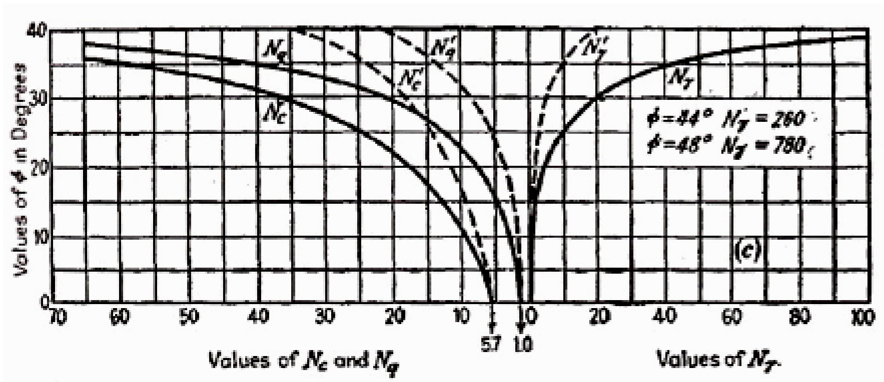


Fig.2.7. Relation between f and bearing capacity factor (after Terzaghi 1943)

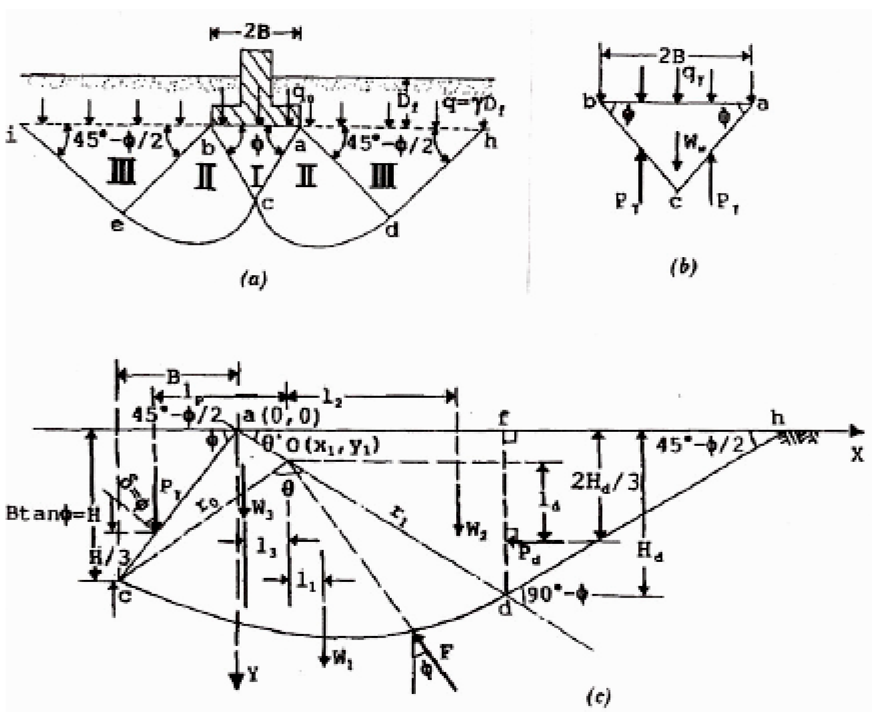


Fig.2.8. Determination of p_γ ($\phi \neq 0$, g $\neq$ 0, q = 0, c = 0) to calculate N_γ (a) Geometry of strip footing and adjacent soil in limit equilibrium;(b) Forces acting on elastic wedge due to self weight;(c) Free-body diagram of wedge acdf.

2.7.1. NUMERICAL SOLUTION FOR N_γ (By Kumbhojkar):

The condition for finding a log spiral that gives minimum P_γ can be easily described as $\partial P_\gamma / \partial \nu = O$, where v is any characteristic variable related to the log-spiral geometry such as a coordinate of the center of the log spiral or θ. Fig. 2.8, shows a trial log spiral *cd* with center $O(x_1,y_1)$ and angle *doc* = θ. The wedge *acdf* is in equilibrium under the forces W_1, W_2, W_3, P_d, F, and P_γ (per unit length of the footing) where

$$W_1 = \text{weight of the block ocd} = \gamma\ r_1^2 - r_o^2 / 4.\ \tan\phi \quad (2.40)$$

$$W_2 = \text{weight of the triangle afd} = \gamma\ (r_1^2\cos\phi + 4\ r_1 x_1 \sin\theta^* + 2x_1^2\tan\theta^*)/4 \quad (2.41)$$

$$W_3 = \text{weight of the triangle aco} = \gamma\ (\tan\phi + \tan\theta^*)x_1\ B/2 \quad (2.42)$$

$$P_d = \text{Rankine passive earth pressure} = \gamma\ (x_1 + r_1\cos\theta^*)^2 / 2 \quad (2.43)$$

F = resultant reaction of frictional force acting along the arc cd, which passes through O.
P_γ = passive force component due to γ.
Taking moment about O, one gets P_γ as

$$P_\gamma = (W_1\ l_1 + W_2 l_2 - W_3 l_3 + P_d l_d) / l_p \quad (2.44)$$

Where the lever arm l_1(Das 1987), l_2, l_3, l_d, and l_p are given by

$$l_1 = 4\tan\phi\{r_1^3(3\tan\phi\ \cos\theta^* - \sin\theta^*) + r_o^3[\sin(\theta+\theta^*) - 3\tan\phi\cos(\theta^* + \theta)]\}\ / 3(9\tan^2\phi + 1)(r1^2 - r_o^2) \quad (2.45)$$

$$l_2 = 2r_1\cos\theta^* - x_1 / 3 \quad (2.46)$$

$$l_3 = x_1 - 2/3\ (x_1 - B)/2\ = 2x_1 + B/3 \quad (2.47)$$

$l_d = 2r_1 \sin\theta^* - x_1 \tan\theta^* / 3$ (2.48)

$l_p = x_1 + 2B/3$ (2.49)

All the quantities on the right-hand side of (2.44) are a function of variables x_1, the x-coordinate of the center of the log spiral, and r_o and r_l, the radii of the log spiral for $\theta = 0$ and $\theta = 0$. The quantities x_1, r_0, and r_l, in turn, can be expressed as a function of θ using geometrical relations.

$x_1 = -B/2 – (1+\sin\phi)\cot\theta B/2\cos\phi$ (2.50a)

$r_1 = (\tan\phi \cos\theta^* + \sin\theta^*)B\ e^{\theta\tan\phi} / \sin\theta$ (2.50b)

Substituting these values in (2.44) and rearranging the terms we get the following explicit expression:

$P_\gamma / \gamma B^2 = \sum c_i\ t_i / c_8\ t_6 + c_9\ t_7$ (2.51)

$\partial Pg/\partial q = \gamma B^2/(c_8\ t_6 + c9\ t_7)^2 \sin^3\theta \quad \sum d_i\ u_i$ (2.52)

Coefficient c_i and terms t_i and terms d_i and u_i are respectively given in Table 2.6 and 2.7. The equations $\partial P_\gamma/\partial q = 0$ is solved numerically to obtained θ for $P_{\gamma min}$ $P_\gamma / \gamma B^2$ is obtained from (2.24) and Ng using Terzaghi;s equation

$N_\gamma = P_{\gamma min} / \gamma\ B^2 - \tan\phi / 2$ (2.53)

Tables 2.8 and 2.9 provide values of N_γ along with the coordinates of the center and angles of the log-spiral for $\phi = 0^o$ to 53^o When ϕ becomes larger, N_γ becomes highly sensitive to ϕ; for $\phi > 35^o$ results are therefore given with an increment of 0.5^o.

Table 2.6. Terms and their Coefficients in Eq. (2.24)

Solution number (1)	Coefficient C_i (2)	Term t_i (3)
1	c_1 = 3tanϕ cos^{4}θ* - sinθ* cos^{3}θ* / 3(8sin^{2}ϕ + 1) + cos^{4}θ*/3 cosϕ	$t_1 = e^{3\theta\tan\phi}$/ sin^{2}θ
2	c_2 = - cos^{2}θ* /4	$t_2 = e^{2\theta\tan\phi}$/sinθ
3	c_3 = -(1 + sinϕ) cos^{2}θ* / 4cosϕ	t_3 = $e^{2\theta\tan\phi}$ cosθ/sin^{2}θ
4	c_4 = 2 cos ^{4}θ* + 3 sin ϕ cos^{2}θ*/ 6(8sin^{2}ϕ + 1) + (1+sinϕ)/8 - (1+sinϕ)2/12cos^{2}ϕ	t_4 = 1/ sinθ
5	c_5 = sinθ* cos3θ* - 3 tanϕ cos^{4}θ* / 3(8 sin^{2}ϕ + 1) + (1+sinϕ)2/ 24 cosϕ	t_5 = cosθ/sin^{2}θ
6	c_6 = (1+ sinϕ)2 / 12 cos^{2}ϕ + cos^{2}ϕ / 24(1+sinϕ) - (1+sinϕ)/8	t_6 = sinθ
7	c_7 = - (1+sinϕ)/12 cosϕ + cosϕ/8 – (1+sinϕ)2/ 24cosϕ	t_7 = cosθ
8	c_8 = cosϕ/6	-
9	c_9 = - (1+sinϕ)/2	-

Table- 2.7. Coefficients and Terms in Equation $\sum d_i u_i$

Solution no. (1)	Coefficient d_i (2)	Term u_i (3)
1	$d_1 = 3c_1 c_8 \tan\phi + c_1 c_9$	$u_1 = \sin^2\theta\, e^{3\theta\tan\phi}$
2	$d_2 = 3 c_1 c_9 \tan\phi – 3 c_{1\ c8}$	$u_2 = \sin\theta \cos\theta\, e^{3\theta\tan\phi}$
3	$d_3 = -2 c_1 c_9$	$u_3 = \cos2\theta\, e^{3\theta\tan\phi}$
4	$d_4 = 2 c_2c_8 \tan\phi – c_3c_8 + c_2c_9$	$u_4 = \sin^3\theta\, e^{2\theta\tan\phi}$
5	$d_5 = 2c_3c_8 \tan\phi + 2 c_2 c_9 \tan\phi – 2 c_2c_8$	$u_5 = \sin2\theta \cos\theta\, e^{2\theta\tan\phi}$
6	$d_6 = 2c_3 c_8 \tan\phi – c_2 c_9 – 3 c_3c_8$	$u_6 = \sin\theta \cos^2\theta\, e^{2\theta\tan\phi}$
7	$d_7 = -2 c_{3\ c9}$	$u_7 = \cos^3\theta\, e^{2\theta\tan\phi}$
8	$d_8 = 2c_4 c_9 + 2c_5 c_8 – c_7 c_8 + c_6 c_9$	$u_8 = \sin^3\theta$
9	$d_9 = -3c_5 c_8 – c_4 c_9$	$u_9 = \sin\theta$
10	$d_{10} = -2 c_4 c_8$	$u_{10} = \cos\theta$
11	$d_{11} = 2 c_4 c_8 – 2 c_5 c_9$	$u_{11} = \cos^3\theta$

2.7.2. COMMENTS:

The values given in Tables 2.8 and 2.9 match the plot in Fig. 2.7 exactly over its entire range: $\phi = 0^o$ to 39^o It is, however, a crude way of comparing since precision of this plot is lower than that of the numerical solution. With the exception of N_γ = 36, 260, and 780, respectively, for $\phi = 34^o$, 44^o and 48^o (Terzaghi 1943), it is not known whether explicit numerical values of N_γ used to plot Fig. 2.7 exist. The results presented in the present paper, therefore, can be compared with only these three values. For $\phi = 34^o$ (38^o versus 36^o) and 44^o, the difference 261 versus 260 is negligibly small and accuracy of the graphical solution is excellent. The large difference, 650 versus 780, in N_γ for $\phi = 48^o$ is probably due to some small error in the graphical analysis magnified by the sensitivity of N_γ to ϕ since the angle that gives $N\gamma = 780$ is about 48.6^oAny interpolation between ϕ = 44^o and 48^o and extrapolation beyond $\phi = 48^o$ in Fig. 2.7 on the basis of $N_\gamma = 780$ are likely to include relatively large errors. Use of approximate methods similar to the graphical method to obtain N_γ are also likely to provide only approximately accurate answers. Bowles (1968), using a curve-fitting method, provides the only other set of numerical values of Terzaghi's N_γ for $\phi = 5^o$, 10^o . . . 50^o For $\phi < 20^o$ his values are approximately double of those given in Table 2.8 and for $\phi > 35$ they become smaller than those given in Table 2.9, although their accuracy is comparable to that of Fig. 2.7. Beyond providing explicit values and enhancing accuracy of N_γ, the analysis given here provides another distinct benefit: it defines log spirals demarking the radial shear zone for each qb.

A numerical solution for Terzaghi's bearing-capacity factor N_γ was presented. In addition to providing values of N_γ up to $\phi) = 53^o$ it also defined the geometry of the log spiral for each value of ϕ. The results showed that within the limits of accuracy of graphical method, Terzaghi's N_γ calculations agree with the almost-exact numerical results.

Table 2.8. Bearing Capacity Factor N_γ and Geometry Details of Log-Spiral Providing for $\phi = 0^o$ to 35^o

Solution	Friction	Log-spiral	Coordinate of center of log-spiral		
Number	Angle ϕ	Angle θ	x_1/B	y_1/B	N_γ
1	0.0	-	-		0
2	1.0	88.833	-0.510	-0.502	0.014
3	2.0	90.910	-0.492	-0.475	0.035
4	3.0	92.494	-0.477	-0.453	0.063
5	4.0	93.753	-0.465	-0.434	0.099
6	5.0	94.782	-0.454	-0.416	0.144
7	6.0	95.637	-0.445	-0.401	0.200
8	7.0	96.356	-0.437	-0.387	0.267
9	8.0	96.966	-0.430	-0.374	0.348
10	9.0	97.486	-0.423	-0.361	0.444
11	10.0	97.931	-0.417	-0.350	0.559
12	11.0	98.311	-0.411	-0.339	0.694
13	12.0	98.637	-0.406	-0.329	0.854
14	13.0	98.916	-0.401	-0.319	1.041
15	14.0	99.152	-0.397	-0.310	1.262
16	15.0	99.352	-0.393	-0.301	1.520
17	16.0	99.519	-0.389	-0.293	1.822
18	17.0	99.656	-0.385	-0.285	2.175
19	18.0	99.768	-0.382	-0.277	2.589
20	19.0	99.855	-0.378	-0.270	3.074
21	20.0	99.921	-0.375	-0.263	3.641
22	21.0	99.968	-0.372	-0.256	4.305
23	22.0	99.996	-0.369	-0.249	5.085
24	23.0	100.009	-0.367	-0.243	6.000
25	24.0	100.006	-0.364	-0.237	7.076
26	25.0	99.989	-0.362	-0.231	8.342
27	26.0	99.960	-0.360	-0.225	9.836
28	27.0	99.918	-0.357	-0.219	11.602
29	28.0	99.866	-0.355	-0.214	13.636
30	29.0	99.804	-0.353	-0.208	16.175
31	30.0	99.732	-0.352	-0.203	19.129
32	31.0	99.652	-0.350	-0.198	22.653
33	32.0	99.563	-0.348	-0.193	26.871
34	33.0	99.467	-0.346	-0.188	31.035
35	34.0	99.363	-0.345	-0.183	38.035
36	35.0	99.253	-0.344	-0.179	45.410

Table 2.9. Bearing Capacity Factor N_γ and Geometry Details of Log-Spiral Providing for $\phi = 35.5^o$ to 53^o

Solution Number	Friction Angle ϕ	Log-spiral Angle θ	Coordinate of center of log-spiral x_1/B	y_1/B	N_γ
1	35.5	99.196	-0.343	-0.177	49.666
2	36.0	99.137	-0.342	-0.174	54.360
3	36.5	99.077	-0.342	-0.172	59.541
4	37.0	99.015	-0.341	-0.170	65.266
5	37.5	98.952	-0.340	-0.168	71.599
6	38.0	98.888	-0.340	-0.166	78.614
7	38.5	98.822	-0.339	-0.164	86.392
8	39.0	98.755	-0.338	-0.162	95.028
9	39.5	98.687	-0.338	-0.159	104.627
10	40.0	98.618	-0.337	-0.157	115.311
11	40.5	98.548	-0.337	-0.155	127.219
12	41.0	98.477	-0.336	-0.153	140.509
13	41.5	98.404	-0.336	-0.151	155.363
14	42.0	98.331	-0.335	-0.149	171.990
15	42.5	98.257	-0.335	-0.148	190.628
16	43.0	98.181	-0.334	-0.146	211.556
17	43.5	98.105	-0.334	-0.144	235.091
18	44.0	98.028	-0.334	-0.142	261.603
19	44.5	97.951	-0.333	-0.140	291.521
20	45.0	97.872	-0.333	-0.138	325.342
21	45.5	97.793	-0.332	-0.136	363.647
22	46.0	97.712	-0.332	-0.134	407.113
23	46.5	97.632	-0.332	-0.133	456.532
24	47.0	97.550	-0.332	-0.131	512.836
25	47.5	97.468	-0.331	-0.129	577.119
26	48.0	97.385	-0.331	-0.127	650.673
27	48.5	97.302	-0.331	-0.125	735.026
28	49.0	97.218	-0.331	-0.124	831.990
29	49.5	97.133	-0.330	-0.122	943.723
30	50.0	97.048	-0.330	-0.120	1072.797
31	50.5	96.962	-0.330	-0.119	1222.294
32	51.0	96.876	-0.330	-0.117	1395.915
33	51.5	96.790	-0.330	-0.115	1598.120
34	52.0	96.703	-0.329	-0.113	1834.301
35	52.5	96.615	-0.329	-0.112	2111.003
36	53.0	96.528	-0.329	-0.110	2436.199

2.8. COMPUTATION OF BEARING CAPACITY FACTOR N_γ BY USING KOTTER'S EQUATION:

The analysis is primarily based on the computation of vertical (R_V) and horizontal (R_H) components of reaction R that acts on the curved part CD of the failure surface [Fig. 2.9]. For this purpose, Kotter's equation (1903) is used.

2.8.1. KOTTER'S EQUATION:

For a cohesionless soil medium, in passive state of equilibrium, Kotter's equation gives a solution for determining the distribution of soil reaction pressure p along the arc of the failure surface in the following form (Fig.2.11):

$$dp/ds + 2p \tan\phi \, d\alpha/ds - \gamma \sin(\alpha+\phi) = 0 \qquad (2.54)$$

In which dp = differential reactive pressure on the elemental length ds of the failure surface; α = angle made by the tangent to the failure surface at the point of interest with the horizontal; and ϕ = angle of soil internal friction. The applicability of Kotter's equation to the analysis of limit equilibrium problems has been demonstrated for a retaining wall problem (Coulomb's mechanism) for the case of a ponderable cohesionless soil by Dewaikar and Halkude (2002).

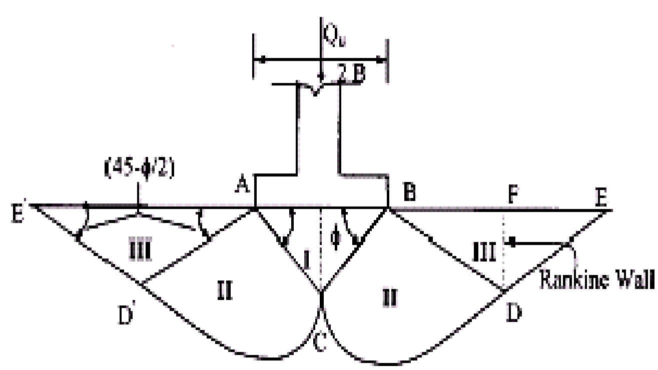
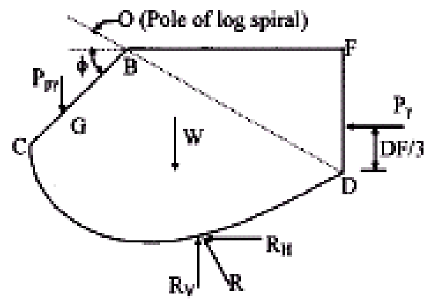


Fig. 2.9. Failure mechanism-Terzaghi's analysis



(b)

Fig. 2.10. Free body diagram of wedge CDFB

2.8.2. OUTLINE OF PROPOSED ANALYSIS:

As shown in Fig.2.10, the known forces that act on the failure wedge CDFB are R_H, R_V, P_γ (passive Rankine thrust), W (weight of wedge CDFB), and unknown is only one force, i.e., the passive thrust $P_{p\gamma}$. Now, if the pole of the log spiral CD is correctly located, the calculated forces P_γ and R_H will be exactly equal to each other so as to satisfy horizontal force equilibrium, otherwise, they will be different. If they are different, the trial location of the pole along the line BD is changed and for this new location of the pole, R_H, R_V, W, and P_γ are again computed. Iterations are thus continued until the horizontal force equilibrium condition is satisfied to a specified decimal accuracy. After satisfying this condition, vertical force equilibrium condition is used to compute the desired value of $P_{p\gamma}$, from which N_γ is calculated.

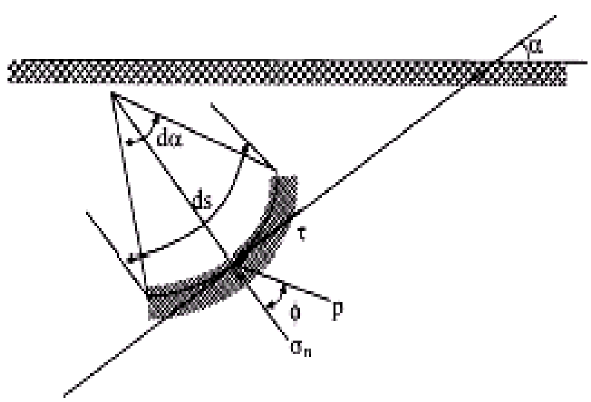


Fig. 2.11. Kotter's equation for cohesionless soil in passive state of equilibrium

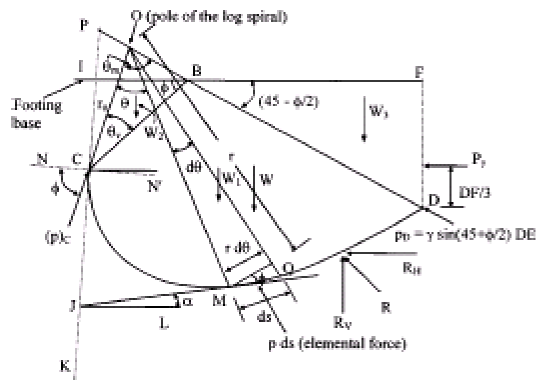


Fig. 2.12. Geometrical relationships for pole above footing.

2.8.3. INTEGRATION OF KOTTER'S EQUATION:

As seen earlier [Fig. 2.9], the failure surface has two parts, namely, CD being part of the log spiral and DE its tangent.

2.8.3.1. INTEGRATION OVER PART DE OF FAILURE SURFACE:

This part of the failure surface being straight, $d\alpha/ds = 0$ and Eq.(2.54) reduces to the following form:

$$\boldsymbol{dp/ds = \gamma \sin(\alpha+\phi)} \qquad \textbf{(2.55)}$$

Integration of the above equation gives the pressure distribution over the plane failure plane DE and the value of p at point D is calculated as

$$p_D = \gamma \sin(45+\phi/2)\mathrm{DE} \qquad (2.56)$$

The distance DE depends upon the location of pole of the log spiral as shown in Fig. 2.12. Referring to Figs. 2.9,2.10 and 2.12, DE is calculated from the geometry of the failure wedge. With this substitution, Eq. (2.56) becomes

$$p_D = \gamma \sin(45+\phi/2)\, K r_o e^{\theta m \tan\phi} \qquad (2.57)$$

in which, r_o , θ_m , and θ_v are as shown in Fig.2.12 and K is as given by the following expression:

$$K = [1 - \sin\theta_v/\sin(45+f/2)\, e^{\theta m \tan\phi}\,] \qquad (2.58)$$

2.8.3.2. COMPUTATION OF VERTICAL AND HORIZONTAL COMPONENTS OF REACTION R ON CURVED FAILURE SURFACE CD:

For this purpose, wedge CDFB as shown in Fig. 2.10 is referred. The magnitude of passive Rankine thrust P_γ is given as

$$P_\gamma = 1/2\ \gamma(DF)^2\ (1+\sin\phi/1-\sin\phi) \tag{2.59}$$

The forces, R_H and R_V are calculated using Kotter's equation for a curved failure surface. For this purpose, Fig. 2.12 is referred.

Integration of Kotter's equation [Eq. (2.54)] gives the pressure distribution on the curved failure surface (Mohapatro 2001) and is given as

$$\begin{aligned}
\mathbf{p} = &\{\gamma r_o K \sin(45+\phi) e^{(3\theta m - 2\theta\tan\phi)}\} + \\
&+\{(\gamma r_o \sec\phi e^{\theta\tan\phi}/1+9\tan^2\phi)\ [3\tan\phi\sin(\theta-\theta_L+\phi) - \cos(\theta-\theta_L+\phi)]\} \\
&-\{\gamma r_o \sec\phi e\ (3\theta_m - 2\theta)\tan\phi/\ (1+9\tan^2\phi) \\
&X\ \{3\tan\phi\sin(\theta-\theta_L+\phi) - \cos(\theta-\theta_L+\phi)\}]
\end{aligned} \tag{2.60}$$

Where θ_L=(90-θ_v) and θ is as shown in Fig. 2.12. In deriving the above expression, reactive pressure at point D as given by Eq. (2.57) is used as a boundary condition.

2.8.3.3. COMPONENTS OF RESULTANT REACTION ON FAILURE SURFACE:

The resultant reaction R on the failure surface is given as

$$R = \int p\ ds \tag{2.61}$$

The vertical component R_V of the reaction is obtained as (Fig. 2.12)

$$R_V = \int p \cos(\theta-\theta_L+\phi)\ ds \tag{2.62}$$

After substituting the value of p from Eq. (2.60) and value of ds from Fig. 2.12, R_V is obtained in the following form:

$$R_V = f_1 + f_2 + f_3 \tag{2.63}$$

Similarly, the horizontal component R_H of the resultant reaction is given as (Fig. 2.12)

$$R_H = \int p \sin(\theta-\theta_L+\phi)\ ds \tag{2.64}$$

After substituting the value of p from Eq. (2.60) and performing integration R_H is obtained as

$$R_H = f_4 + f_5 + f_6 \tag{2.65}$$

Where, f_1, f_2, f_3, f_4, f_5, and f_6 are –

$$f_1 = \gamma r_0^2 K \sin\left(45+\frac{\phi}{2}\right) e^{3\theta_m \tan\phi}\left[e^{-\tan\phi\,\theta_m}\sin\left(45-\frac{\phi}{2}\right)-\sin\left(45-\theta_m-\frac{\phi}{2}\right)\right] \tag{21}$$

$$f_2 = \left[\frac{\gamma r_o^2 \sec\phi}{4(1+9\tan^2\phi)} 3\tan\phi\{e^{2\theta_m\tan\phi}\sin 2\phi + \sin 2(\theta_m-\phi)\}\right] - \left[\frac{\gamma r_o^2 \sec^2\phi}{4(1+9\tan^2\phi)}\left\{\begin{array}{c}\frac{1}{\tan\phi}[e^{2\theta_m\tan\phi}-1] \\ +\frac{1}{\sec\phi}[e^{2\theta_m\tan\phi}\cos 2\phi - \cos 2(\phi-\theta_m)]\end{array}\right\}\right] \tag{22}$$

$$f_3 = \frac{\gamma r_0^2 \sec\phi\, e^{3\theta_m\tan\phi}}{(1+9\tan^2\phi)}\left\{e^{-\theta_m\tan\phi}\left\{\sin\left(45-\frac{\phi}{2}\right)-\sin\left(45-\theta_m-\frac{\phi}{2}\right)\right\}\right\}\left\{3\tan\phi\sin\left(45+\frac{\phi}{2}\right)-\cos\left(45+\frac{\phi}{2}\right)\right\} \tag{23}$$

$$f_4 = \gamma r_o^2 K \sin\left(45+\frac{\phi}{2}\right) e^{3\theta_m\tan\phi}\left\{\cos\left(45-\theta_m-\frac{\phi}{2}\right) - e^{-\theta_m\tan\phi}\cos\left(45-\frac{\phi}{2}\right)\right\} \tag{24}$$

$$f_5 = \left\{\frac{\gamma r_o^2 \sec^2\phi\tan\phi}{4(1+9\tan^2\phi)}\left[\begin{array}{c}\frac{1}{\tan\phi}(e^{2\theta_m\tan\phi}-1) \\ -\frac{1}{\sec\phi}(e^{2\theta_m\tan\phi}\cos(2\phi)-\cos(2\phi-2\theta_m))\end{array}\right]\right\} - \left\{\frac{\gamma r_o^2\sec\phi}{4(1+9\tan^2\phi)}\{e^{\theta_m\tan\phi}\sin 2\phi + \sin(2\theta_m - 2\phi)\}\right\} \tag{25}$$

$$f_6 = -\frac{\gamma r_0^2 \sec\phi\, e^{3\theta_m\tan\phi}}{(1+9\tan^2\phi)}\left\{3\tan\phi\sin\left(45+\frac{\phi}{2}\right)-\cos\left(45+\frac{\phi}{2}\right)\right\}\left\{\cos\left(45-\theta_m-\frac{\phi}{2}\right)-e^{-\theta_m\tan\phi}\cos\left(45-\frac{\phi}{2}\right)\right\} \tag{26}$$

2.8.4. SELF WEIGHT OF WEDGE CDFB:

This is obtained by calculating weight, W_1 of part OCD, W_2 of part OCB, and W_3 of part BDF as shown in Fig. 2.12. The required weight W (of part CDFB) is given as

$$W = (W_1 - W_2 + W_3) \tag{2.66}$$

In which

$$W_1 = (\gamma r_o^2 / 4\tan\phi)\,[e^{2\theta m \tan\phi} - 1] \tag{2.67a}$$

$$W_2 = 1/2\, \gamma r_o^2 \sin\theta_v \sin\theta_m / \sin(45+\phi/2) \quad \text{and} \tag{2.67b}$$

$$W_3 = 1/4\, \gamma r_o^2 K^2 e^{2\theta m \tan\phi} \cos\phi \tag{2.671c}$$

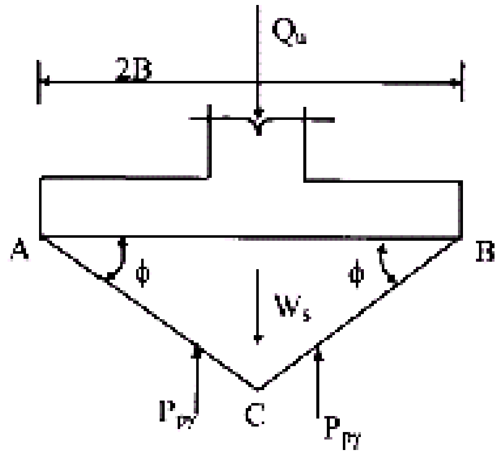


Fig. 2.13. Free body diagram of triangular wedge ABC for the determination of N_γ

2.8.5. COMPUTATION OF PASSIVE THRUST $P_{P\gamma}$:

The passive thrust is obtained by using the two equations of force equilibrium (Fig.2.12) Vertical force equilibrium

$$R_V - P_{p\gamma} - W = 0 \quad (2.68a)$$

Horizontal force equilibrium

$$-R_H - P_\gamma = 0 \quad (2.68b)$$

The procedure of obtaining the desired value of $P_{p\gamma}$ has been described in the outline of the proposed analysis. The iterations were carried out till the computed values of $P\gamma$ and R_H matched with each other up to four decimal places. The computed values of $P_{p\gamma}$ and $N\gamma$ are therefore correct up to four decimal places. The computation further showed that the pole of the log spiral was located very close to the footing edge.

2.8.6. COMPUTATION OF N_γ:

For this computation, Fig. 2.13 is referred, which shows the free body diagram of triangular wedge ABC (of Fig.2.9), subjected to forces Q_u (ultimate load), W_s (weight of the triangular soil wedge ABC), and $P_{p\gamma}$, the passive thrust.

The vertical force equilibrium gives

$$Q_u + W_s = 2\ P_{p\gamma} \tag{2.69}$$

After substituting the value of W_s, Eq. (2.73) becomes

$$Q_u = 2\ P_{p\gamma} - \gamma B^2 \tan\phi \tag{2.70}$$

Dividing the above expression throughout by 2B (footing width) yields the ultimate bearing pressure q_u, *which* is given as

$$q_u = P_{p\gamma}/B - \gamma B/2\ \tan\phi \tag{2.71}$$

On comparing Eq. (2.75) with Eq. $q_u = \gamma$ B N_γ, the bearing capacity factor N_γ is finally obtained as

$$N_\gamma = P_{p\gamma}/\gamma B^2 - \tan\phi/2 \tag{2.72}$$

2.8.7. THE FOLLOWING MAIN CONCLUSIONS ARE DRAWN FROM THE PROPOSED ANALYSIS:

1. The concept of force equilibrium condition coupled with Kotter's equation identifies the unique failure surface, consistent with the specified failure mechanism.
2. Application of Kotter's equation makes the analysis statically determinate.
3. The $N\gamma$ values that are obtained from the proposed analysis based on Terzaghi's failure mechanism with the limit equilibrium approach are the unique values since; no other simplifying assumptions are made to evaluate them.
4. The $N\gamma$ values as obtained from the proposed analysis show a good agreement with experimental values and this establishes reliability of the proposed method of analysis.

Table 2.10. Comparision of bearing capacity Factor, N_γ with other theories and Experimental results.

ϕ	Proposed analysis	Ingra & becher (1983)	Zadroga (1994)	Meyerhof (1963)	Baki & Beik (1970)	Hansen (1970)	Chen (1975)	Kumbh-ojkar (1993)	Frydman & Burd (1997)	Michal -owski (1997)	Soubra (1999)
25	8.363	14.570	22.307	6.764	12.8	6.758	12.409	8.342	-NA-	9.765	9.81
30	21.404	34.605	45.147	15.676	27	15.069	26.702	19.129	21.7	21.394	21.51
35	53.844	82.187	91.371	37.168	60	33.920	60.236	45.410	54.2	58.681	49.00
40	141.32	195.19	184.921	93.712	149	79.54	146.76	115.311	147.0	118.827	119.81
45	407.14	463.58	374.251	262.793	400	200.81	400.47	325.342	422.0	322.835	326.59

CHAPTER 3

BEHAVIOR OF CIRCULAR FOOTINGS RESTING ON CONFINED GRANULAR SOIL

Raft foundations are widely used in supporting structures form any reasons such as weak soil conditions or heavy columns loads. In many cases, some problems arise such as the construction is adjacent to an old building and/or the foundation depth is so great that the excavation needs to be braced during foundation construction (e.g., basement excavation). One of the available solutions is to use sheet piles to support the excavation sides during construction. Due to the difficulty of removing these piles, they become part of the permanent structure and two problems arise. The first problem deals with the structural analysis of the raft if the piles are used as end supports for the raft. The second problem is the effect of these piles on the lateral movement of the soil underneath the raft and the effect of this confinement on the bearing capacity of the soil. While there are several solutions for the first problem, such as isolating the raft from the piles, the confining effect of these piles on the raft behavior is not clearly understood. Looking to the problem in a smaller scale, it can be modeled as a circular footing supported on a soil, which is surrounded by a confining cylinder. The strength of confined sand was studied by Rajagopal et al. (1999). They carried out a large number of triaxial compression tests to study the influence of geocell confinement on the strength and stiffness behavior of granular soils. Geocells fabricated by hand using different geotextiles were used to investigate the effect of the stiffness of the geocell on the overall performance of geocell soil composite.

The aim of this research is to model and investigate the effect of soil confinement by piles on the behavior of soil foundation system. Also, we studied the idea of improving the footing response by using confining cylinders around each individual footing. To achieve that objective, more than 35 tests were carried out with a wide range of variables as detailed in Table 3.1.

Table 3.1. Model Test Program

Test series	Constant parameter	Varible parameters
A	Test on unconfined sand	Test is repeated three times
B	d/D = 0.66 and u/D = 0.0	h/D = 0.5, 1.00, 1.5, 2.00
C	d/D = 1.07 and u/D = 0.0	h/D = 0.5, 1.00, 1.5, 2.00
D	d/D = 1.33 and u/D = 0.0	h/D = 0.5, 1.00, 1.5, 2.00
E	d/D = 1.60 and u/D = 0.0	h/D = 0.5, 1.00, 1.5, 2.00
F	d/D = 2.00 and u/D = 0.0	h/D = 0.5, 1.00, 1.5, 2.00
G	d/D = 2.66 and u/D = 0.0	h/D = 0.5, 1.00, 1.5, 2.00
H	d/D = 1.33 and h/D = 1.0	u/D = 0..0, 0.07, 0.13, 0.50, 1.0
I	d/D = 1.33 and h/D = 1.5	z/D = 0.0, 0.17, 0.33, 0.50, 0.67

3.1. LABORATORY MODEL TESTS:

3.1.1. MODEL BOX AND FOOTING :

Nine series of laboratory model tests were conducted in a test box, having inside dimensions of 0.90m x 30.50m in plan and 0.5 m in depth. The tank is made from steel with the front wall made of 20 mm thick glass and is supported directly on two steel columns as shown in Fig. 3.1. These columns are firmly fixed in two horizontal steel beams, which are firmly clamped in the lab ground using four pins. The loading system is mounted by a horizontal Standard I beam steel beam supported on the two columns. It consists of a hand-operated hydraulic jack and precalibrated load ring. Since the sand raining technique is used to deposit the sand inside the tank, the beam was designed to swing about one end. Therefore, the beam can be swung out during deposition of the sand from the sand raining box and returned back, when sand deposition is completed, to the original loading position above the tank. The sand-raining box is made from wood and is 0.85 m 30.38 m in plan and 0.10 m in depth. The sand particles rain from the box through a square grid of holes (4 mm diameter and 20 mm spacing) in the base plate. The height of sand raining, measured from the bottom of the box to sand surface in the tank, can be changed up or down by using a manual winch. A circular model footing made of steel with a hole at its top center was used. The footing is 75 mm in diameter and 10 mm in thickness. A rough base condition was achieved by fixing a thin layer of sand onto the base of the model footing with epoxy glue. The load is transferred to the footing through a ball bearing, which was placed, between the footing and the proving ring. Such an arrangement produced a hinge, which allowed the footing to rotate freely as it approached failure and eliminated any potential moment transfer from the loading fixture. An overall view of the apparatus is illustrated in Fig. 3.1.

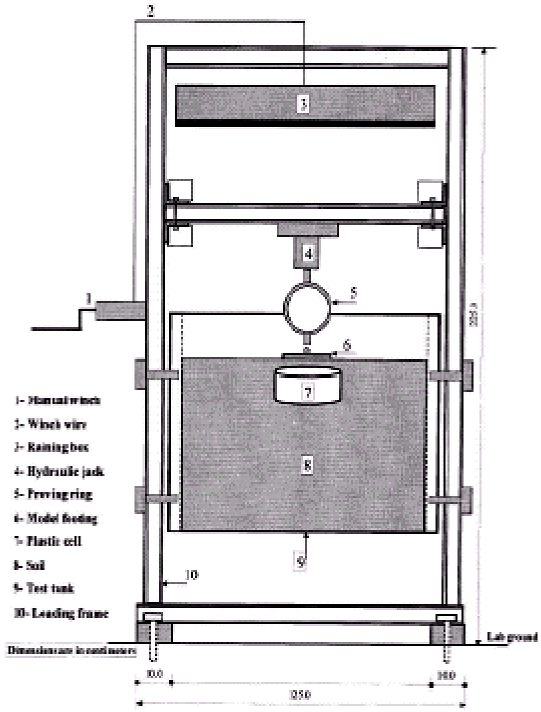


Fig.3.1. Schematic view of the experimental apparatus

3.1.2. TEST MATERIAL:

The sand used in this research is medium to coarse sand, washed, Dried, and sorted by particle size. It is composed of rounded-to sub rounded particles. The specific gravity of the soil particles was determined by the gas jar method. Three tests were carried out producing an average value of 2.654. The maximum and the minimum dry densities of the sand were found to be 19.95 and 16.34 kN/m^3 and the corresponding values of the minimum and the maximum void ratios are 0.305 and 0.593, respectively. The particle size distribution was determined using the dry sieving method and the results are shown in Fig. 3.2. The effective size (D_{10}), uniformity coefficient (C_u), and coefficient of curvature (C_c) for the sand were 0.152 mm, 4.071, and 0.771, respectively. In order to set up a sample, the sand was poured in 50 mm in height layers by raining technique in which sand is allowed to rain through air at a controlled discharge rate and height of fall to give uniform densities. A series of tests were carried out to check the relative density obtained and uniformity of the sand samples by using three density molds placed at different locations in the test box. After pouring, each mold was carefully excavated and the density of the sample calculated. The raining technique adopted in this study provided a uniform relative density of approximately 75.8% with a unit weight of 18.94 kN/m^3. The results also showed that the obtained relative densities from the three samples did not depend on the position of the mold. A series of direct shear tests were performed at the same relative density of the sand and the estimated internal friction angle was approximately 42°.

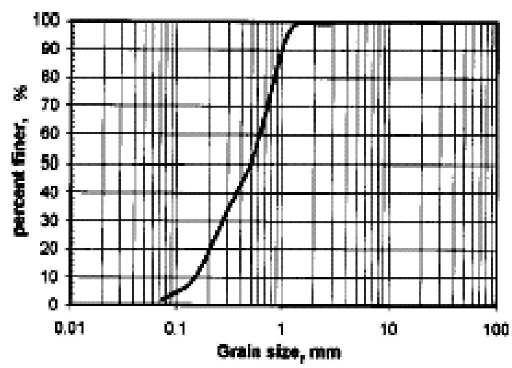


Fig. 3.2. Grain size distribution of the sand

The confining elements were made of unplasticized polyvinylchloride (UPVC) Cylinders with different diameters and heights. The used diameters were 50, 80, 100, 120, 150, and 200 mm. UPVC is produced from the polymerization of a vinyl chloride monomer with certain additives including heat stabilizers and lubricants. Its actual strength for any situation depends on the wall thickness uniformity, the rate of loading, and the temperature of plastic materials. The interior and exterior surfaces of the cylinders were made very smooth. The thickness of the cylinder wall is 2.5 mm and its properties as given by the manufacturer are shown in Table 3.2. Some of the tests were carried out by introducing the UPVC cylinders initially in position and then a sand bed was placed by raining. The ultimate loads were determined and compared with those of tests performed with cylinders installed vertically after setting sand samples. The difference of the ultimate loads in the two cases was found to be less than 1.5% and load–

settlement relationships were approximately of the same pattern. Therefore, it was decided to carry out the entire test program using only one method by installing the cylinders vertically after setting sand beds, and considering the difference in the relative densities of the samples resulting from installing cells with different diameters and heights to be small and negligible.

Table 3.2. Properties of the Unplasticized Polyvinyle Chloride Cylinder

Maximum hydraulic pressure for 1 h at 23^{o}C Bar	23
Specific gravity	1.4
Tensile strength, 10^3 Kpa	55
Tensile modulus, 10^5 Kpa	28
Water adsorption at 100^{o}C for 24 h, mg/cm^2	4

3.1.3. EXPERIMENTAL SETUP AND TEST PROGRAM :

After the sand surface was set up, the cells were pushed vertically into the sand at the design place, the footing was placed on position, and the load was applied on it by the hydraulic jack. The load was applied in small increments until reaching failure. Each load increment was maintained constant until the footing settlement had stabilized. The settlements of the footing were measured using two dial gauges placed on opposite sides of the footing. The geometry of the soil, model footing, and confining cylinder are shown in Fig. 3.3. The test program consisted of carrying out nine series of tests on the circular model footing to study the effect of soil confinement on the soil–foundation response as shown in Table 3.1. Initially, the behavior of the footing supported on the unconfined conditions was determined. Then, each series of the tests was carried out to study the effect of one parameter while the other variables were kept constant. The studied variables are the cell height (h) and cell diameter (d) for cases when the cells are placed under the foundation level and the embedded depth (z) for cases when the foundation level is lower than the cell top. Several tests were repeated at least twice to verify the repeatability and the consistency of the test data.

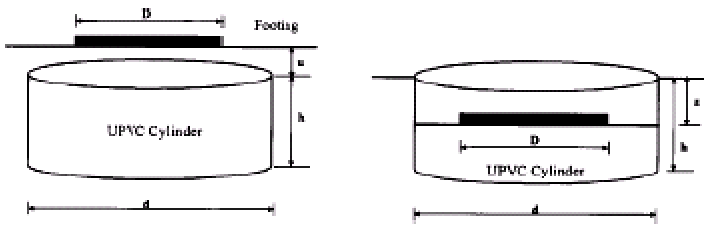


Fig. 3.3. Geometric parameters of confined sand-foundation model

3.2. RESULTS AND DISCUSSION:

The load–settlement relationship and the ultimate bearing capacity of the footing with and without confinement were obtained. The bearing capacity improvement due to the soil confinement is represented using a nondimensional factor, called the bearing capacity ratio (BCR). This factor is defined as the ratio of the footing ultimate load with soil confinement to the footing ultimate load in tests without confinement. The footing settlement (*S*) is also expressed in nondimensional form in terms of the footing diameter (*D*) as the ratio (*S*/*D*,%). The measured ultimate load and the associated ultimate displacement for the nonconfined case are 250 N and 5.24 mm, respectively. The theoretical ultimate bearing capacity can be calculated from the equation $q_o = 0.5\ \gamma\ D\ \zeta_\gamma N$. Using the shape factor proposed for circular footing by De Beer (1970) (ζ_γ=0.6) and the values of the bearing capacity factor $N\gamma$ taken from Meyerhof (1963) (N_γ=139.3) or Hansen (1968) (N_γ =136.7), the theoretical bearing capacities are 59.36 kPa (262 N) and 58.25 kPa (257 N), respectively. These data show a close agreement between both the theoretical values and the experimental results. Typical variations of bearing pressure with footing settlement ratios (*S*/*D*) with and without soil confinement for different heights of confining cells are presented in Fig. 3.4. It can be seen that the installation of confining cylinders appreciably improves the bearing capacity of the footing as well as the stiffness of the foundation bed. It is apparent from the curves that the mode of failure is a general shear failure in which a pronounced peak can be observed in the load–settlement curve, after which the footing collapses and the load decreases (Vesic 1973). Also, the value of the settlement ratio *S*/*D* at the ultimate load in the confined tests varied from about 12% to 18%. The observed improvement in the bearing capacity loads due to soil confinement along with the increase in the settlement ratio was reported by many investigators when using soil reinforcement (Omar et al. 1993a,b; Das et al. 1996). Comparing the curves of Fig.3.4. at the ultimate *S*/*D* ratio of the unconfined case (the values across the dotted line, *S*/*D* = 7%), it can be seen that soil confinement improved the bearing load from 56.59 kPa for the unconfined case to 562.5 kPa for the confined soil using cells with a *d*/*D* ratio of 1.33 and *h*/*D* ratio of 2.0. Therefore, it can be concluded that, in cases when the excessive settlement is the controlling factor in determining the allowable bearing capacity, using confining cells may significantly decrease the settlement ratio for the same level of bearing load.

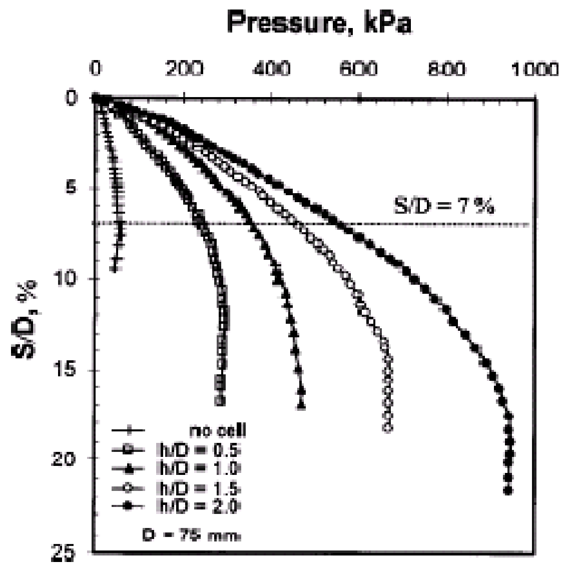


Fig. 3.4. Variation of bearing pressure with (S/D) ratio for different cell heights (Series D)

3.2.1. EFFECT OF CELL DIAMETER:

In order to investigate the effect of cell diameter on the footing behavior, six cells with diameters of 50, 80, 100, 120, 150, and 200 mm were used. Fig. 3.5. shows the variation of BCR with normalized cell diameter for different cell heights with a constant footing diameter of 75 mm. A significant increase in the bearing capacity of the model footing supported on confined sand with the increase of normalized cell diameter *d*/*D* is observed until a specific value of *d*/*D* after which the BCR decreases with an increase in the *d*/*D* ratio. While conducting the model tests, it was observed that as failure approached in tests carried out with small cell diameters, sand inside the cell and the cell behaved as one unit (when the load was increased, the cell, sand, and footing settled altogether). In tests carried out with large cell diameters, this behavior was noticed initially,

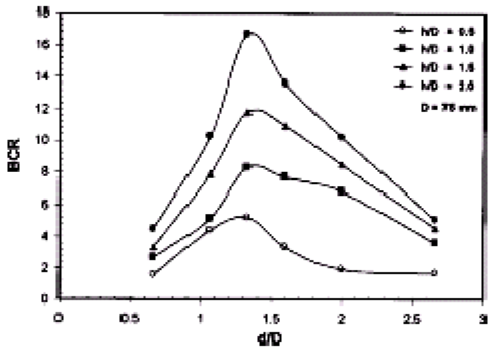


Fig. 3.5. Variation of bearing capacity ratio with normalized cell diameter (d/D) for different cell height.

But as the load was increased it was no longer observed (the footing settled down while the cell was unaffected with the increase of the load). Fig. 3.5. also shows that using soil confinement could result in an improvement in bearing capacity as high as 17 times more than that without soil confinement. It is clear that the best benefit of soil confinement could be obtained with a (*d*/*D*) ratio between 1.0 to 2.0 with the maximum improvement in the bearing capacity at a ratio of about 1.4 for different heights of confining cells. This significant increase in the bearing capacity of the footing can be explained with the aid of Fig. 3.6. as follows. When the footing is loaded, such confinement resists the lateral displacements of soil particles underneath the footing and confines the soil leading to a significant decrease in the vertical settlement and hence improving the bearing capacity. For small cell diameters, as the pressure is increased, the plastic state is developed initially around the edges of the footing and then spreads downward and outward. The mobilized vertical frictions between the sand and the inside wall of the cylinder increase with the increase of the acting active earth pressure until the point when the system (the cylinder, sand, and footing) starts to behave as one unit. The behavior is similar to that observed in deep foundations (piles and caissons) in which the bearing load increases due to the shear resistance of cell surface. This illustrates the increase of the bearing load with the increase of the cell diameter and cell height. Based on tests performed with cells made with very smooth surfaces, it can be concluded that increased surface roughness results in greater bearing load improvement. In comparison to this response, sand beds at relative density of 70% and reinforced with a geocell mattress carried out by Dash et al. (2001b) mobilized bearing capacity pressure as high as eight times the ultimate capacity of the unreinforced sand. Also, tests on sand beds at a relative density of 75% and reinforced with planar reinforcement carried out by Omar et al. (1993a,b) and Khing et al. (1993) failed with clearly pronounced peak loads of about five times the ultimate capacity of unreinforced soil at settlements equal to about 20% of the footing width.

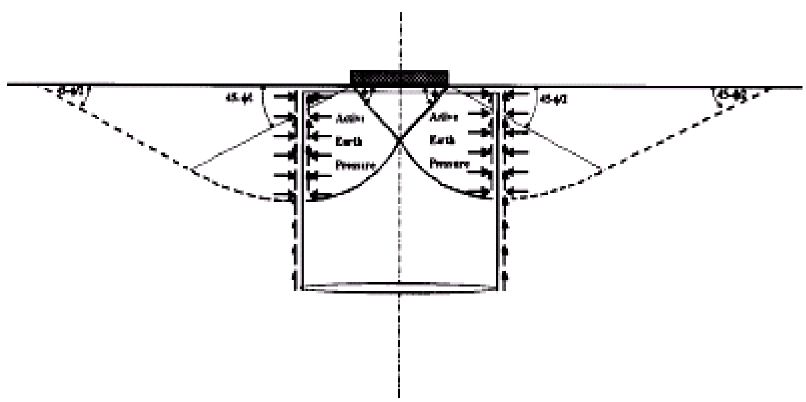


Fig. 3.6. Interaction of failure surface with the cylinder.

3.2.2. EFFECT OF CELL HEIGHT:

In order to investigate the effect of cell height on the footing response, tests were carried out using four different heights for each cell diameter. The variation of BCR with normalized cell height (*h*/*D*) is shown in Fig.3.7. for different normalized cell diameters (*d*/*D*). The figure shows the same pattern of behavior for the different cell diameters. Increasing cell heights results in a greater improvement in the BCR. This increase in cell height results in the enlargement in the surface area of the cell–model footing leading to a higher bearing capacity load. The slope of the BCR versus *h*/*D* curves for *d*/*D* ratios of 0.67 and 2.67 are less than the comparable slopes for *d*/*D* ratios of 1.33 and 1.6. This trend confirms the previous conclusion that the greatest benefit of cell confinement can be obtained at a *d*/*D* ratio of about 1.4.

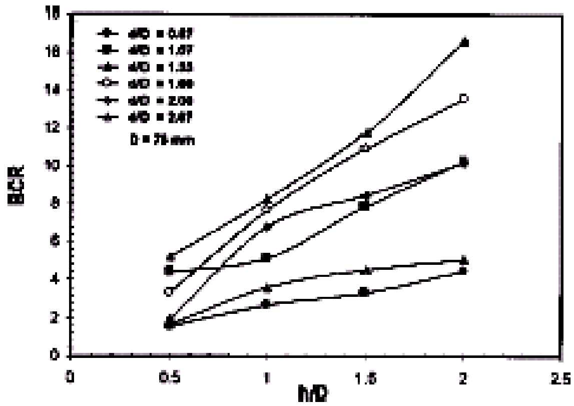


Fig.3.7. Variation of bearing capacity ratio with normalized cell height (h/D) for different cell diameter(d).

3.2.3. EFFECT OF THE SOIL PRESSURE ON THE CELL:

One of the proposed parameters to be investigated was the thickness of the cell wall to study the effect of the cell rigidity on the footing–cell system behavior and also to study the hoop tension in the cell wall due to the pressure under the footing. However, according to the manufacturer data, the supplied cell with a wall thickness of 2.5 mm can withstand internal hydraulic pressure of 23 bars (2,300 kPa) with maximum tensile strength of the wall of 55,000 kPa. In the model tests, the most critical case occurs with *h*/*D*=2 and *d*/*D*=1.33 at failure vertical pressure of 950 kPa. The horizontal pressure acting on the sidewall of the cell is equal to the vertical pressure multiplied by the coefficient of lateral earth pressure. It can be seen that the maximum estimated horizontal earth pressures on the sidewalls of the cell are very small in comparison to the allowable hydraulic pressure. Another point is that the given allowable value is the net inside pressure while the cell in the model is subjected to both internal and external pressures. Checks were performed after each test to observe any change in the cell wall and measurements were taken to check the internal diameter as well as the thickness of the cell wall. There was no noticeable change in the cell or its dimension. Therefore, it was concluded that for the given model and dimensions, the pressures under the footing have no disturbing effects on the cell wall and, therefore, it was decided to use them again.

3.3. CONCLUSIONS:

Soil confinement has a significant effect on improving the behavior of circular footing supported on granular soil. The ultimate capacity was found to increase by a factor of 17 as compared to the unreinforced case. Therefore, it can be concluded that the piles (or sheet piles) used to brace cuts have a significant effect on improving the bearing capacity of soils under raft foundations. However, more research in this area is required to study cases in which piles are constructed only on one, two, or three sides. Also, theoretical analysis is needed to modify the bearing capacity equation to consider the effect of pile confinement. Based on the experimental results, soil confinement could be considered as a method to improve the bearing capacity of isolated footings bearing on medium to dense sand. UPVC cells with different heights, diameters, and thickness could be easily manufactured and placed around the individual footings leading to a significant improvement in their response.

CHAPTER-4

ANALYSIS OF SKIRTED CIRCULAR FOOTING

4.1. INTRODUCTION:

In this chapter a skirted circular footing is analyzed of different heights and diameters.

The ultimate bearing capacity of circular footing supported on confining sand bed was studied. The studied parameter include the skirt height and skirt diameter.

Initially, the response of a nonconfined case was determined and then compared with that of confined soil. The result were than analyzed to study the effect of each parameter.

The results indicate that the bearing capacity of circular footing can be appreciably increased by soil confinement. It was concluded that such reinforcement (skirts) resist lateral displacement of soil underneath the footing leading to a significant improvement in the response of the footing. For small skirt diameters, the skirt-soil footing behaves as one unit (deep foundation), while this pattern of behavior was no longer observed with large skirt diameters. The recommended skirt heights, depth and diameter that give the maximum bearing capacity improvement are presented and discussed.

4.2. MODELING DETAILS :

The geometry of the soil, model footing, and confining cylindrical skirt are shown in figure 4.1.and 4.2.

The diameter of circular foundation is taken as 2 m and the skirt diameters used in analysis are 3,4,5,6,7 m and heights of skirt are1,2,3,4,& 5 metre.

The analysis is carrying out to study the effect of soil confinement on bearing capacity of foundation by varying height and diameters of cylindrical skirts as shown in table 4.1

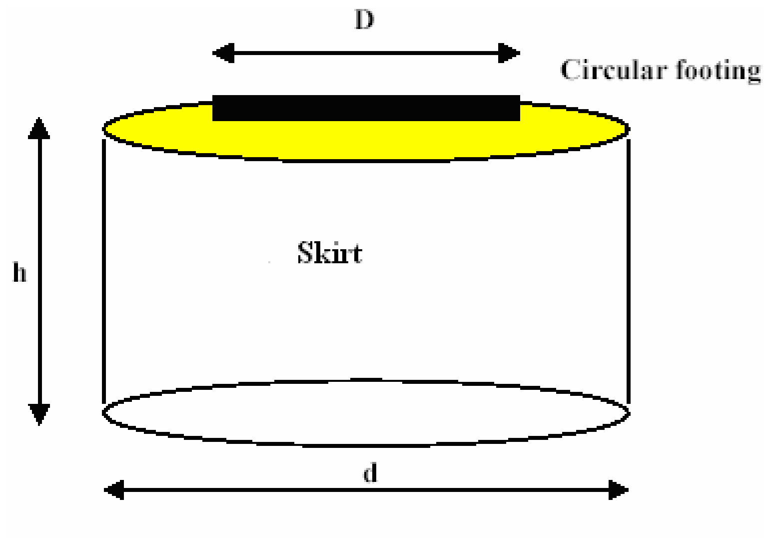


Fig.4.1.Model of footing and skirt.

Table 4.1.

	Constant Parameters	Variable Parameters
1.	d/D = 1.5	h/D = 0.5,1.0,1.5,2.0,2.5
2.	d/D = 2.0	h/D = 0.5,1.0,1.5,2.0,2.5
3.	d/D = 2.5	h/D = 0.5,1.0,1.5,2.0,2.5
4.	d/D = 3.0	h/D = 0.5,1.0,1.5,2.0,2.5
5.	d/D = 3.5	h/D = 0.5,1.0,1.5,2.0,2.5

4.3.PROPERTIES OF MATERIAL AND GENERAL INFORMATION:

Table 4.2.Unit

Type	Unit
Length	m
Force	kN
Time	Day
Bearing capicity	kN/ rad.

Table 4.3. Model dimensions

	min.	max.
X	0.000	15.000
Y	0.000	12.000

Table 4.4. Model

Model	Plane strain
Element	15-Noded

Table 4.5. Beam data sets parameters

No.	Identification	EA [kN/m]	EI [kNm²/m]	w [kN/m/m]	ν [-]	Mp [kNm/m]	Np [kN/m]
1	**Circular Footing t=0.143 m**	5E6	8500.00	0.00	0.00	1E15	1E15
2	**Skirt t=0.346m**	1.2E7	1.2E5	8.30	0.15	1E15	1E15

Table 4.6.Soil data sets parameters

Mohr-Coulomb		1 Sand
Type		Drained
γ_{unsat}	[kN/m³]	17.00
γ_{sat}	[kN/m³]	20.00
k_x	[m/day]	1.000
k_y	[m/day]	1.000
e_{init}	[-]	1.000
c_k	[-]	1E15
E_{ref}	[kN/m²]	40000.000
ν	[-]	0.300
G_{ref}	[kN/m²]	15384.615
E_{oed}	[kN/m²]	53846.154
c_{ref}	[kN/m²]	1.00
φ	[°]	32.00
ψ	[°]	2.00
E_{inc}	[kN/m²/m]	0.00
y_{ref}	[m]	0.000
$c_{increment}$	[kN/m²/m]	0.00
$T_{str.}$	[kN/m²]	0.00
$R_{inter.}$	[-]	0.67
Interface permeability		Neutral

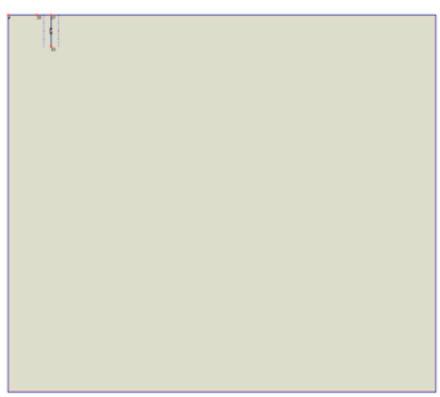


Fig.4.2.Geometry of the problem

4.4.ANALYSIS SEQUENCE OF THE PROBLEM:

This problem is simulated by PLAXIS. The sequence of analysis is given below. This sequence is repeated for every adopted combination of soil , footing and skirt in the analysis.

Soil geometry

↓

Boundary condition

↓

Footing geometry

↓

Skirt geometry

↓

Material properties

↓

Mesh generation

↓

Initial conditions

↓

Calculation phases

↓

Calculation

↓

Output result

↓

Report generation

Fig. 4.3.Graph of UBC without any skirt

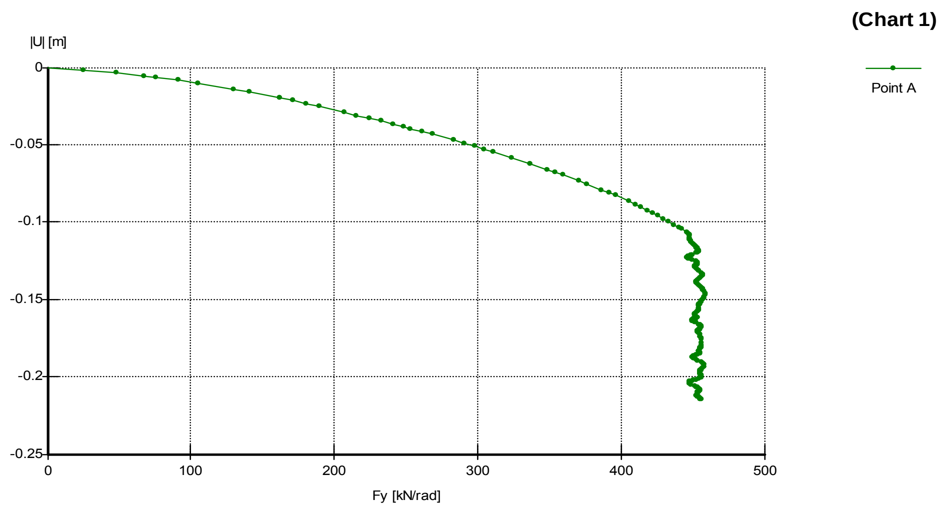


Fig. 4.4.Graph of UBC, skirt height 1.0 m & dia. 3.0m

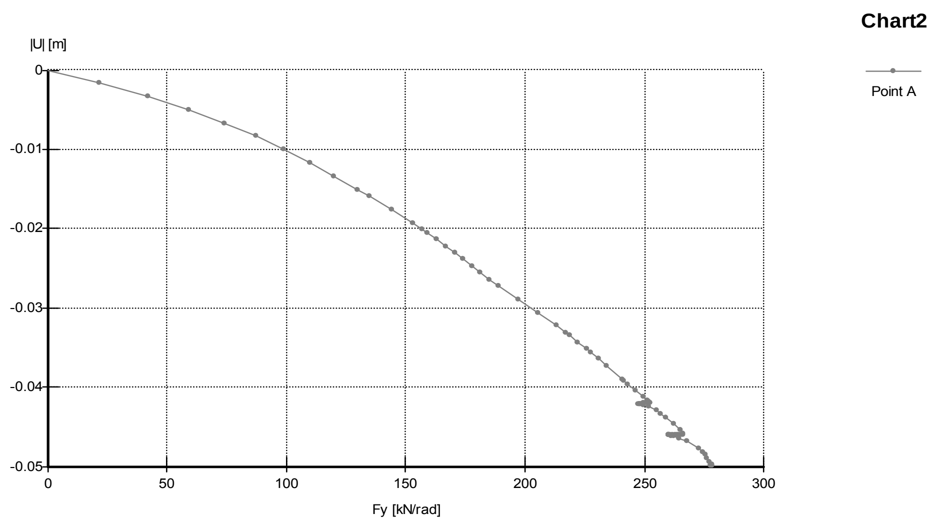


Fig. 4.5.Graph of UBC, skirt height 2.0 m & dia. 3.0 m

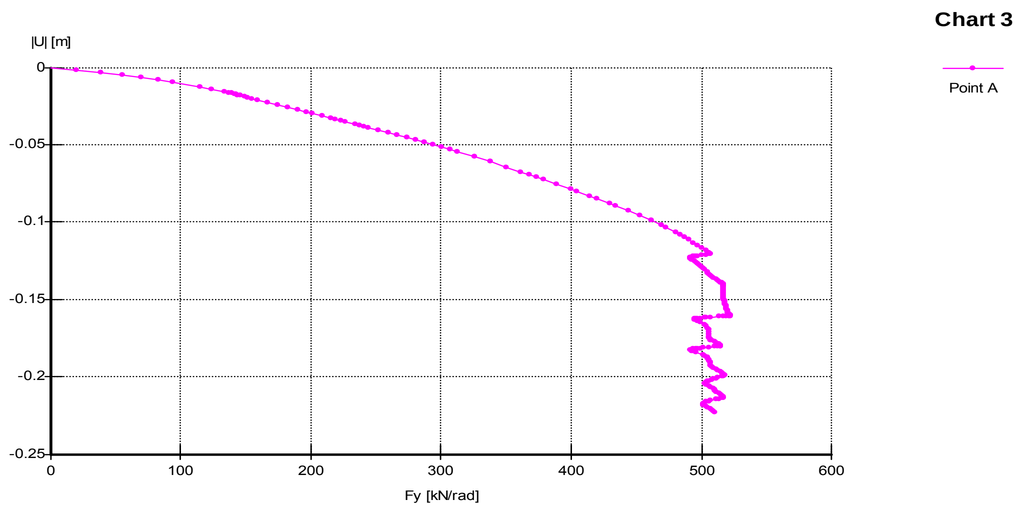


Fig. 4.6.Graph of UBC, skirt height 3.0 m & dia. 3.0 m

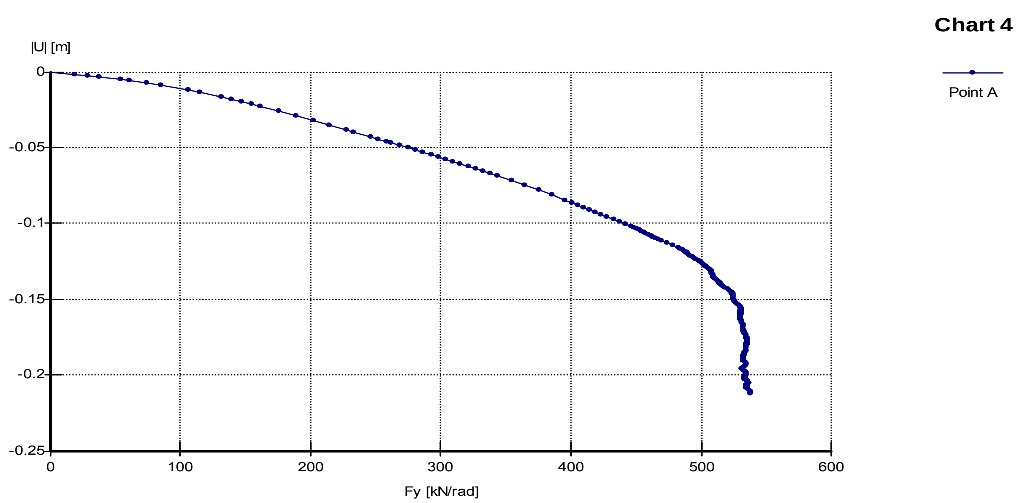


Fig. 4.7.Graph of UBC, skirt height 4.0 m & dia. 3.0 m

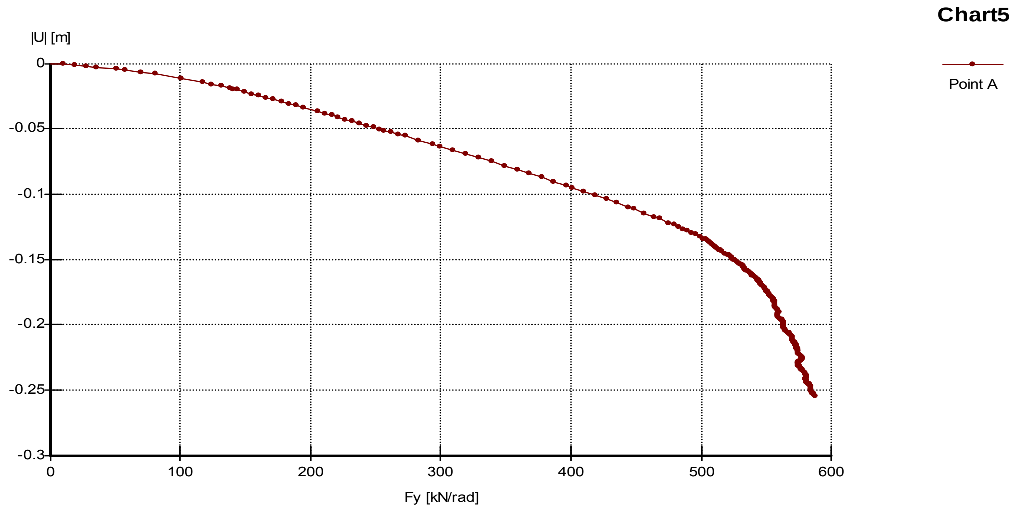


Fig. 4.8.Graph of UBC, skirt height 5.0 m & dia. 3.0 m

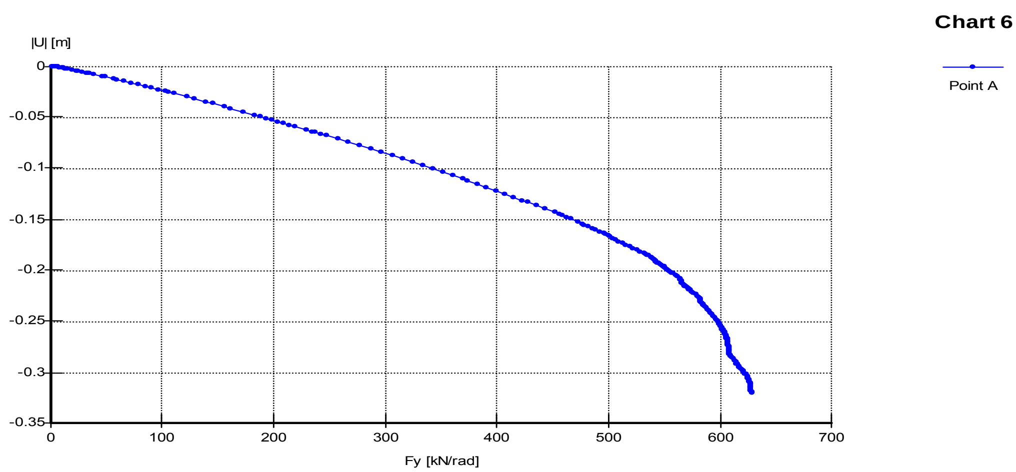


Fig. 4.9. Comparison of UBC, skirt height 1.0 to 5.0 m & dia. 3.0 m constant

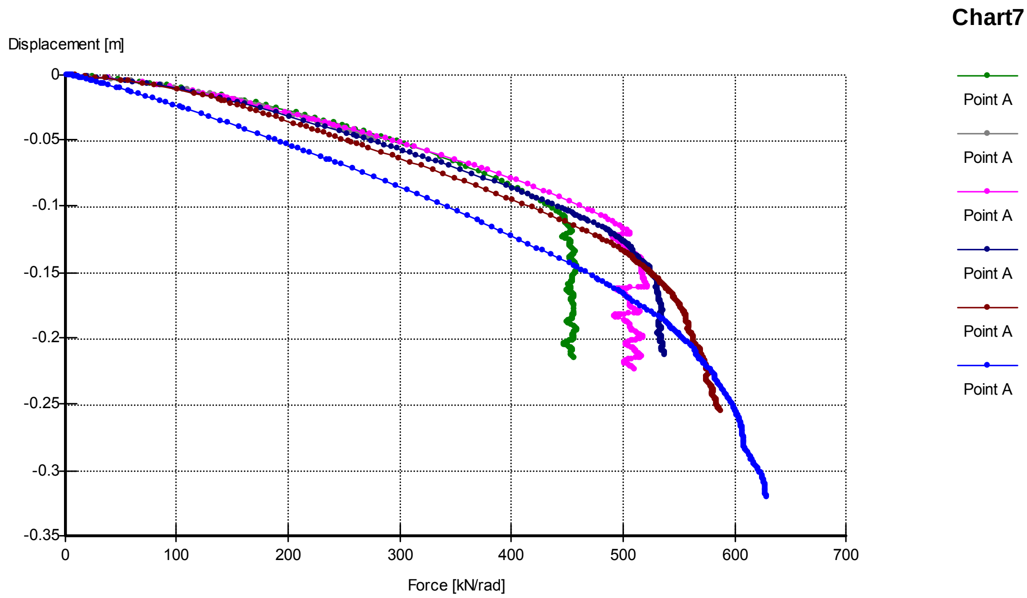


Fig. 4.10.Graph of UBC, skirt height 1.0 m & dia. 4.0 m

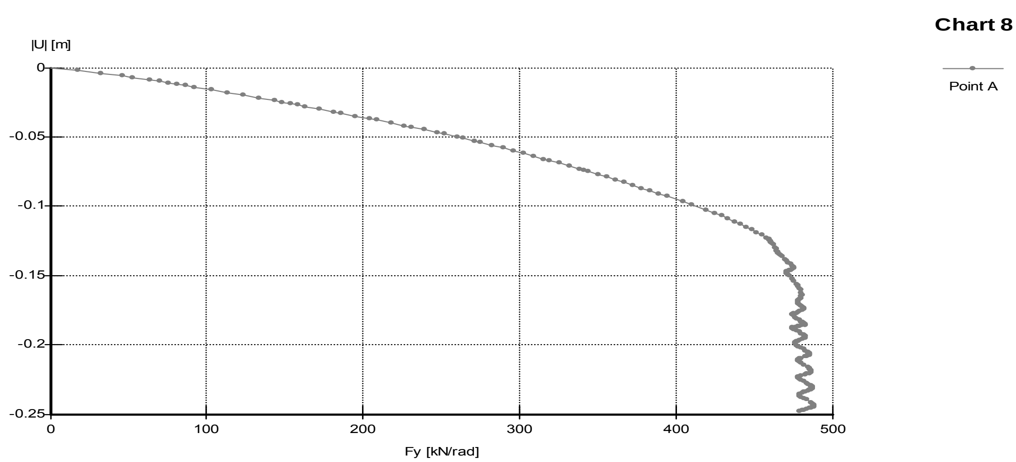


Fig. 4.11.Graph of UBC, skirt height 2.0 m & dia. 4.0 m

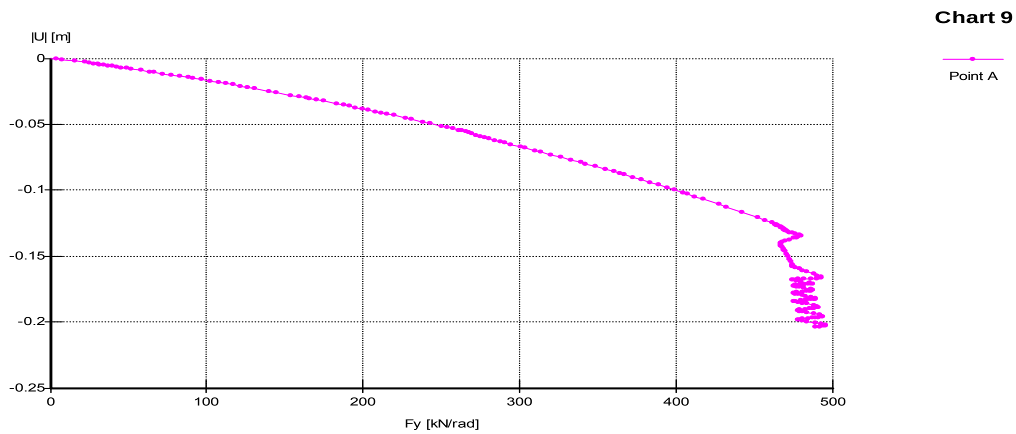


Fig. 4.12.Graph of UBC, skirt height 3.0 m & dia. 4.0 m

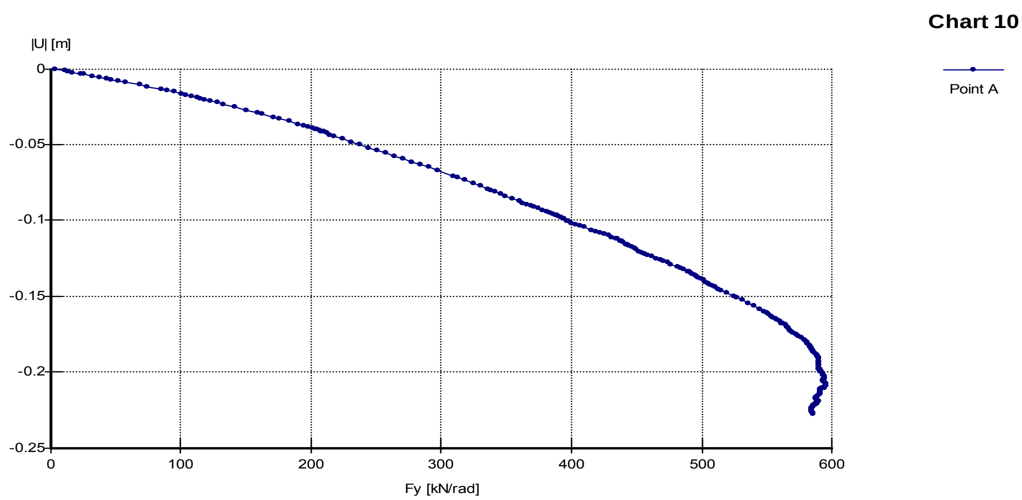


Fig. 4.13.Graph of UBC, skirt height 4.0 m & dia. 4.0 m

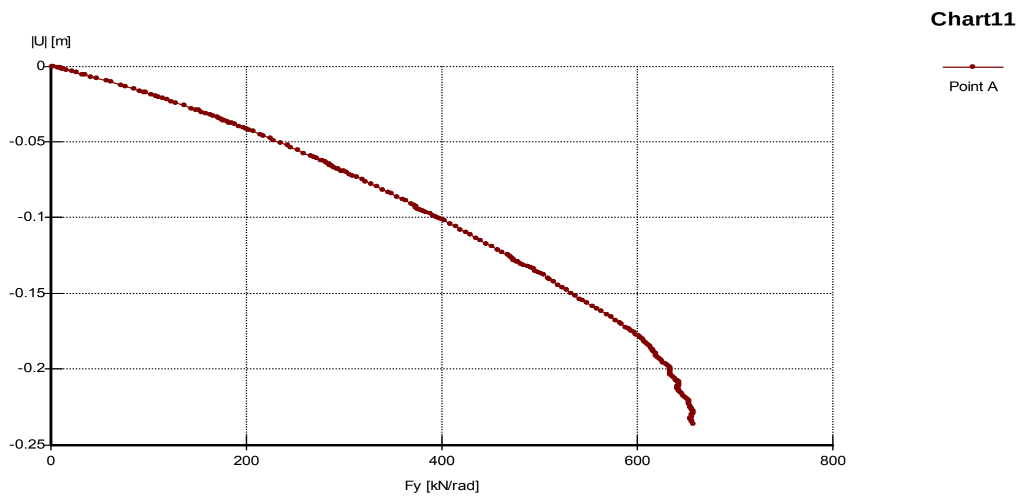


Fig. 4.14.Graph of UBC, skirt height 5.0 m & dia. 4.0 m

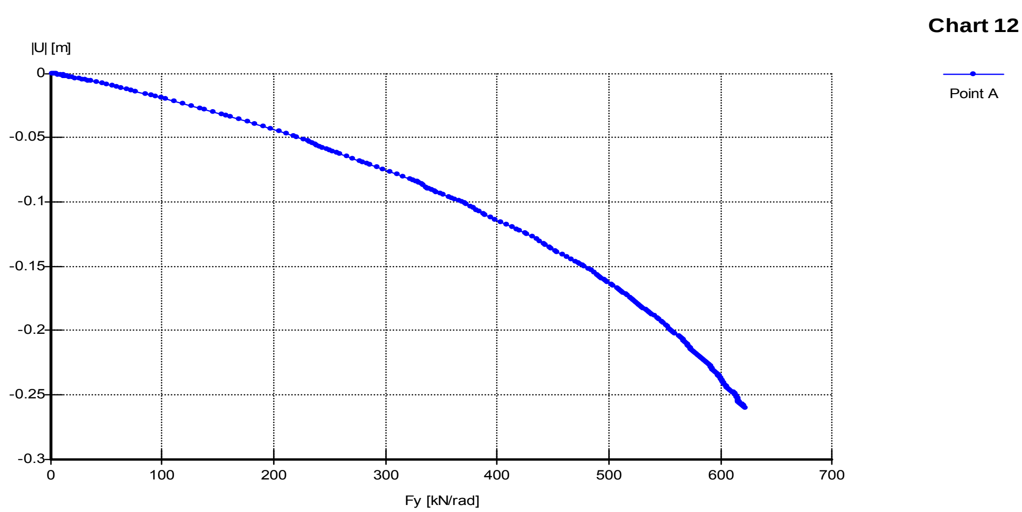


Fig. 4.15. Comparison of UBC, skirt height 1.0 to 5.0 m & dia. 4.0 m constant

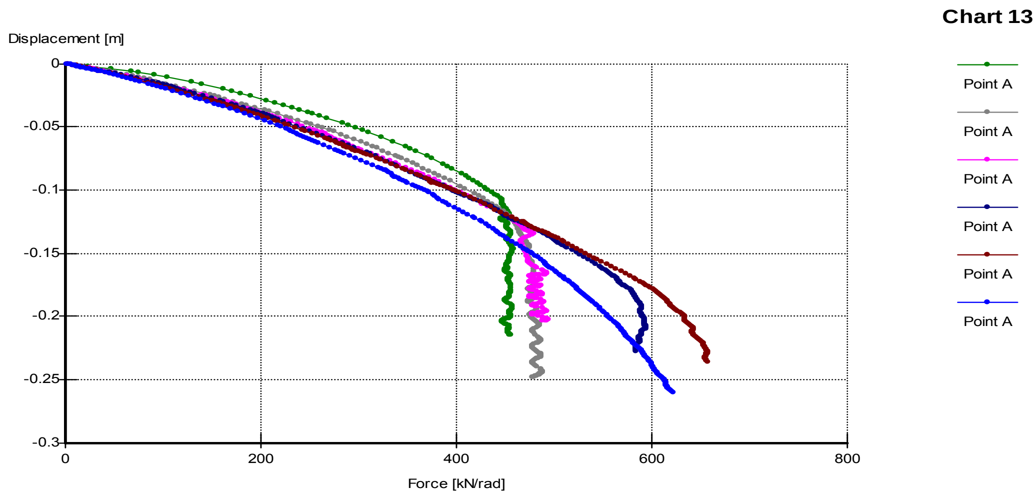


Fig. 4.16.Graph of UBC, skirt height 1.0 m & dia. 5.0 m

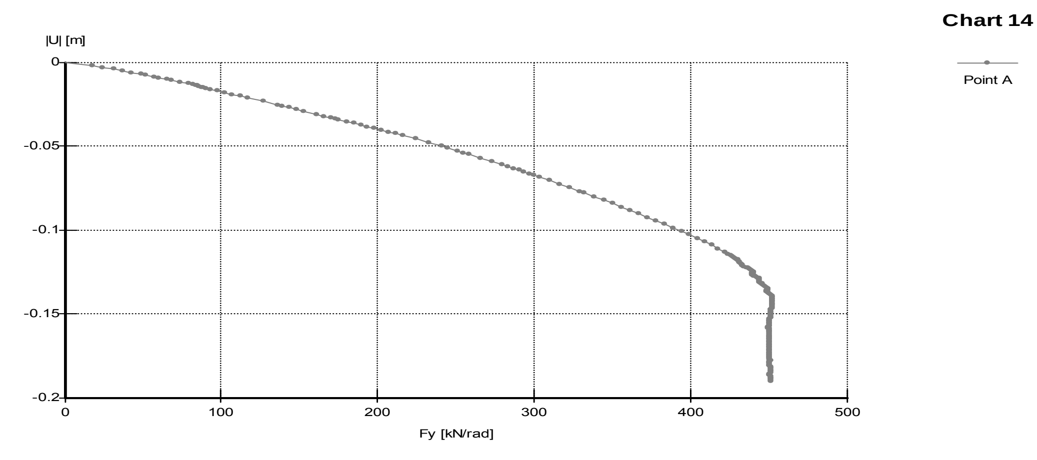


Fig. 4.17.Graph of UBC, skirt height 2.0 m & dia. 5.0 m

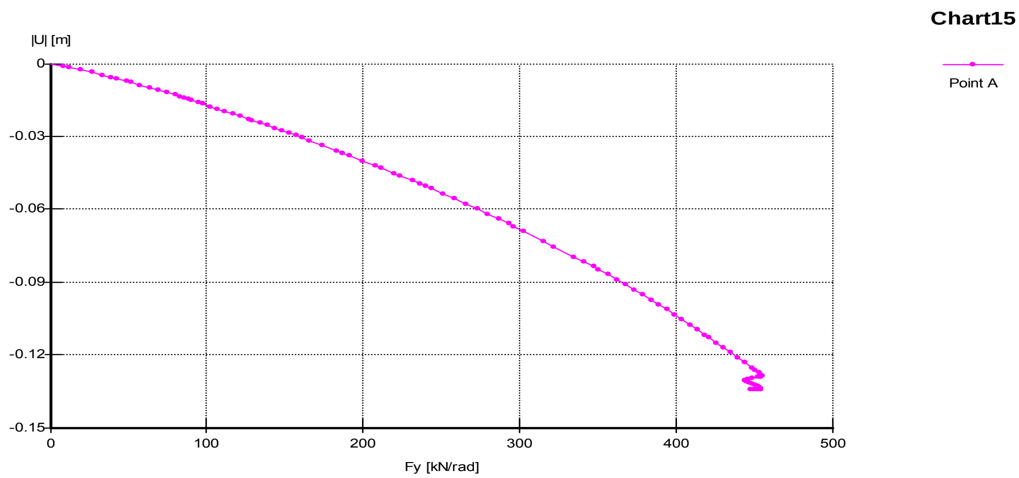


Fig. 4.18.Graph of UBC, skirt height 3.0 m & dia. 5.0 m

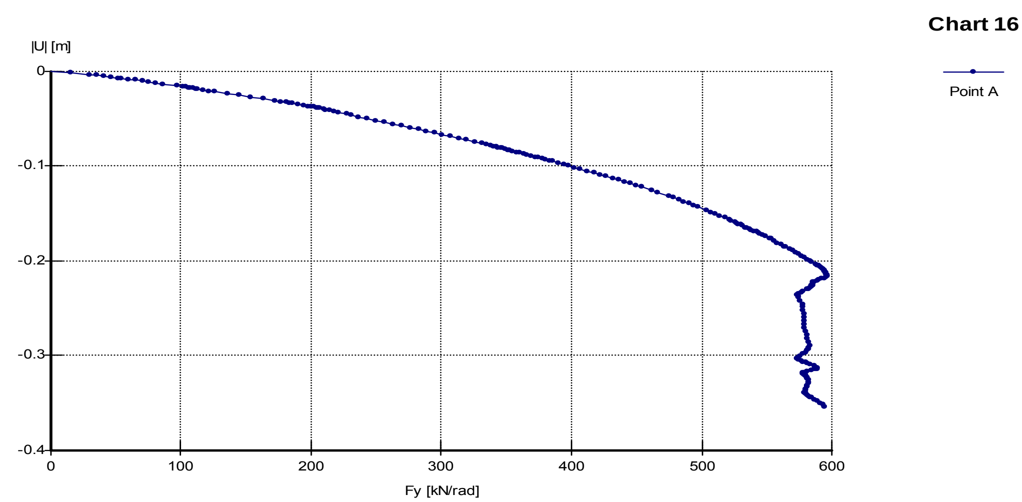


Fig. 4.19.Graph of UBC, skirt height 4.0 m & dia. 5.0 m

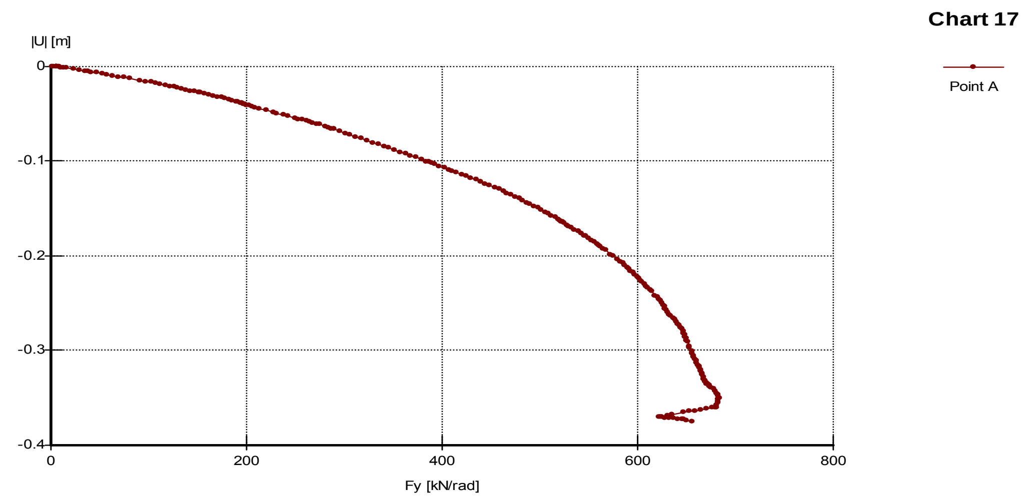


Fig. 4.20.Graph of UBC, skirt height 5.0 m & dia. 5.0 m

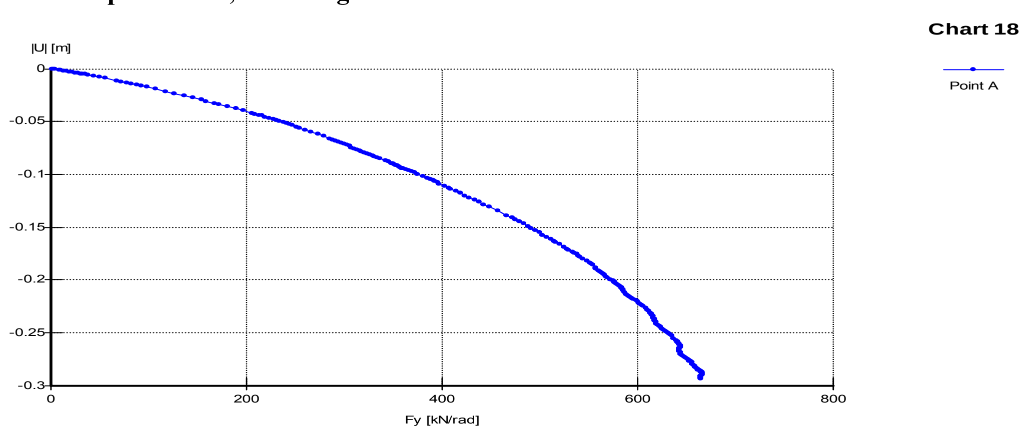


Fig. 4.21. Comparison of UBC, skirt height 1.0 to 5.0 m & dia. 5.0 m constant

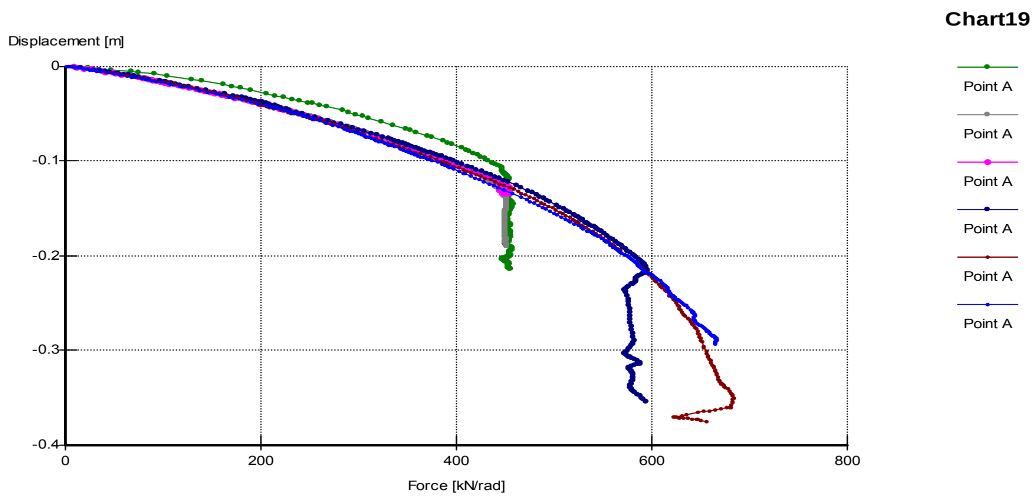


Fig. 4.22.Graph of UBC, skirt height 1.0 m & dia. 6.0 m

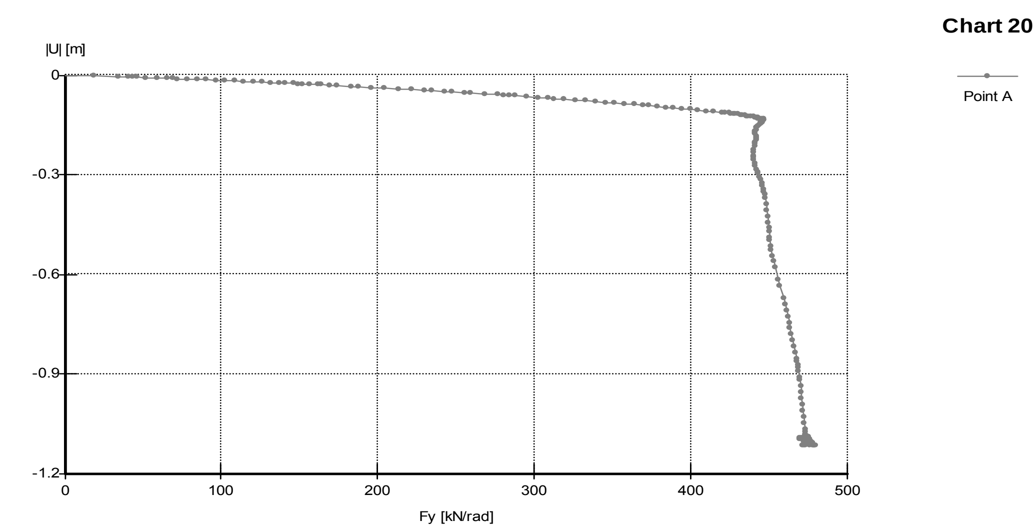


Fig. 4.23.Graph of UBC, skirt height 2.0 m & dia. 6.0 m

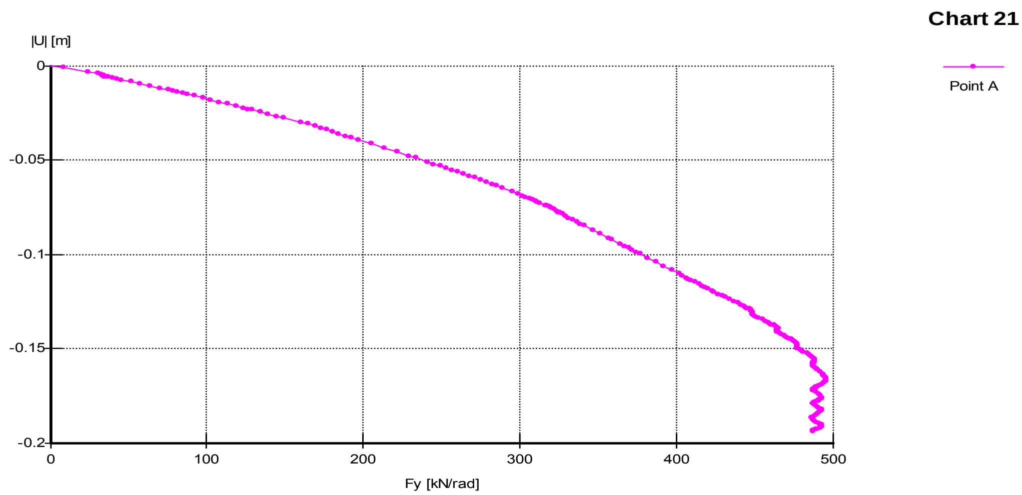


Fig. 4.24.Graph of UBC, skirt height 3.0 m & dia. 6.0 m

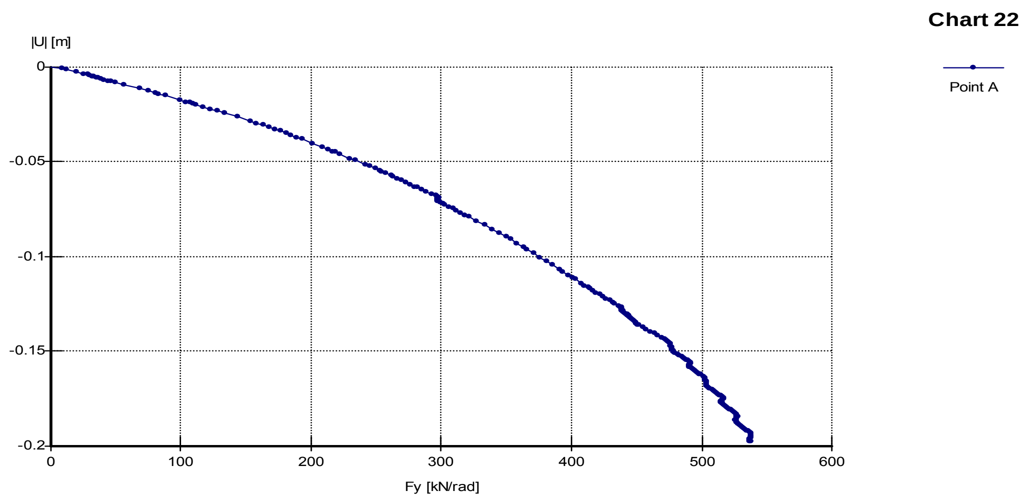


Fig. 4.25.Graph of UBC, skirt height 4.0 m & dia. 6.0 m

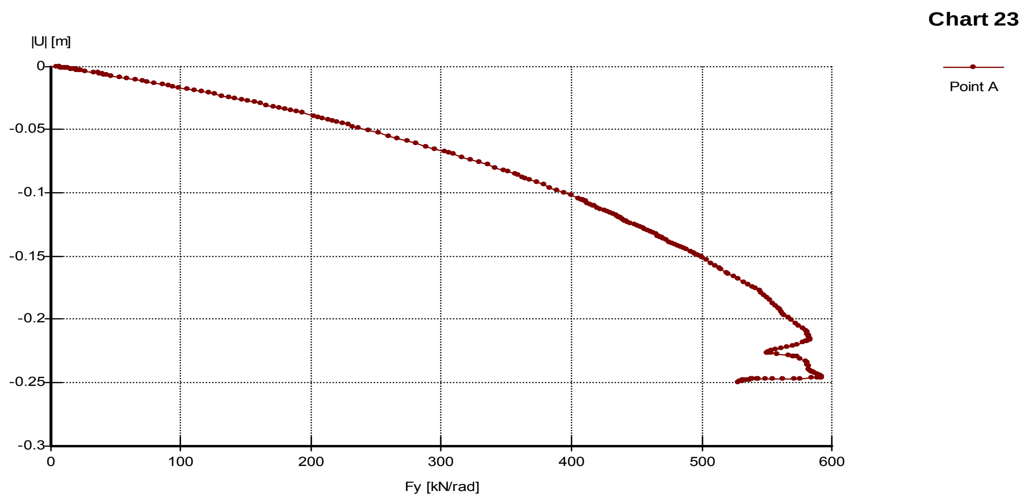


Fig. 4.26.Graph of UBC, skirt height 5.0 m & dia. 6.0 m

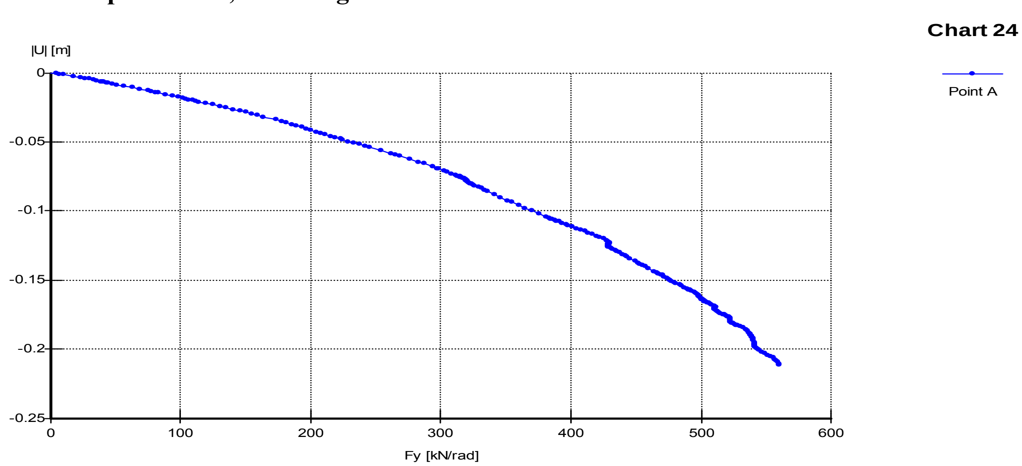


Fig. 4.27. Comparison of UBC, skirt height 1.0 to 5.0 m & dia. 6.0 m constant

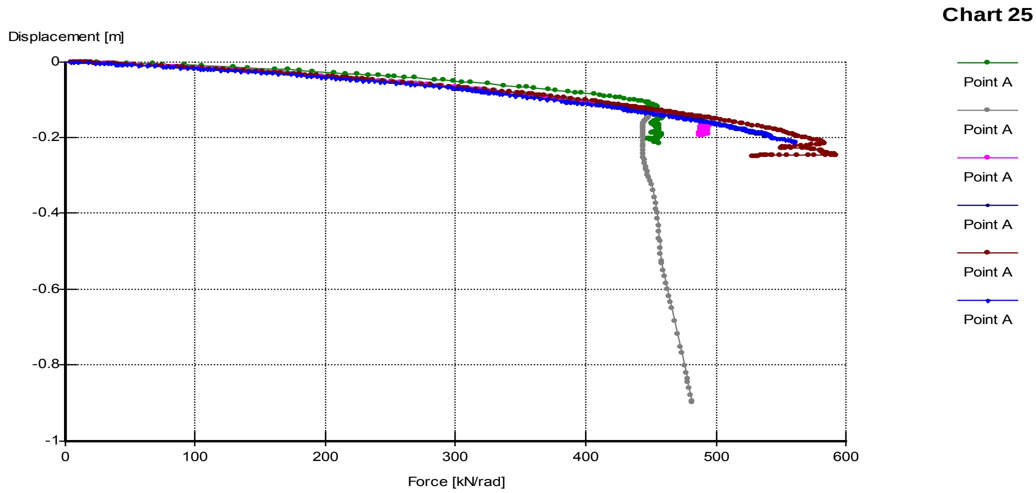


Fig. 4.28.Graph of UBC, skirt height 1.0 m & dia. 7.0 m

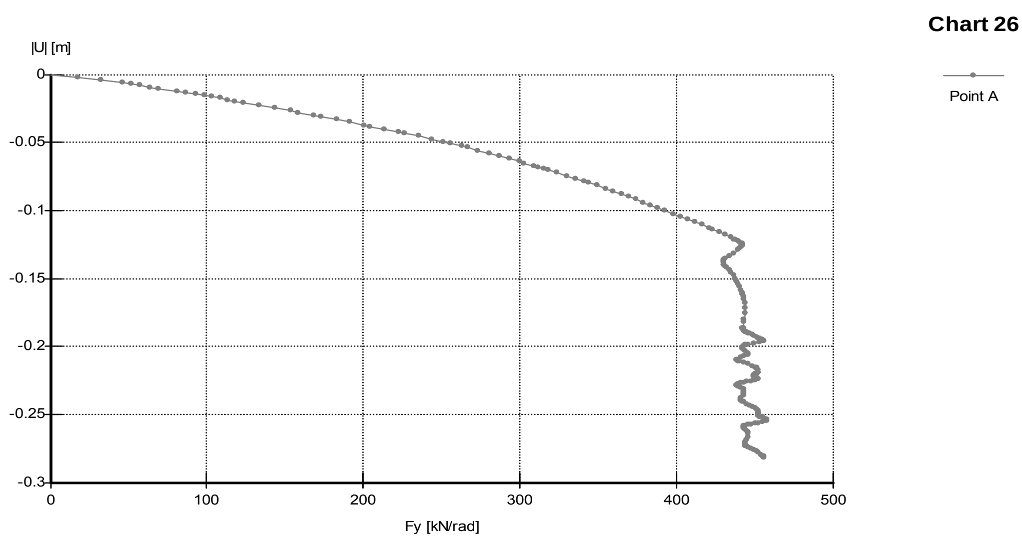


Fig. 4.29.Graph of UBC, skirt height 2.0 m & dia. 7.0 m

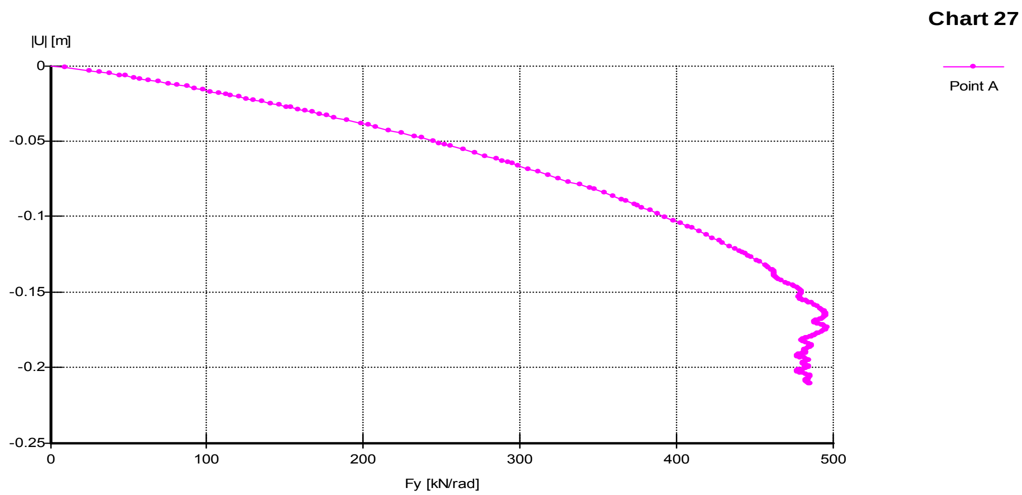


Fig. 4.30.Graph of UBC, skirt height 3.0 m & dia. 7.0 m

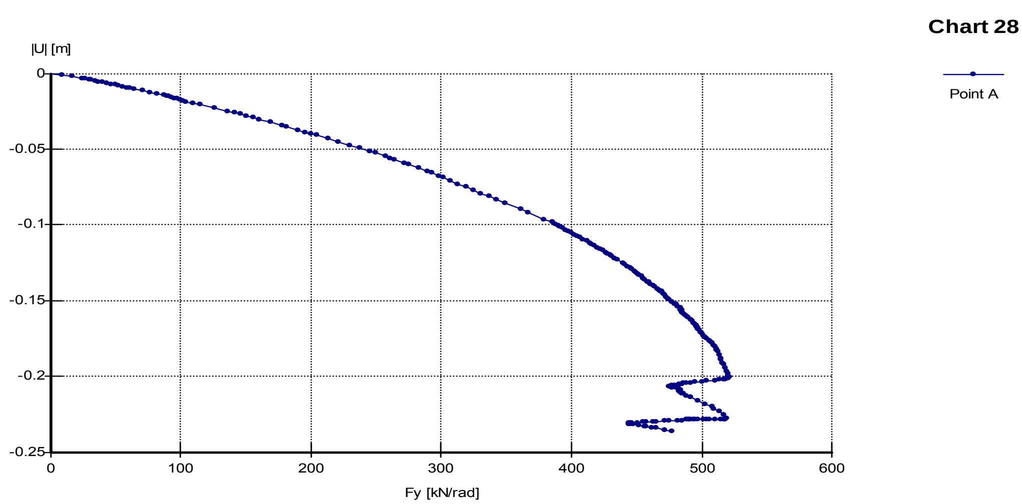


Fig. 4.31.Graph of UBC, skirt height 4.0 m & dia. 7.0 m

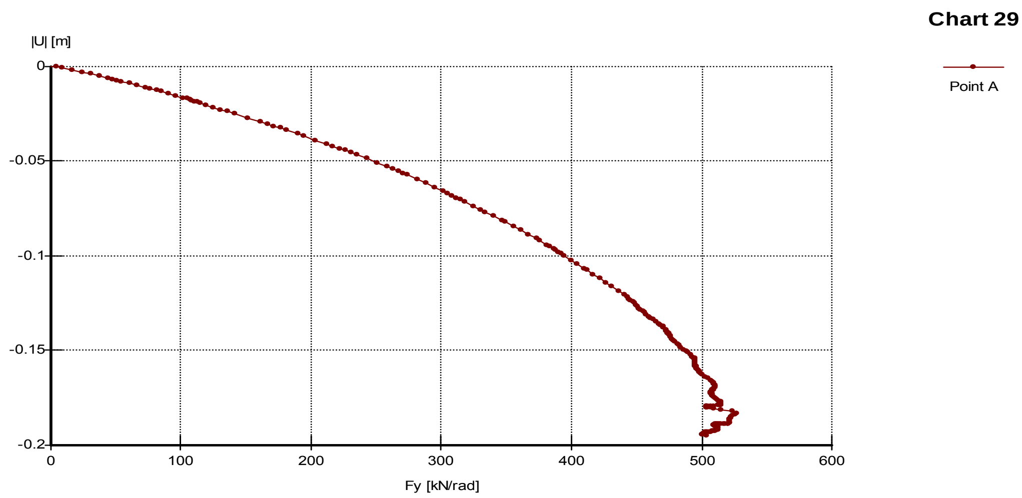


Fig. 4.32.Graph of UBC, skirt height 5.0 m & dia. 7.0 m

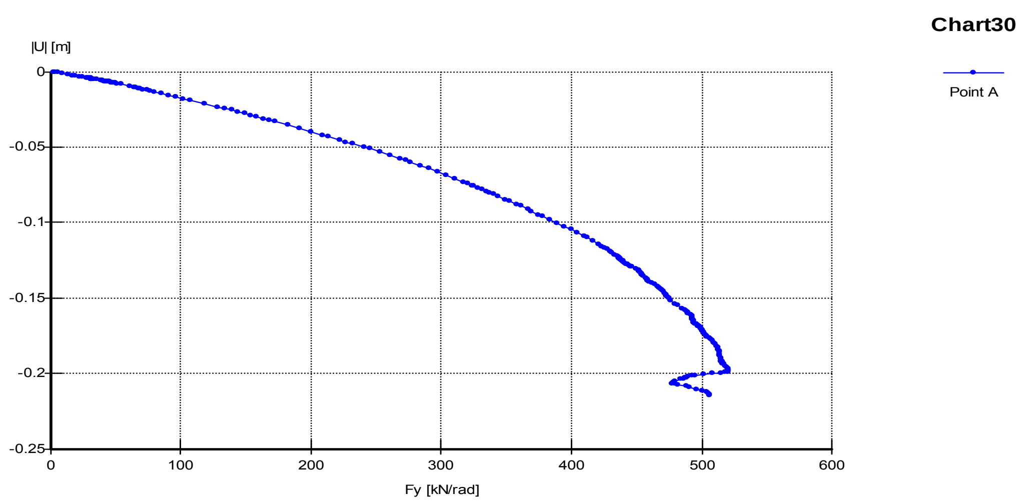


Fig. 4.33. Comparison of UBC, skirt height 1.0 to 5.0 m & dia. 7.0 m constant

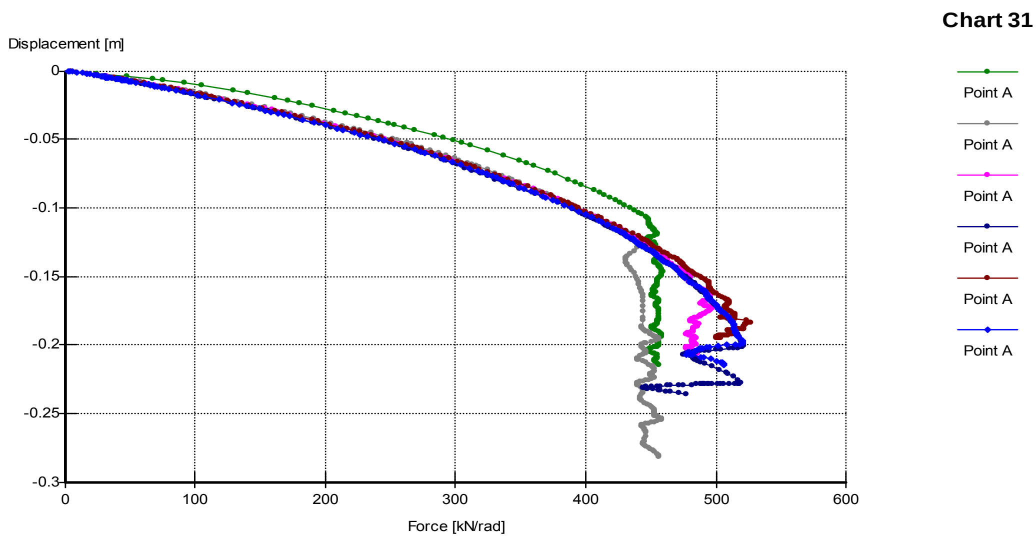


Table 4.7. Variation of UBC , d/D Vs. h/D

	F_Y,h/D=0.5	F_Y,h/D=1.0	F_Y,h/D=1.5	F_Y,h/D=2.0	F_Y,h/D=2.5
d/D					
1.5	266.27	506.82	530.54	559.37	606.58
2	475.79	480.42	589.93	634.47	622.17
2.5	440.4	455.25	596.01	683.94	666.58
3	469.63	465.12	516.28	582.61	522.59
3.5	442.71	463.12	520.62	495.82	520.39

Fig.4.34. Variation of UBC with skirt diameter d/D for different skirt heights

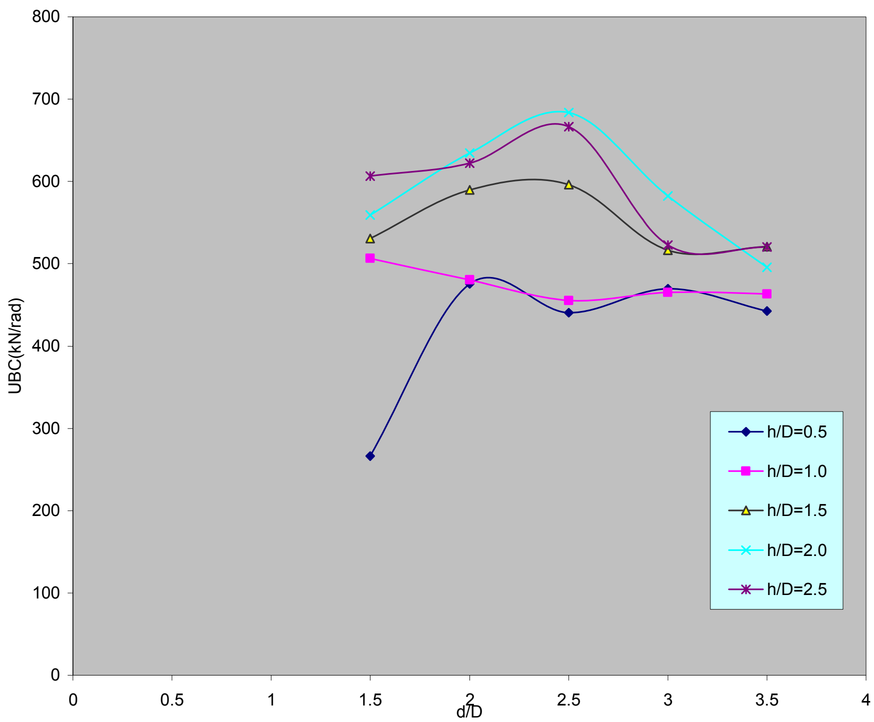
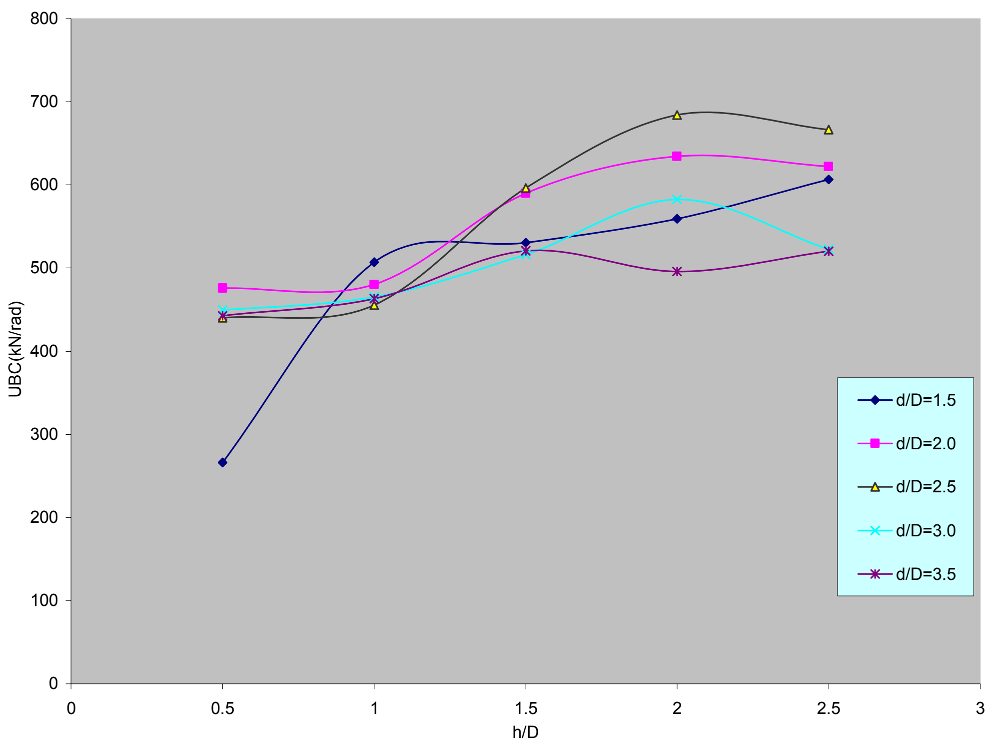


Table 4.8. Variation of UBC , h/D Vs d/D

	d/D=1.5	d/D=2.0	d/D=2.5	d/D=3.0	d/D=3.5
h/D	F_Y	F_Y	F_Y	F_Y	F_Y
0.5	266.27	475.79	440.4	449.63	442.71
1	506.82	480.42	455.25	465.12	463.12
1.5	530.54	589.93	596.01	516.28	520.62
2	559.37	634.47	683.94	582.61	495.82
2.5	606.58	622.17	666.58	522.59	520.39

Fig.4.35. Variation of UBC with skirt height h/D for different diameter d/D



4.5. RESULT AND DISCUSSION :

4.5.1. EFFECT OF SKIRT DIAMETER : In order to investigate the effect of skirt diameter on the footing behavior five diameters of 3,4,5,6 & 7 metre were used.

Fig. 4.34.& table 4.7.shows the variation of bearing capacity of the footing increases as the normalized skirt diameter d/D increase up to a specific limit, and after which bearing capacity decreases with an increase in the d/D ratio beyond h/D = 1.0

4.5.2. EFFECT OF SKIRT HEIGHT : To investigate the effect of skirt height on the footing response, analysis has been done by using six heights 1,2,3,4,5 & 6 metre.

Fig.4.35. shows that in general the bearing capacity increased as the height is increases. Its means increasing in skirt heights gives the result of improvement in bearing capacity.

Result shows that for adopted combination of skirt height and diameter the bearing capacity is the greatest when the d/D 2.5 and h/D 2.0

The significant increase in the bearing capacity of the footing can be explained as follows, when the footing is loaded, such confinement resist the lateral displacement of soil piratical underneath the footing and confines the soil leading to a significant decrease in the vertical settlement and hence improving the bearing capacity. For small cylindrical skirt diameters, as the pressure is increased, the plastic state is developed initially around the edges of the footing and then spreads initially around the edges of the footing and then spread downward and outward. The mobilized vertical friction between the sand and the inside wall of the skirt increases with the increase of the active earth pressure until the point when the system (the skirt, sand and footing) starts behave as one unit. The behavior is similar to that observed in deep foundations (piles and caissons) in which the bearing load increases due to the shear resistance of skirt surface.

CHAPTER 5
CONCLUSION AND SCOPE OF FURTHER STUDY

5.1. CONCLUSION:

Based on the analysis and discussion of the problem of skirted circular footings, the following conclusions can be drawn-

(1) soil confinement has a significant effect on improving the behavior of a circular footing supported on granular soil, but if the skirting is very near to circular foundation on very week and low ϕ soil, it is possible that after loading, the skirt may rise or deflect from the initial installation position. It means that the sand may become loose due to the dislocation of skirt in spite of confinement. In such cases bearing capacity of the foundation decreases.

(2) For large diameter confining skirt relative to footing size ,the skirt-sand-footing system behaves initially as one unit(deep foundation) but as the failure approaches ,the footing only settles while the skirt seems to be unaffected.

(3)In case where the structure are very sensitive to settlement, soil confinement can be used to obtain the same allowable bearing capacity at a much lower settlement.

(4)The bearing capacity is highly dependent on the d/D ratio (Skirt diameter/Footing diameter).

For the adopted combination of d/D, soil and skirt ,the optimum ratio of d/D is about 2.5 beyond the h/D 1.0.After increasing the d/D ratio by 2.5 the value of bearing capacity starts to decrease.

(5)For adopted combination of soil, circular footing, skirt with different heights and different diameters in this thesis, the maximum bearing capacity may be achieved by adopting the d/D ratio of 2.5 with h/D ratio 2.0.

(6)Increasing the height of skirt, results in increasing the surface area of skirt footing, which transfers footing load to deeper depth and leads to improving the bearing capacity.

5.2. SCOPE OF FURTHER STUDY:

(1)The analysis may be done by taking skirt made of different type of material which is economical and corrosion resistant. In such a way we can optimize the skirt value and skirt may serve for a long time.

(2)Actual datas of soil interaction and bearing capacity may be obtained by providing some sensors during SPT or some other bearing capacity field tests and may be compared by my thesis results.

(3)The behavior of other footing (square or rectangular) along with the influence of the roughness and the stiffness of skirt material were not studied. Therefore, it is recommended that future work investigates consider the effect of these parameters, for both dry and wet sand conditions.

(4)The effect of soil confinement by a differential diameter of decreasing or increasing order to the bottom of a skirt may be studied in further research work.

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APPENDIX

Table 1. Settlement Vs load intensity table with out any skirt

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	24.99	(0.00)	64.00	452.61	(0.12)	127.00	457.12	(0.15)	190.00	452.39	(0.19)
2.00	48.17	(0.00)	65.00	452.95	(0.12)	128.00	456.37	(0.15)	191.00	451.29	(0.19)
3.00	67.80	(0.01)	66.00	453.19	(0.12)	129.00	456.02	(0.15)	192.00	450.93	(0.19)
4.00	75.99	(0.01)	67.00	453.38	(0.12)	130.00	455.36	(0.15)	193.00	450.63	(0.19)
5.00	91.71	(0.01)	68.00	453.57	(0.12)	131.00	455.06	(0.15)	194.00	450.38	(0.19)
6.00	105.26	(0.01)	69.00	453.98	(0.12)	132.00	454.76	(0.15)	195.00	450.37	(0.19)
7.00	130.00	(0.01)	70.00	454.42	(0.12)	133.00	454.54	(0.15)	196.00	450.77	(0.19)
8.00	141.05	(0.02)	71.00	454.57	(0.12)	134.00	454.44	(0.15)	197.00	451.47	(0.19)
9.00	161.77	(0.02)	72.00	454.59	(0.12)	135.00	454.47	(0.16)	198.00	452.45	(0.19)
10.00	171.52	(0.02)	73.00	454.46	(0.12)	136.00	454.54	(0.16)	199.00	453.60	(0.19)
11.00	180.88	(0.02)	74.00	453.81	(0.12)	137.00	454.49	(0.16)	200.00	455.94	(0.19)
12.00	189.83	(0.03)	75.00	452.85	(0.12)	138.00	454.39	(0.16)	201.00	457.46	(0.19)
13.00	207.21	(0.03)	76.00	450.30	(0.12)	139.00	454.21	(0.16)	202.00	457.89	(0.19)
14.00	215.93	(0.03)	77.00	449.68	(0.12)	140.00	453.78	(0.16)	203.00	458.17	(0.19)
15.00	224.55	(0.03)	78.00	449.09	(0.12)	141.00	453.19	(0.16)	204.00	458.42	(0.19)
16.00	232.85	(0.03)	79.00	448.53	(0.12)	142.00	452.56	(0.16)	205.00	458.17	(0.19)
17.00	240.97	(0.04)	80.00	447.96	(0.12)	143.00	451.58	(0.16)	206.00	457.66	(0.19)
18.00	249.02	(0.04)	81.00	447.39	(0.12)	144.00	451.70	(0.16)	207.00	456.61	(0.20)
19.00	253.04	(0.04)	82.00	446.89	(0.12)	145.00	452.13	(0.16)	208.00	456.20	(0.20)
20.00	261.03	(0.04)	83.00	446.08	(0.12)	146.00	453.07	(0.16)	209.00	455.86	(0.20)
21.00	268.86	(0.04)	84.00	446.25	(0.12)	147.00	453.33	(0.16)	210.00	455.60	(0.20)
22.00	283.92	(0.05)	85.00	447.10	(0.12)	148.00	453.22	(0.16)	211.00	455.29	(0.20)
23.00	290.96	(0.05)	86.00	447.89	(0.12)	149.00	452.96	(0.16)	212.00	455.31	(0.20)
24.00	297.96	(0.05)	87.00	449.50	(0.12)	150.00	452.48	(0.16)	213.00	455.55	(0.20)
25.00	304.83	(0.05)	88.00	452.22	(0.13)	151.00	451.20	(0.16)	214.00	456.01	(0.20)
26.00	311.52	(0.05)	89.00	452.86	(0.13)	152.00	450.69	(0.16)	215.00	456.30	(0.20)
27.00	324.41	(0.06)	90.00	453.28	(0.13)	153.00	450.31	(0.16)	216.00	456.33	(0.20)
28.00	336.74	(0.06)	91.00	453.41	(0.13)	154.00	450.08	(0.16)	217.00	456.13	(0.20)
29.00	348.61	(0.07)	92.00	453.28	(0.13)	155.00	450.06	(0.16)	218.00	455.91	(0.20)
30.00	354.30	(0.07)	93.00	453.00	(0.13)	156.00	450.58	(0.16)	219.00	455.65	(0.20)
31.00	359.91	(0.07)	94.00	452.38	(0.13)	157.00	451.38	(0.16)	220.00	455.36	(0.20)
32.00	370.97	(0.07)	95.00	452.00	(0.13)	158.00	452.38	(0.17)	221.00	454.71	(0.20)
33.00	376.28	(0.08)	96.00	452.02	(0.13)	159.00	454.60	(0.17)	222.00	454.14	(0.20)
34.00	386.77	(0.08)	97.00	452.32	(0.13)	160.00	455.47	(0.17)	223.00	452.62	(0.20)
35.00	391.82	(0.08)	98.00	452.75	(0.13)	161.00	455.82	(0.17)	224.00	450.84	(0.20)
36.00	396.62	(0.08)	99.00	453.62	(0.13)	162.00	456.36	(0.17)	225.00	449.92	(0.20)
37.00	405.94	(0.09)	100.00	454.16	(0.13)	163.00	456.39	(0.17)	226.00	448.33	(0.20)
38.00	410.30	(0.09)	101.00	454.81	(0.13)	164.00	456.11	(0.17)	227.00	448.02	(0.20)
39.00	414.48	(0.09)	102.00	456.00	(0.13)	165.00	455.67	(0.17)	228.00	447.82	(0.20)
40.00	418.54	(0.09)	103.00	456.82	(0.13)	166.00	455.09	(0.17)	229.00	447.61	(0.20)
41.00	422.46	(0.09)	104.00	456.99	(0.13)	167.00	454.53	(0.17)	230.00	447.63	(0.20)
42.00	426.28	(0.10)	105.00	457.00	(0.13)	168.00	454.02	(0.17)	231.00	447.97	(0.20)
43.00	430.03	(0.10)	106.00	456.72	(0.14)	169.00	453.67	(0.17)	232.00	448.92	(0.21)
44.00	433.72	(0.10)	107.00	455.84	(0.14)	170.00	453.75	(0.17)	233.00	451.44	(0.21)
45.00	437.39	(0.10)	108.00	455.18	(0.14)	171.00	454.29	(0.17)	234.00	452.63	(0.21)
46.00	441.05	(0.10)	109.00	454.45	(0.14)	172.00	455.02	(0.17)	235.00	453.77	(0.21)
47.00	442.80	(0.10)	110.00	453.83	(0.14)	173.00	455.75	(0.17)	236.00	454.54	(0.21)
48.00	446.16	(0.11)	111.00	452.77	(0.14)	174.00	456.19	(0.17)	237.00	455.47	(0.21)
49.00	447.36	(0.11)	112.00	452.66	(0.14)	175.00	456.39	(0.18)	238.00	455.40	(0.21)
50.00	447.64	(0.11)	113.00	452.79	(0.14)	176.00	456.55	(0.18)	239.00	454.86	(0.21)
51.00	447.81	(0.11)	114.00	453.20	(0.14)	177.00	456.39	(0.18)	240.00	454.15	(0.21)
52.00	447.95	(0.11)	115.00	454.49	(0.14)	178.00	456.18	(0.18)	241.00	453.84	(0.21)
53.00	448.00	(0.11)	116.00	455.65	(0.14)	179.00	455.99	(0.18)	242.00	453.40	(0.21)
54.00	448.05	(0.11)	117.00	456.54	(0.14)	180.00	455.74	(0.18)	243.00	453.13	(0.21)
55.00	448.15	(0.11)	118.00	456.91	(0.14)	181.00	455.60	(0.18)	244.00	453.12	(0.21)
56.00	448.38	(0.11)	119.00	457.29	(0.14)	182.00	455.30	(0.18)	245.00	453.33	(0.21)
57.00	448.67	(0.11)	120.00	457.67	(0.14)	183.00	454.70	(0.18)	246.00	453.67	(0.21)
58.00	449.05	(0.11)	121.00	458.35	(0.15)	184.00	454.63	(0.18)	247.00	454.54	(0.21)
59.00	449.95	(0.11)	122.00	458.82	(0.15)	185.00	454.74	(0.18)	248.00	455.27	(0.21)
60.00	450.49	(0.11)	123.00	458.90	(0.15)	186.00	454.98	(0.18)	249.00	455.74	(0.21)
61.00	451.11	(0.11)	124.00	458.69	(0.15)	187.00	455.01	(0.18)	250.00	456.00	(0.21)
62.00	451.69	(0.12)	125.00	458.29	(0.15)	188.00	454.49	(0.19)			
63.00	452.19	(0.12)	126.00	457.79	(0.15)	189.00	453.54	(0.19)			

Table 2. Settlement Vs load intensity table with skirt height 1.0m & dia. 3.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	21.65	(0.00)	64.00	266.27	(0.05)
2.00	42.17	(0.00)	65.00	265.61	(0.05)
3.00	59.56	(0.01)	66.00	264.30	(0.05)
4.00	74.24	(0.01)	67.00	264.23	(0.05)
5.00	87.37	(0.01)	68.00	264.14	(0.05)
6.00	99.06	(0.01)	69.00	263.95	(0.05)
7.00	109.82	(0.01)	70.00	263.55	(0.05)
8.00	120.18	(0.01)	71.00	262.69	(0.05)
9.00	130.13	(0.02)	72.00	261.84	(0.05)
10.00	134.87	(0.02)	73.00	260.42	(0.05)
11.00	144.00	(0.02)	74.00	259.96	(0.05)
12.00	152.85	(0.02)	75.00	259.92	(0.05)
13.00	157.14	(0.02)	76.00	259.93	(0.05)
14.00	159.23	(0.02)	77.00	259.95	(0.05)
15.00	163.22	(0.02)	78.00	260.00	(0.05)
16.00	167.01	(0.02)	79.00	260.08	(0.05)
17.00	170.60	(0.02)	80.00	260.25	(0.05)
18.00	174.07	(0.02)	81.00	260.57	(0.05)
19.00	177.58	(0.02)	82.00	261.16	(0.05)
20.00	181.23	(0.03)	83.00	262.29	(0.05)
21.00	185.10	(0.03)	84.00	264.36	(0.05)
22.00	189.13	(0.03)	85.00	268.01	(0.05)
23.00	197.28	(0.03)	86.00	272.71	(0.05)
24.00	205.26	(0.03)	87.00	274.25	(0.05)
25.00	213.03	(0.03)	88.00	275.28	(0.05)
26.00	216.85	(0.03)	89.00	276.20	(0.05)
27.00	218.67	(0.03)	90.00	277.18	(0.05)
28.00	222.15	(0.03)	91.00	278.23	(0.05)
29.00	225.57	(0.04)	92.00	278.36	(0.05)
30.00	227.29	(0.04)	93.00	278.31	(0.05)
31.00	230.67	(0.04)	94.00	278.11	(0.05)
32.00	234.00	(0.04)	95.00	277.91	(0.05)
33.00	240.52	(0.04)	96.00	277.71	(0.05)
34.00	241.39	(0.04)			
35.00	243.12	(0.04)			
36.00	246.49	(0.04)			
37.00	249.74	(0.04)			
38.00	251.26	(0.04)			
39.00	251.97	(0.04)			
40.00	252.27	(0.04)			
41.00	252.08	(0.04)			
42.00	251.92	(0.04)			
43.00	251.59	(0.04)			
44.00	250.98	(0.04)			
45.00	250.55	(0.04)			
46.00	249.73	(0.04)			
47.00	249.07	(0.04)			
48.00	248.54	(0.04)			
49.00	247.63	(0.04)			
50.00	247.61	(0.04)			
51.00	247.65	(0.04)			
52.00	247.72	(0.04)			
53.00	247.88	(0.04)			
54.00	248.19	(0.04)			
55.00	248.77	(0.04)			
56.00	249.80	(0.04)			
57.00	251.67	(0.04)			
58.00	254.93	(0.04)			
59.00	256.90	(0.04)			
60.00	258.70	(0.04)			
61.00	262.11	(0.04)			
62.00	265.09	(0.05)			
63.00	266.22	(0.05)			

Table 3. Settlement Vs load intensity table with skirt height 2.0m & dia. 3.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	19.99	(0.00)	64.00	480.40	(0.11)	127.00	518.14	(0.15)	190.00	502.69	(0.19)
2.00	38.76	(0.00)	65.00	483.90	(0.11)	128.00	518.35	(0.15)	191.00	504.10	(0.19)
3.00	55.80	(0.00)	66.00	487.35	(0.11)	129.00	518.50	(0.15)	192.00	505.06	(0.19)
4.00	70.02	(0.01)	67.00	490.72	(0.11)	130.00	518.59	(0.15)	193.00	505.70	(0.19)
5.00	82.81	(0.01)	68.00	494.03	(0.11)	131.00	518.79	(0.16)	194.00	506.18	(0.19)
6.00	94.03	(0.01)	69.00	497.26	(0.11)	132.00	519.14	(0.16)	195.00	506.57	(0.19)
7.00	114.86	(0.01)	70.00	500.40	(0.12)	133.00	519.53	(0.16)	196.00	506.89	(0.19)
8.00	124.34	(0.01)	71.00	503.30	(0.12)	134.00	519.96	(0.16)	197.00	507.19	(0.19)
9.00	133.56	(0.02)	72.00	505.88	(0.12)	135.00	520.26	(0.16)	198.00	507.59	(0.19)
10.00	137.86	(0.02)	73.00	506.82	(0.12)	136.00	520.97	(0.16)	199.00	508.02	(0.19)
11.00	139.89	(0.02)	74.00	506.60	(0.12)	137.00	521.70	(0.16)	200.00	509.37	(0.19)
12.00	141.74	(0.02)	75.00	506.12	(0.12)	138.00	522.00	(0.16)	201.00	511.02	(0.20)
13.00	142.61	(0.02)	76.00	504.95	(0.12)	139.00	522.03	(0.16)	202.00	512.65	(0.20)
14.00	144.15	(0.02)	77.00	503.50	(0.12)	140.00	521.76	(0.16)	203.00	514.22	(0.20)
15.00	145.87	(0.02)	78.00	500.28	(0.12)	141.00	521.19	(0.16)	204.00	515.66	(0.20)
16.00	149.41	(0.02)	79.00	496.92	(0.12)	142.00	519.20	(0.16)	205.00	516.95	(0.20)
17.00	151.31	(0.02)	80.00	495.56	(0.12)	143.00	516.57	(0.16)	206.00	517.35	(0.20)
18.00	155.17	(0.02)	81.00	494.40	(0.12)	144.00	513.45	(0.16)	207.00	517.34	(0.20)
19.00	159.04	(0.02)	82.00	493.43	(0.12)	145.00	506.69	(0.16)	208.00	517.19	(0.20)
20.00	166.91	(0.02)	83.00	492.66	(0.12)	146.00	503.51	(0.16)	209.00	516.32	(0.20)
21.00	174.70	(0.02)	84.00	491.44	(0.12)	147.00	502.15	(0.16)	210.00	515.11	(0.20)
22.00	182.40	(0.03)	85.00	491.26	(0.12)	148.00	499.55	(0.16)	211.00	512.38	(0.20)
23.00	190.01	(0.03)	86.00	491.50	(0.12)	149.00	497.37	(0.16)	212.00	510.97	(0.20)
24.00	197.40	(0.03)	87.00	492.05	(0.12)	150.00	495.60	(0.16)	213.00	509.53	(0.20)
25.00	201.11	(0.03)	88.00	492.72	(0.12)	151.00	494.73	(0.16)	214.00	508.17	(0.20)
26.00	208.51	(0.03)	89.00	494.23	(0.13)	152.00	494.75	(0.16)	215.00	505.64	(0.20)
27.00	215.73	(0.03)	90.00	495.72	(0.13)	153.00	495.35	(0.16)	216.00	504.64	(0.20)
28.00	219.31	(0.03)	91.00	497.08	(0.13)	154.00	496.95	(0.16)	217.00	502.95	(0.20)
29.00	222.93	(0.03)	92.00	498.37	(0.13)	155.00	498.63	(0.17)	218.00	502.87	(0.20)
30.00	226.66	(0.04)	93.00	499.55	(0.13)	156.00	501.86	(0.17)	219.00	503.19	(0.20)
31.00	233.95	(0.04)	94.00	500.66	(0.13)	157.00	503.09	(0.17)	220.00	503.92	(0.20)
32.00	237.47	(0.04)	95.00	501.67	(0.13)	158.00	504.91	(0.17)	221.00	505.50	(0.21)
33.00	241.09	(0.04)	96.00	502.59	(0.13)	159.00	505.37	(0.17)	222.00	507.07	(0.21)
34.00	244.79	(0.04)	97.00	504.27	(0.13)	160.00	505.88	(0.17)	223.00	508.51	(0.21)
35.00	252.12	(0.04)	98.00	505.13	(0.13)	161.00	506.04	(0.17)	224.00	509.69	(0.21)
36.00	259.34	(0.04)	99.00	506.13	(0.13)	162.00	506.09	(0.17)	225.00	510.54	(0.21)
37.00	266.50	(0.04)	100.00	506.77	(0.13)	163.00	506.16	(0.18)	226.00	511.26	(0.21)
38.00	273.54	(0.05)	101.00	508.14	(0.14)	164.00	506.57	(0.18)	227.00	511.72	(0.21)
39.00	280.50	(0.05)	102.00	509.53	(0.14)	165.00	507.13	(0.18)	228.00	512.98	(0.21)
40.00	287.36	(0.05)	103.00	510.91	(0.14)	166.00	507.92	(0.18)	229.00	514.42	(0.21)
41.00	294.01	(0.05)	104.00	512.26	(0.14)	167.00	509.78	(0.18)	230.00	515.75	(0.21)
42.00	300.51	(0.05)	105.00	513.65	(0.14)	168.00	511.65	(0.18)	231.00	516.87	(0.21)
43.00	306.77	(0.05)	106.00	515.05	(0.14)	169.00	513.44	(0.18)	232.00	517.13	(0.21)
44.00	313.01	(0.06)	107.00	515.66	(0.14)	170.00	514.96	(0.18)	233.00	516.98	(0.21)
45.00	325.51	(0.06)	108.00	516.22	(0.14)	171.00	514.96	(0.18)	234.00	515.73	(0.21)
46.00	337.77	(0.06)	109.00	516.63	(0.14)	172.00	514.71	(0.18)	235.00	513.80	(0.21)
47.00	349.81	(0.06)	110.00	516.92	(0.14)	173.00	514.15	(0.18)	236.00	511.63	(0.22)
48.00	361.69	(0.07)	111.00	517.03	(0.14)	174.00	512.45	(0.18)	237.00	507.03	(0.22)
49.00	367.52	(0.07)	112.00	517.08	(0.14)	175.00	510.33	(0.18)	238.00	505.27	(0.22)
50.00	373.32	(0.07)	113.00	517.12	(0.14)	176.00	505.49	(0.18)	239.00	503.68	(0.22)
51.00	378.81	(0.07)	114.00	517.14	(0.14)	177.00	500.90	(0.18)	240.00	502.36	(0.22)
52.00	389.24	(0.08)	115.00	517.14	(0.14)	178.00	498.88	(0.18)	241.00	501.35	(0.22)
53.00	399.48	(0.08)	116.00	517.12	(0.14)	179.00	497.01	(0.18)	242.00	500.93	(0.22)
54.00	404.58	(0.08)	117.00	517.09	(0.15)	180.00	495.48	(0.18)	243.00	501.10	(0.22)
55.00	414.67	(0.08)	118.00	516.98	(0.15)	181.00	494.11	(0.18)	244.00	501.69	(0.22)
56.00	419.60	(0.08)	119.00	516.84	(0.15)	182.00	492.95	(0.18)	245.00	503.24	(0.22)
57.00	429.32	(0.09)	120.00	516.70	(0.15)	183.00	491.98	(0.18)	246.00	504.90	(0.22)
58.00	434.09	(0.09)	121.00	516.60	(0.15)	184.00	491.73	(0.18)	247.00	506.45	(0.22)
59.00	443.56	(0.09)	122.00	516.63	(0.15)	185.00	491.94	(0.18)	248.00	507.77	(0.22)
60.00	452.66	(0.10)	123.00	516.82	(0.15)	186.00	492.66	(0.18)	249.00	508.85	(0.22)
61.00	461.24	(0.10)	124.00	517.12	(0.15)	187.00	493.69	(0.18)	250.00	509.61	(0.22)
62.00	469.29	(0.10)	125.00	517.48	(0.15)	188.00	496.09	(0.18)			
63.00	473.06	(0.10)	126.00	517.84	(0.15)	189.00	500.90	(0.19)			

Table 4. Settlement Vs load intensity table with skirt height 3.0m & dia. 3.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	19.75	(0.00)	64.00	465.24	(0.11)	127.00	525.33	(0.15)	190.00	533.72	(0.18)
2.00	28.85	(0.00)	65.00	467.35	(0.11)	128.00	525.74	(0.15)	191.00	533.32	(0.19)
3.00	37.63	(0.00)	66.00	469.47	(0.11)	129.00	526.67	(0.15)	192.00	533.14	(0.19)
4.00	54.25	(0.00)	67.00	473.78	(0.11)	130.00	527.69	(0.15)	193.00	532.82	(0.19)
5.00	61.41	(0.01)	68.00	478.11	(0.11)	131.00	528.68	(0.15)	194.00	532.69	(0.19)
6.00	74.61	(0.01)	69.00	482.17	(0.12)	132.00	529.55	(0.15)	195.00	532.59	(0.19)
7.00	85.93	(0.01)	70.00	483.95	(0.12)	133.00	530.18	(0.16)	196.00	532.51	(0.19)
8.00	106.01	(0.01)	71.00	485.59	(0.12)	134.00	530.54	(0.16)	197.00	532.40	(0.19)
9.00	114.90	(0.01)	72.00	486.97	(0.12)	135.00	530.60	(0.16)	198.00	532.23	(0.19)
10.00	131.97	(0.02)	73.00	488.19	(0.12)	136.00	530.58	(0.16)	199.00	532.04	(0.19)
11.00	139.82	(0.02)	74.00	488.66	(0.12)	137.00	530.54	(0.16)	200.00	531.92	(0.19)
12.00	147.41	(0.02)	75.00	489.58	(0.12)	138.00	530.49	(0.16)	201.00	531.98	(0.19)
13.00	154.74	(0.02)	76.00	490.17	(0.12)	139.00	530.42	(0.16)	202.00	532.17	(0.19)
14.00	161.97	(0.02)	77.00	491.58	(0.12)	140.00	530.44	(0.16)	203.00	532.53	(0.19)
15.00	175.93	(0.03)	78.00	493.15	(0.12)	141.00	530.55	(0.16)	204.00	533.06	(0.19)
16.00	189.18	(0.03)	79.00	494.72	(0.12)	142.00	530.61	(0.16)	205.00	533.57	(0.19)
17.00	201.99	(0.03)	80.00	496.22	(0.12)	143.00	530.47	(0.16)	206.00	533.98	(0.19)
18.00	214.67	(0.04)	81.00	497.63	(0.12)	144.00	530.33	(0.16)	207.00	534.23	(0.19)
19.00	227.22	(0.04)	82.00	498.94	(0.13)	145.00	530.11	(0.16)	208.00	534.23	(0.19)
20.00	233.48	(0.04)	83.00	500.14	(0.13)	146.00	530.11	(0.16)	209.00	534.13	(0.19)
21.00	246.04	(0.04)	84.00	501.26	(0.13)	147.00	530.19	(0.16)	210.00	533.84	(0.19)
22.00	252.39	(0.04)	85.00	501.84	(0.13)	148.00	530.33	(0.16)	211.00	533.02	(0.19)
23.00	258.77	(0.05)	86.00	503.04	(0.13)	149.00	530.49	(0.16)	212.00	532.08	(0.19)
24.00	262.03	(0.05)	87.00	503.69	(0.13)	150.00	530.91	(0.16)	213.00	531.70	(0.20)
25.00	268.55	(0.05)	88.00	504.97	(0.13)	151.00	531.32	(0.17)	214.00	531.42	(0.20)
26.00	274.79	(0.05)	89.00	505.56	(0.13)	152.00	531.49	(0.17)	215.00	531.44	(0.20)
27.00	280.83	(0.05)	90.00	506.61	(0.13)	153.00	531.77	(0.17)	216.00	531.70	(0.20)
28.00	286.67	(0.05)	91.00	507.01	(0.13)	154.00	531.87	(0.17)	217.00	532.18	(0.20)
29.00	292.36	(0.05)	92.00	507.36	(0.13)	155.00	532.01	(0.17)	218.00	533.37	(0.20)
30.00	297.99	(0.06)	93.00	507.69	(0.13)	156.00	532.06	(0.17)	219.00	533.83	(0.20)
31.00	303.67	(0.06)	94.00	508.16	(0.13)	157.00	532.09	(0.17)	220.00	534.22	(0.20)
32.00	309.42	(0.06)	95.00	508.44	(0.13)	158.00	532.13	(0.17)	221.00	534.46	(0.20)
33.00	315.20	(0.06)	96.00	508.64	(0.13)	159.00	532.20	(0.17)	222.00	534.55	(0.20)
34.00	321.01	(0.06)	97.00	508.73	(0.13)	160.00	532.38	(0.17)	223.00	534.49	(0.20)
35.00	326.82	(0.06)	98.00	508.98	(0.14)	161.00	532.60	(0.17)	224.00	534.26	(0.20)
36.00	332.55	(0.07)	99.00	509.25	(0.14)	162.00	532.82	(0.17)	225.00	533.99	(0.20)
37.00	338.17	(0.07)	100.00	509.72	(0.14)	163.00	533.06	(0.17)	226.00	533.65	(0.20)
38.00	343.65	(0.07)	101.00	510.26	(0.14)	164.00	533.31	(0.17)	227.00	533.30	(0.20)
39.00	354.31	(0.07)	102.00	511.42	(0.14)	165.00	533.57	(0.17)	228.00	533.05	(0.20)
40.00	364.75	(0.08)	103.00	512.51	(0.14)	166.00	533.83	(0.17)	229.00	533.01	(0.20)
41.00	375.05	(0.08)	104.00	512.93	(0.14)	167.00	534.29	(0.17)	230.00	533.22	(0.20)
42.00	385.37	(0.08)	105.00	513.68	(0.14)	168.00	534.64	(0.17)	231.00	533.71	(0.20)
43.00	395.64	(0.08)	106.00	514.07	(0.14)	169.00	534.92	(0.18)	232.00	534.33	(0.20)
44.00	400.59	(0.09)	107.00	514.96	(0.14)	170.00	535.01	(0.18)	233.00	535.61	(0.20)
45.00	405.47	(0.09)	108.00	515.55	(0.14)	171.00	535.07	(0.18)	234.00	535.98	(0.20)
46.00	410.07	(0.09)	109.00	516.81	(0.14)	172.00	535.09	(0.18)	235.00	536.29	(0.21)
47.00	414.54	(0.09)	110.00	518.16	(0.14)	173.00	535.10	(0.18)	236.00	536.19	(0.21)
48.00	418.91	(0.09)	111.00	519.50	(0.14)	174.00	535.09	(0.18)	237.00	535.91	(0.21)
49.00	423.35	(0.09)	112.00	520.81	(0.14)	175.00	535.14	(0.18)	238.00	535.53	(0.21)
50.00	427.87	(0.10)	113.00	522.03	(0.14)	176.00	535.24	(0.18)	239.00	535.02	(0.21)
51.00	432.50	(0.10)	114.00	523.09	(0.15)	177.00	535.31	(0.18)	240.00	534.47	(0.21)
52.00	437.20	(0.10)	115.00	523.46	(0.15)	178.00	535.27	(0.18)	241.00	534.03	(0.21)
53.00	441.88	(0.10)	116.00	523.76	(0.15)	179.00	535.13	(0.18)	242.00	534.05	(0.21)
54.00	446.47	(0.10)	117.00	524.00	(0.15)	180.00	534.86	(0.18)	243.00	534.21	(0.21)
55.00	448.62	(0.10)	118.00	524.18	(0.15)	181.00	534.56	(0.18)	244.00	534.60	(0.21)
56.00	450.70	(0.10)	119.00	524.33	(0.15)	182.00	534.28	(0.18)	245.00	535.12	(0.21)
57.00	452.63	(0.10)	120.00	524.45	(0.15)	183.00	534.08	(0.18)	246.00	535.66	(0.21)
58.00	454.35	(0.11)	121.00	524.54	(0.15)	184.00	533.98	(0.18)	247.00	536.66	(0.21)
59.00	455.93	(0.11)	122.00	524.63	(0.15)	185.00	533.99	(0.18)	248.00	537.32	(0.21)
60.00	457.53	(0.11)	123.00	524.70	(0.15)	186.00	534.08	(0.18)	249.00	537.57	(0.21)
61.00	459.30	(0.11)	124.00	524.70	(0.15)	187.00	534.08	(0.18)	250.00	537.44	(0.21)
62.00	461.20	(0.11)	125.00	524.73	(0.15)	188.00	534.02	(0.18)			
63.00	463.18	(0.11)	126.00	524.84	(0.15)	189.00	533.89	(0.18)			

Table 5. Settlement Vs load intensity table with skirt height 4.0m & dia. 3.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	10.06	(0.00)	64.00	482.41	(0.13)	127.00	550.32	(0.17)	190.00	573.08	(0.22)
2.00	19.27	(0.00)	65.00	485.88	(0.13)	128.00	550.74	(0.17)	191.00	573.21	(0.22)
3.00	27.89	(0.00)	66.00	489.29	(0.13)	129.00	551.19	(0.18)	192.00	573.35	(0.22)
4.00	36.04	(0.00)	67.00	492.63	(0.13)	130.00	551.74	(0.18)	193.00	573.54	(0.22)
5.00	51.23	(0.00)	68.00	495.85	(0.13)	131.00	552.34	(0.18)	194.00	573.72	(0.22)
6.00	57.85	(0.01)	69.00	498.89	(0.13)	132.00	552.99	(0.18)	195.00	573.86	(0.22)
7.00	70.31	(0.01)	70.00	501.73	(0.13)	133.00	553.65	(0.18)	196.00	573.93	(0.22)
8.00	81.02	(0.01)	71.00	503.03	(0.14)	134.00	554.30	(0.18)	197.00	573.97	(0.22)
9.00	100.40	(0.01)	72.00	504.27	(0.14)	135.00	554.87	(0.18)	198.00	574.01	(0.22)
10.00	116.95	(0.01)	73.00	505.46	(0.14)	136.00	555.36	(0.18)	199.00	574.19	(0.22)
11.00	124.37	(0.02)	74.00	506.58	(0.14)	137.00	555.77	(0.18)	200.00	574.55	(0.22)
12.00	131.42	(0.02)	75.00	507.59	(0.14)	138.00	556.02	(0.18)	201.00	575.10	(0.22)
13.00	138.02	(0.02)	76.00	508.39	(0.14)	139.00	556.14	(0.18)	202.00	575.83	(0.22)
14.00	141.02	(0.02)	77.00	509.09	(0.14)	140.00	556.17	(0.18)	203.00	576.61	(0.22)
15.00	143.79	(0.02)	78.00	509.80	(0.14)	141.00	556.21	(0.18)	204.00	577.30	(0.23)
16.00	149.21	(0.02)	79.00	510.28	(0.14)	142.00	556.32	(0.19)	205.00	577.45	(0.23)
17.00	154.66	(0.02)	80.00	510.82	(0.14)	143.00	556.50	(0.19)	206.00	577.47	(0.23)
18.00	160.35	(0.02)	81.00	511.97	(0.14)	144.00	556.79	(0.19)	207.00	577.34	(0.23)
19.00	166.12	(0.03)	82.00	513.18	(0.14)	145.00	557.11	(0.19)	208.00	577.09	(0.23)
20.00	171.92	(0.03)	83.00	514.43	(0.14)	146.00	557.86	(0.19)	209.00	576.72	(0.23)
21.00	177.73	(0.03)	84.00	515.69	(0.14)	147.00	558.59	(0.19)	210.00	576.23	(0.23)
22.00	183.51	(0.03)	85.00	518.25	(0.15)	148.00	559.14	(0.19)	211.00	575.75	(0.23)
23.00	189.19	(0.03)	86.00	519.49	(0.15)	149.00	559.37	(0.19)	212.00	574.85	(0.23)
24.00	194.78	(0.03)	87.00	520.70	(0.15)	150.00	559.07	(0.19)	213.00	574.59	(0.23)
25.00	205.80	(0.04)	88.00	521.84	(0.15)	151.00	558.54	(0.19)	214.00	574.46	(0.23)
26.00	211.10	(0.04)	89.00	522.90	(0.15)	152.00	558.10	(0.19)	215.00	574.42	(0.23)
27.00	216.35	(0.04)	90.00	523.86	(0.15)	153.00	558.11	(0.19)	216.00	574.45	(0.23)
28.00	221.55	(0.04)	91.00	524.66	(0.15)	154.00	558.31	(0.19)	217.00	574.60	(0.23)
29.00	226.76	(0.04)	92.00	525.45	(0.15)	155.00	558.88	(0.19)	218.00	574.92	(0.23)
30.00	232.03	(0.04)	93.00	526.31	(0.15)	156.00	559.65	(0.19)	219.00	575.40	(0.23)
31.00	237.38	(0.05)	94.00	527.34	(0.15)	157.00	560.53	(0.20)	220.00	576.05	(0.23)
32.00	242.80	(0.05)	95.00	528.56	(0.15)	158.00	561.42	(0.20)	221.00	576.76	(0.23)
33.00	248.23	(0.05)	96.00	529.76	(0.15)	159.00	562.21	(0.20)	222.00	577.14	(0.23)
34.00	253.58	(0.05)	97.00	530.78	(0.15)	160.00	562.79	(0.20)	223.00	577.89	(0.24)
35.00	256.26	(0.05)	98.00	531.63	(0.16)	161.00	563.11	(0.20)	224.00	578.53	(0.24)
36.00	261.67	(0.05)	99.00	532.34	(0.16)	162.00	563.15	(0.20)	225.00	579.07	(0.24)
37.00	267.12	(0.05)	100.00	532.67	(0.16)	163.00	563.19	(0.20)	226.00	579.59	(0.24)
38.00	272.53	(0.06)	101.00	533.37	(0.16)	164.00	563.23	(0.20)	227.00	580.10	(0.24)
39.00	283.22	(0.06)	102.00	533.81	(0.16)	165.00	563.26	(0.20)	228.00	580.49	(0.24)
40.00	293.77	(0.06)	103.00	534.75	(0.16)	166.00	563.33	(0.20)	229.00	580.55	(0.24)
41.00	299.01	(0.06)	104.00	535.30	(0.16)	167.00	563.49	(0.20)	230.00	580.49	(0.24)
42.00	309.39	(0.07)	105.00	536.40	(0.16)	168.00	563.67	(0.20)	231.00	580.28	(0.24)
43.00	319.54	(0.07)	106.00	536.86	(0.16)	169.00	563.88	(0.20)	232.00	580.08	(0.24)
44.00	329.58	(0.07)	107.00	537.28	(0.16)	170.00	564.41	(0.20)	233.00	580.10	(0.24)
45.00	339.49	(0.08)	108.00	537.63	(0.16)	171.00	565.12	(0.21)	234.00	580.26	(0.24)
46.00	349.23	(0.08)	109.00	538.24	(0.16)	172.00	565.99	(0.21)	235.00	580.56	(0.24)
47.00	358.77	(0.08)	110.00	538.87	(0.16)	173.00	566.97	(0.21)	236.00	581.09	(0.24)
48.00	368.22	(0.08)	111.00	539.68	(0.16)	174.00	567.98	(0.21)	237.00	581.75	(0.25)
49.00	377.59	(0.09)	112.00	540.62	(0.16)	175.00	568.89	(0.21)	238.00	582.47	(0.25)
50.00	386.85	(0.09)	113.00	541.64	(0.16)	176.00	569.51	(0.21)	239.00	583.10	(0.25)
51.00	395.98	(0.09)	114.00	542.67	(0.17)	177.00	569.62	(0.21)	240.00	583.53	(0.25)
52.00	400.49	(0.10)	115.00	543.59	(0.17)	178.00	569.65	(0.21)	241.00	583.74	(0.25)
53.00	409.49	(0.10)	116.00	544.34	(0.17)	179.00	569.59	(0.21)	242.00	583.85	(0.25)
54.00	418.35	(0.10)	117.00	544.59	(0.17)	180.00	569.65	(0.21)	243.00	583.93	(0.25)
55.00	427.01	(0.10)	118.00	544.95	(0.17)	181.00	569.91	(0.21)	244.00	584.16	(0.25)
56.00	435.51	(0.11)	119.00	545.30	(0.17)	182.00	570.42	(0.21)	245.00	584.49	(0.25)
57.00	443.87	(0.11)	120.00	545.74	(0.17)	183.00	571.05	(0.21)	246.00	584.93	(0.25)
58.00	447.99	(0.11)	121.00	546.06	(0.17)	184.00	571.66	(0.21)	247.00	585.43	(0.25)
59.00	456.18	(0.11)	122.00	546.80	(0.17)	185.00	571.90	(0.21)	248.00	585.74	(0.25)
60.00	464.21	(0.12)	123.00	547.63	(0.17)	186.00	572.32	(0.22)	249.00	586.39	(0.25)
61.00	468.02	(0.12)	124.00	548.48	(0.17)	187.00	572.48	(0.22)	250.00	586.90	(0.25)
62.00	475.37	(0.12)	125.00	549.23	(0.17)	188.00	572.74	(0.22)			
63.00	478.91	(0.12)	126.00	549.83	(0.17)	189.00	572.95	(0.22)			

Table 6. Settlement Vs load intensity table with skirt height 5.0m & dia. 3.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	2.03	(0.00)	64.00	315.83	(0.09)	127.00	554.16	(0.20)	190.00	605.67	(0.27)
2.00	2.86	(0.00)	65.00	325.05	(0.09)	128.00	555.28	(0.20)	191.00	606.06	(0.27)
3.00	3.62	(0.00)	66.00	334.15	(0.10)	129.00	556.51	(0.20)	192.00	606.36	(0.27)
4.00	4.35	(0.00)	67.00	343.13	(0.10)	130.00	557.77	(0.20)	193.00	606.53	(0.27)
5.00	5.04	(0.00)	68.00	352.05	(0.10)	131.00	560.22	(0.20)	194.00	606.58	(0.27)
6.00	5.69	(0.00)	69.00	360.91	(0.11)	132.00	561.30	(0.21)	195.00	606.56	(0.27)
7.00	6.28	(0.00)	70.00	369.66	(0.11)	133.00	562.23	(0.21)	196.00	606.44	(0.27)
8.00	6.55	(0.00)	71.00	373.96	(0.11)	134.00	563.77	(0.21)	197.00	606.38	(0.27)
9.00	7.08	(0.00)	72.00	382.46	(0.12)	135.00	564.27	(0.21)	198.00	606.48	(0.27)
10.00	7.57	(0.00)	73.00	390.87	(0.12)	136.00	564.66	(0.21)	199.00	606.69	(0.27)
11.00	8.54	(0.00)	74.00	399.15	(0.12)	137.00	564.90	(0.21)	200.00	607.19	(0.27)
12.00	10.47	(0.00)	75.00	407.28	(0.13)	138.00	565.11	(0.21)	201.00	607.70	(0.27)
13.00	12.40	(0.00)	76.00	415.32	(0.13)	139.00	565.40	(0.21)	202.00	608.09	(0.28)
14.00	13.34	(0.00)	77.00	423.30	(0.13)	140.00	565.91	(0.21)	203.00	608.28	(0.28)
15.00	14.24	(0.00)	78.00	427.33	(0.13)	141.00	566.63	(0.21)	204.00	608.30	(0.28)
16.00	16.01	(0.00)	79.00	435.45	(0.14)	142.00	567.47	(0.21)	205.00	608.21	(0.28)
17.00	19.59	(0.00)	80.00	443.67	(0.14)	143.00	568.40	(0.22)	206.00	608.16	(0.28)
18.00	23.23	(0.00)	81.00	451.78	(0.14)	144.00	569.38	(0.22)	207.00	608.06	(0.28)
19.00	25.08	(0.00)	82.00	455.61	(0.14)	145.00	570.38	(0.22)	208.00	608.04	(0.28)
20.00	28.71	(0.01)	83.00	459.20	(0.15)	146.00	571.38	(0.22)	209.00	607.99	(0.28)
21.00	32.29	(0.01)	84.00	462.73	(0.15)	147.00	572.31	(0.22)	210.00	607.89	(0.28)
22.00	34.09	(0.01)	85.00	466.16	(0.15)	148.00	573.19	(0.22)	211.00	607.93	(0.28)
23.00	35.91	(0.01)	86.00	472.98	(0.15)	149.00	574.93	(0.22)	212.00	608.21	(0.28)
24.00	39.54	(0.01)	87.00	476.44	(0.15)	150.00	575.87	(0.22)	213.00	608.76	(0.28)
25.00	46.62	(0.01)	88.00	478.22	(0.16)	151.00	577.82	(0.22)	214.00	609.47	(0.28)
26.00	49.98	(0.01)	89.00	481.83	(0.16)	152.00	579.70	(0.23)	215.00	610.22	(0.28)
27.00	56.64	(0.01)	90.00	485.43	(0.16)	153.00	581.32	(0.23)	216.00	610.96	(0.29)
28.00	59.90	(0.01)	91.00	488.94	(0.16)	154.00	581.87	(0.23)	217.00	611.68	(0.29)
29.00	66.34	(0.01)	92.00	492.30	(0.16)	155.00	582.22	(0.23)	218.00	612.92	(0.29)
30.00	72.67	(0.02)	93.00	495.48	(0.16)	156.00	582.38	(0.23)	219.00	613.98	(0.29)
31.00	78.91	(0.02)	94.00	496.93	(0.16)	157.00	582.53	(0.23)	220.00	614.90	(0.29)
32.00	85.07	(0.02)	95.00	499.65	(0.17)	158.00	582.78	(0.23)	221.00	615.39	(0.29)
33.00	91.13	(0.02)	96.00	500.98	(0.17)	159.00	583.24	(0.23)	222.00	616.44	(0.29)
34.00	97.13	(0.02)	97.00	503.69	(0.17)	160.00	583.84	(0.23)	223.00	617.05	(0.29)
35.00	103.10	(0.02)	98.00	506.53	(0.17)	161.00	584.47	(0.23)	224.00	618.41	(0.30)
36.00	106.08	(0.03)	99.00	509.43	(0.17)	162.00	585.13	(0.23)	225.00	619.15	(0.30)
37.00	111.93	(0.03)	100.00	512.44	(0.17)	163.00	586.43	(0.24)	226.00	620.74	(0.30)
38.00	123.26	(0.03)	101.00	515.55	(0.18)	164.00	587.06	(0.24)	227.00	621.46	(0.30)
39.00	128.83	(0.03)	102.00	518.76	(0.18)	165.00	588.34	(0.24)	228.00	622.78	(0.30)
40.00	139.99	(0.04)	103.00	522.01	(0.18)	166.00	589.60	(0.24)	229.00	623.35	(0.30)
41.00	145.55	(0.04)	104.00	525.27	(0.18)	167.00	590.85	(0.24)	230.00	624.33	(0.30)
42.00	156.55	(0.04)	105.00	528.50	(0.18)	168.00	592.08	(0.24)	231.00	624.70	(0.30)
43.00	161.90	(0.04)	106.00	531.63	(0.18)	169.00	593.33	(0.24)	232.00	624.99	(0.31)
44.00	172.63	(0.04)	107.00	533.07	(0.18)	170.00	594.66	(0.25)	233.00	625.31	(0.31)
45.00	183.33	(0.05)	108.00	534.42	(0.18)	171.00	595.97	(0.25)	234.00	625.64	(0.31)
46.00	188.62	(0.05)	109.00	535.68	(0.19)	172.00	597.21	(0.25)	235.00	625.95	(0.31)
47.00	193.95	(0.05)	110.00	538.03	(0.19)	173.00	598.41	(0.25)	236.00	626.25	(0.31)
48.00	199.23	(0.05)	111.00	539.13	(0.19)	174.00	598.95	(0.25)	237.00	626.55	(0.31)
49.00	204.45	(0.05)	112.00	540.12	(0.19)	175.00	599.45	(0.25)	238.00	626.82	(0.31)
50.00	209.55	(0.06)	113.00	540.53	(0.19)	176.00	599.90	(0.25)	239.00	627.04	(0.31)
51.00	214.56	(0.06)	114.00	541.29	(0.19)	177.00	600.60	(0.26)	240.00	627.14	(0.31)
52.00	219.58	(0.06)	115.00	542.01	(0.19)	178.00	600.97	(0.26)	241.00	627.08	(0.31)
53.00	229.65	(0.06)	116.00	542.77	(0.19)	179.00	601.42	(0.26)	242.00	627.03	(0.31)
54.00	234.68	(0.06)	117.00	543.66	(0.19)	180.00	601.92	(0.26)	243.00	627.01	(0.31)
55.00	237.23	(0.07)	118.00	544.75	(0.19)	181.00	602.44	(0.26)	244.00	627.05	(0.31)
56.00	242.39	(0.07)	119.00	545.96	(0.19)	182.00	603.00	(0.26)	245.00	627.16	(0.32)
57.00	247.44	(0.07)	120.00	547.20	(0.19)	183.00	603.60	(0.26)	246.00	627.31	(0.32)
58.00	257.48	(0.07)	121.00	548.39	(0.20)	184.00	604.16	(0.26)	247.00	627.47	(0.32)
59.00	267.38	(0.07)	122.00	549.45	(0.20)	185.00	604.51	(0.26)	248.00	627.69	(0.32)
60.00	277.21	(0.08)	123.00	550.33	(0.20)	186.00	604.70	(0.26)	249.00	627.95	(0.32)
61.00	287.01	(0.08)	124.00	551.20	(0.20)	187.00	604.81	(0.26)	250.00	628.16	(0.32)
62.00	296.79	(0.08)	125.00	552.13	(0.20)	188.00	604.96	(0.26)			
63.00	306.41	(0.09)	126.00	553.13	(0.20)	189.00	605.28	(0.26)			

Table 7. Settlement Vs load intensity table with skirt height 1.0m & dia. 4.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	17.71	(0.00)	64.00	441.67	(0.11)	127.00	482.11	(0.17)	190.00	480.62	(0.21)
2.00	32.78	(0.00)	65.00	445.41	(0.12)	128.00	482.00	(0.17)	191.00	479.51	(0.21)
3.00	46.35	(0.01)	66.00	448.91	(0.12)	129.00	481.79	(0.17)	192.00	478.72	(0.21)
4.00	52.44	(0.01)	67.00	452.20	(0.12)	130.00	481.22	(0.18)	193.00	478.58	(0.21)
5.00	64.01	(0.01)	68.00	455.37	(0.12)	131.00	479.48	(0.18)	194.00	478.83	(0.21)
6.00	69.88	(0.01)	69.00	458.35	(0.12)	132.00	478.38	(0.18)	195.00	479.27	(0.21)
7.00	75.77	(0.01)	70.00	459.65	(0.12)	133.00	477.07	(0.18)	196.00	480.41	(0.21)
8.00	81.59	(0.01)	71.00	460.17	(0.12)	134.00	475.90	(0.18)	197.00	481.77	(0.21)
9.00	87.21	(0.01)	72.00	460.59	(0.13)	135.00	474.97	(0.18)	198.00	484.56	(0.22)
10.00	92.72	(0.01)	73.00	461.31	(0.13)	136.00	474.99	(0.18)	199.00	485.48	(0.22)
11.00	103.19	(0.02)	74.00	461.95	(0.13)	137.00	475.11	(0.18)	200.00	485.94	(0.22)
12.00	113.32	(0.02)	75.00	462.55	(0.13)	138.00	475.29	(0.18)	201.00	486.44	(0.22)
13.00	123.43	(0.02)	76.00	463.71	(0.13)	139.00	475.73	(0.18)	202.00	486.88	(0.22)
14.00	133.52	(0.02)	77.00	464.24	(0.13)	140.00	476.73	(0.18)	203.00	486.98	(0.22)
15.00	143.64	(0.02)	78.00	464.75	(0.13)	141.00	477.78	(0.18)	204.00	486.84	(0.22)
16.00	148.71	(0.03)	79.00	465.31	(0.13)	142.00	478.94	(0.18)	205.00	486.32	(0.22)
17.00	153.75	(0.03)	80.00	465.68	(0.13)	143.00	480.13	(0.18)	206.00	485.34	(0.22)
18.00	158.60	(0.03)	81.00	466.49	(0.13)	144.00	480.82	(0.18)	207.00	484.20	(0.22)
19.00	163.29	(0.03)	82.00	467.37	(0.14)	145.00	481.21	(0.18)	208.00	482.79	(0.22)
20.00	172.38	(0.03)	83.00	468.27	(0.14)	146.00	481.96	(0.18)	209.00	479.83	(0.22)
21.00	181.51	(0.03)	84.00	470.06	(0.14)	147.00	482.60	(0.19)	210.00	478.77	(0.22)
22.00	186.13	(0.03)	85.00	470.97	(0.14)	148.00	482.85	(0.19)	211.00	478.43	(0.22)
23.00	195.43	(0.04)	86.00	471.91	(0.14)	149.00	482.61	(0.19)	212.00	478.61	(0.22)
24.00	204.63	(0.04)	87.00	472.39	(0.14)	150.00	481.52	(0.19)	213.00	479.10	(0.22)
25.00	209.14	(0.04)	88.00	473.38	(0.14)	151.00	479.23	(0.19)	214.00	480.40	(0.23)
26.00	218.10	(0.04)	89.00	474.40	(0.14)	152.00	478.01	(0.19)	215.00	481.95	(0.23)
27.00	226.72	(0.04)	90.00	475.41	(0.14)	153.00	476.96	(0.19)	216.00	483.60	(0.23)
28.00	230.99	(0.04)	91.00	475.79	(0.14)	154.00	475.03	(0.19)	217.00	485.23	(0.23)
29.00	239.50	(0.05)	92.00	475.74	(0.14)	155.00	474.64	(0.19)	218.00	486.58	(0.23)
30.00	247.77	(0.05)	93.00	475.55	(0.15)	156.00	474.73	(0.19)	219.00	487.06	(0.23)
31.00	251.93	(0.05)	94.00	475.01	(0.15)	157.00	475.35	(0.19)	220.00	487.53	(0.23)
32.00	260.14	(0.05)	95.00	473.98	(0.15)	158.00	477.12	(0.19)	221.00	487.74	(0.23)
33.00	264.13	(0.05)	96.00	472.78	(0.15)	159.00	478.94	(0.19)	222.00	487.96	(0.23)
34.00	271.93	(0.05)	97.00	472.29	(0.15)	160.00	480.60	(0.19)	223.00	487.84	(0.23)
35.00	275.55	(0.05)	98.00	471.36	(0.15)	161.00	481.87	(0.19)	224.00	486.96	(0.23)
36.00	282.64	(0.06)	99.00	471.04	(0.15)	162.00	482.39	(0.19)	225.00	485.90	(0.23)
37.00	289.53	(0.06)	100.00	471.19	(0.15)	163.00	482.97	(0.19)	226.00	484.74	(0.23)
38.00	296.33	(0.06)	101.00	472.11	(0.15)	164.00	483.22	(0.19)	227.00	483.44	(0.23)
39.00	302.95	(0.06)	102.00	473.09	(0.15)	165.00	483.45	(0.19)	228.00	482.03	(0.23)
40.00	309.51	(0.06)	103.00	474.76	(0.15)	166.00	483.22	(0.20)	229.00	480.78	(0.23)
41.00	316.11	(0.07)	104.00	476.02	(0.15)	167.00	482.49	(0.20)	230.00	478.88	(0.24)
42.00	319.41	(0.07)	105.00	477.27	(0.16)	168.00	481.40	(0.20)	231.00	478.95	(0.24)
43.00	325.89	(0.07)	106.00	477.94	(0.16)	169.00	479.08	(0.20)	232.00	479.32	(0.24)
44.00	332.21	(0.07)	107.00	478.63	(0.16)	170.00	477.95	(0.20)	233.00	480.50	(0.24)
45.00	338.48	(0.07)	108.00	479.30	(0.16)	171.00	477.49	(0.20)	234.00	481.91	(0.24)
46.00	341.55	(0.07)	109.00	479.81	(0.16)	172.00	476.64	(0.20)	235.00	483.51	(0.24)
47.00	344.52	(0.08)	110.00	480.51	(0.16)	173.00	476.41	(0.20)	236.00	486.79	(0.24)
48.00	350.26	(0.08)	111.00	480.84	(0.16)	174.00	476.53	(0.20)	237.00	487.89	(0.24)
49.00	355.92	(0.08)	112.00	480.67	(0.17)	175.00	477.49	(0.20)	238.00	488.30	(0.24)
50.00	361.56	(0.08)	113.00	480.41	(0.17)	176.00	478.70	(0.20)	239.00	488.61	(0.24)
51.00	367.15	(0.08)	114.00	480.00	(0.17)	177.00	480.16	(0.20)	240.00	488.72	(0.24)
52.00	372.67	(0.09)	115.00	479.45	(0.17)	178.00	481.73	(0.20)	241.00	488.71	(0.24)
53.00	378.16	(0.09)	116.00	479.18	(0.17)	179.00	483.29	(0.20)	242.00	488.56	(0.24)
54.00	383.64	(0.09)	117.00	478.65	(0.17)	180.00	484.46	(0.21)	243.00	487.92	(0.25)
55.00	389.05	(0.09)	118.00	478.06	(0.17)	181.00	484.95	(0.21)	244.00	486.74	(0.25)
56.00	394.40	(0.09)	119.00	478.16	(0.17)	182.00	485.39	(0.21)	245.00	485.41	(0.25)
57.00	404.95	(0.10)	120.00	478.79	(0.17)	183.00	485.56	(0.21)	246.00	483.99	(0.25)
58.00	410.02	(0.10)	121.00	479.51	(0.17)	184.00	485.68	(0.21)	247.00	482.53	(0.25)
59.00	419.90	(0.10)	122.00	479.96	(0.17)	185.00	485.67	(0.21)	248.00	481.06	(0.25)
60.00	424.63	(0.11)	123.00	480.32	(0.17)	186.00	485.53	(0.21)	249.00	479.61	(0.25)
61.00	429.25	(0.11)	124.00	481.06	(0.17)	187.00	485.02	(0.21)	250.00	479.03	(0.25)
62.00	433.61	(0.11)	125.00	481.69	(0.17)	188.00	484.23	(0.21)			
63.00	437.72	(0.11)	126.00	482.13	(0.17)	189.00	483.07	(0.21)			

Table 8. Settlement Vs load intensity table with skirt height 2.0m & dia. 4.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	4.32	(0.00)	64.00	277.83	(0.06)	127.00	466.97	(0.14)	190.00	475.89	(0.18)
2.00	8.27	(0.00)	65.00	281.14	(0.06)	128.00	467.12	(0.14)	191.00	476.58	(0.18)
3.00	15.80	(0.00)	66.00	284.51	(0.06)	129.00	467.63	(0.14)	192.00	478.58	(0.18)
4.00	22.43	(0.00)	67.00	287.83	(0.06)	130.00	468.26	(0.14)	193.00	480.80	(0.18)
5.00	25.44	(0.00)	68.00	291.07	(0.06)	131.00	468.97	(0.14)	194.00	483.06	(0.18)
6.00	27.95	(0.00)	69.00	294.28	(0.07)	132.00	469.67	(0.15)	195.00	487.10	(0.18)
7.00	30.42	(0.00)	70.00	300.70	(0.07)	133.00	470.32	(0.15)	196.00	489.51	(0.18)
8.00	31.76	(0.00)	71.00	303.91	(0.07)	134.00	471.49	(0.15)	197.00	489.43	(0.18)
9.00	34.39	(0.01)	72.00	310.23	(0.07)	135.00	472.41	(0.15)	198.00	488.78	(0.18)
10.00	37.18	(0.01)	73.00	313.43	(0.07)	136.00	473.11	(0.15)	199.00	487.07	(0.18)
11.00	39.94	(0.01)	74.00	319.88	(0.07)	137.00	473.70	(0.15)	200.00	485.00	(0.18)
12.00	42.78	(0.01)	75.00	326.37	(0.08)	138.00	474.29	(0.16)	201.00	482.80	(0.18)
13.00	45.75	(0.01)	76.00	332.86	(0.08)	139.00	474.71	(0.16)	202.00	480.63	(0.18)
14.00	48.87	(0.01)	77.00	339.30	(0.08)	140.00	475.09	(0.16)	203.00	476.55	(0.18)
15.00	51.99	(0.01)	78.00	342.51	(0.08)	141.00	475.70	(0.16)	204.00	475.52	(0.18)
16.00	58.09	(0.01)	79.00	348.88	(0.08)	142.00	476.62	(0.16)	205.00	475.60	(0.18)
17.00	63.95	(0.01)	80.00	355.11	(0.08)	143.00	478.87	(0.16)	206.00	476.29	(0.18)
18.00	66.85	(0.01)	81.00	361.21	(0.09)	144.00	481.25	(0.16)	207.00	478.50	(0.19)
19.00	72.47	(0.01)	82.00	364.12	(0.09)	145.00	483.69	(0.16)	208.00	480.99	(0.19)
20.00	77.87	(0.01)	83.00	367.00	(0.09)	146.00	488.56	(0.16)	209.00	483.55	(0.19)
21.00	83.09	(0.01)	84.00	372.69	(0.09)	147.00	490.78	(0.16)	210.00	488.09	(0.19)
22.00	88.26	(0.01)	85.00	378.23	(0.09)	148.00	492.66	(0.17)	211.00	490.73	(0.19)
23.00	91.02	(0.02)	86.00	383.67	(0.09)	149.00	493.38	(0.17)	212.00	490.97	(0.19)
24.00	96.66	(0.02)	87.00	389.03	(0.10)	150.00	493.15	(0.17)	213.00	490.42	(0.19)
25.00	102.29	(0.02)	88.00	394.35	(0.10)	151.00	492.27	(0.17)	214.00	489.63	(0.19)
26.00	107.71	(0.02)	89.00	399.59	(0.10)	152.00	491.33	(0.17)	215.00	488.58	(0.19)
27.00	112.67	(0.02)	90.00	404.72	(0.10)	153.00	489.93	(0.17)	216.00	487.28	(0.19)
28.00	117.37	(0.02)	91.00	407.24	(0.10)	154.00	486.37	(0.17)	217.00	485.83	(0.19)
29.00	121.84	(0.02)	92.00	412.37	(0.10)	155.00	482.51	(0.17)	218.00	482.76	(0.19)
30.00	126.26	(0.02)	93.00	417.53	(0.11)	156.00	478.72	(0.17)	219.00	479.72	(0.19)
31.00	130.74	(0.02)	94.00	427.69	(0.11)	157.00	477.18	(0.17)	220.00	478.49	(0.19)
32.00	139.94	(0.03)	95.00	432.72	(0.11)	158.00	475.15	(0.17)	221.00	477.96	(0.19)
33.00	144.68	(0.03)	96.00	442.76	(0.12)	159.00	475.06	(0.17)	222.00	478.28	(0.19)
34.00	154.24	(0.03)	97.00	452.49	(0.12)	160.00	475.64	(0.17)	223.00	479.07	(0.19)
35.00	159.03	(0.03)	98.00	457.06	(0.12)	161.00	477.79	(0.17)	224.00	481.22	(0.19)
36.00	163.82	(0.03)	99.00	461.43	(0.12)	162.00	480.27	(0.17)	225.00	483.64	(0.19)
37.00	166.19	(0.03)	100.00	463.34	(0.13)	163.00	485.46	(0.17)	226.00	488.49	(0.19)
38.00	170.77	(0.03)	101.00	464.21	(0.13)	164.00	487.39	(0.17)	227.00	491.82	(0.19)
39.00	175.14	(0.03)	102.00	465.06	(0.13)	165.00	487.87	(0.17)	228.00	494.04	(0.20)
40.00	183.50	(0.03)	103.00	465.98	(0.13)	166.00	487.37	(0.17)	229.00	493.97	(0.20)
41.00	187.55	(0.04)	104.00	466.91	(0.13)	167.00	486.54	(0.17)	230.00	493.56	(0.20)
42.00	191.59	(0.04)	105.00	467.80	(0.13)	168.00	484.40	(0.17)	231.00	492.53	(0.20)
43.00	195.67	(0.04)	106.00	468.52	(0.13)	169.00	482.01	(0.17)	232.00	491.05	(0.20)
44.00	199.77	(0.04)	107.00	469.07	(0.13)	170.00	479.41	(0.17)	233.00	489.21	(0.20)
45.00	203.89	(0.04)	108.00	469.45	(0.13)	171.00	476.80	(0.17)	234.00	487.18	(0.20)
46.00	207.97	(0.04)	109.00	469.69	(0.13)	172.00	475.85	(0.17)	235.00	485.04	(0.20)
47.00	211.96	(0.04)	110.00	469.98	(0.13)	173.00	475.28	(0.17)	236.00	480.74	(0.20)
48.00	215.85	(0.04)	111.00	470.73	(0.13)	174.00	475.31	(0.17)	237.00	478.99	(0.20)
49.00	219.68	(0.04)	112.00	471.73	(0.13)	175.00	475.98	(0.17)	238.00	478.61	(0.20)
50.00	227.20	(0.05)	113.00	473.04	(0.13)	176.00	477.08	(0.17)	239.00	478.66	(0.20)
51.00	231.08	(0.05)	114.00	474.54	(0.13)	177.00	479.56	(0.17)	240.00	479.25	(0.20)
52.00	238.96	(0.05)	115.00	476.16	(0.13)	178.00	482.09	(0.17)	241.00	481.48	(0.20)
53.00	242.92	(0.05)	116.00	479.27	(0.13)	179.00	486.69	(0.18)	242.00	483.94	(0.20)
54.00	250.84	(0.05)	117.00	480.32	(0.13)	180.00	487.84	(0.18)	243.00	489.09	(0.20)
55.00	254.59	(0.05)	118.00	480.42	(0.13)	181.00	487.94	(0.18)	244.00	493.16	(0.20)
56.00	258.21	(0.05)	119.00	479.97	(0.14)	182.00	487.61	(0.18)	245.00	495.50	(0.20)
57.00	261.64	(0.05)	120.00	478.74	(0.14)	183.00	486.62	(0.18)	246.00	495.48	(0.20)
58.00	263.28	(0.05)	121.00	477.32	(0.14)	184.00	485.32	(0.18)	247.00	495.04	(0.20)
59.00	266.39	(0.06)	122.00	475.81	(0.14)	185.00	483.84	(0.18)	248.00	493.67	(0.20)
60.00	267.62	(0.06)	123.00	472.77	(0.14)	186.00	480.75	(0.18)	249.00	491.81	(0.20)
61.00	269.87	(0.06)	124.00	470.07	(0.14)	187.00	477.65	(0.18)	250.00	489.69	(0.20)
62.00	272.15	(0.06)	125.00	468.04	(0.14)	188.00	476.38	(0.18)			
63.00	274.85	(0.06)	126.00	467.04	(0.14)	189.00	475.76	(0.18)			

Table 9. Settlement Vs load intensity table with skirt height 3.0m & dia. 4.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	4.05	(0.00)	64.00	338.31	(0.08)	127.00	499.19	(0.14)	190.00	590.02	(0.20)
2.00	11.04	(0.00)	65.00	340.98	(0.08)	128.00	501.00	(0.14)	191.00	590.36	(0.20)
3.00	14.18	(0.00)	66.00	346.24	(0.08)	129.00	502.69	(0.14)	192.00	591.17	(0.20)
4.00	17.27	(0.00)	67.00	348.87	(0.08)	130.00	504.22	(0.14)	193.00	591.61	(0.20)
5.00	23.42	(0.00)	68.00	354.18	(0.09)	131.00	505.78	(0.14)	194.00	592.48	(0.20)
6.00	26.45	(0.00)	69.00	359.74	(0.09)	132.00	507.55	(0.14)	195.00	593.19	(0.20)
7.00	32.17	(0.00)	70.00	362.63	(0.09)	133.00	509.57	(0.14)	196.00	593.70	(0.20)
8.00	37.83	(0.01)	71.00	365.60	(0.09)	134.00	511.81	(0.15)	197.00	593.80	(0.20)
9.00	43.58	(0.01)	72.00	368.61	(0.09)	135.00	514.19	(0.15)	198.00	593.80	(0.20)
10.00	46.53	(0.01)	73.00	371.65	(0.09)	136.00	519.19	(0.15)	199.00	593.62	(0.20)
11.00	52.38	(0.01)	74.00	374.67	(0.09)	137.00	524.21	(0.15)	200.00	593.45	(0.20)
12.00	58.03	(0.01)	75.00	377.66	(0.09)	138.00	526.63	(0.15)	201.00	593.30	(0.21)
13.00	69.11	(0.01)	76.00	380.55	(0.09)	139.00	531.33	(0.15)	202.00	593.25	(0.21)
14.00	74.54	(0.01)	77.00	383.34	(0.10)	140.00	535.72	(0.15)	203.00	593.35	(0.21)
15.00	85.13	(0.01)	78.00	385.94	(0.10)	141.00	539.91	(0.16)	204.00	593.61	(0.21)
16.00	90.37	(0.01)	79.00	387.17	(0.10)	142.00	543.91	(0.16)	205.00	594.06	(0.21)
17.00	95.60	(0.02)	80.00	388.37	(0.10)	143.00	547.72	(0.16)	206.00	594.63	(0.21)
18.00	100.38	(0.02)	81.00	389.54	(0.10)	144.00	549.56	(0.16)	207.00	595.18	(0.21)
19.00	104.70	(0.02)	82.00	391.81	(0.10)	145.00	551.31	(0.16)	208.00	595.46	(0.21)
20.00	108.84	(0.02)	83.00	394.01	(0.10)	146.00	553.02	(0.16)	209.00	595.43	(0.21)
21.00	112.83	(0.02)	84.00	396.25	(0.10)	147.00	554.70	(0.16)	210.00	595.03	(0.21)
22.00	114.91	(0.02)	85.00	397.53	(0.10)	148.00	556.36	(0.16)	211.00	594.33	(0.21)
23.00	119.10	(0.02)	86.00	400.18	(0.10)	149.00	558.00	(0.17)	212.00	593.41	(0.21)
24.00	123.51	(0.02)	87.00	403.18	(0.10)	150.00	559.65	(0.17)	213.00	592.37	(0.21)
25.00	127.98	(0.02)	88.00	406.23	(0.10)	151.00	561.33	(0.17)	214.00	591.82	(0.21)
26.00	132.47	(0.02)	89.00	409.36	(0.10)	152.00	562.15	(0.17)	215.00	590.86	(0.21)
27.00	141.46	(0.03)	90.00	415.75	(0.11)	153.00	563.76	(0.17)	216.00	590.62	(0.21)
28.00	150.28	(0.03)	91.00	418.97	(0.11)	154.00	565.15	(0.17)	217.00	590.27	(0.21)
29.00	158.86	(0.03)	92.00	422.21	(0.11)	155.00	565.65	(0.17)	218.00	590.08	(0.21)
30.00	163.07	(0.03)	93.00	425.33	(0.11)	156.00	566.06	(0.17)	219.00	590.13	(0.21)
31.00	171.37	(0.03)	94.00	428.30	(0.11)	157.00	566.41	(0.17)	220.00	590.34	(0.21)
32.00	175.37	(0.03)	95.00	431.11	(0.11)	158.00	567.20	(0.17)	221.00	590.41	(0.21)
33.00	183.20	(0.03)	96.00	433.81	(0.11)	159.00	567.72	(0.17)	222.00	590.39	(0.21)
34.00	190.76	(0.04)	97.00	435.03	(0.11)	160.00	568.98	(0.17)	223.00	590.12	(0.21)
35.00	194.41	(0.04)	98.00	437.20	(0.11)	161.00	569.78	(0.17)	224.00	589.51	(0.22)
36.00	198.00	(0.04)	99.00	438.14	(0.11)	162.00	571.51	(0.18)	225.00	588.80	(0.22)
37.00	201.51	(0.04)	100.00	440.00	(0.11)	163.00	572.45	(0.18)	226.00	588.13	(0.22)
38.00	203.33	(0.04)	101.00	441.82	(0.12)	164.00	574.38	(0.18)	227.00	587.57	(0.22)
39.00	205.12	(0.04)	102.00	442.80	(0.12)	165.00	576.26	(0.18)	228.00	587.24	(0.22)
40.00	206.78	(0.04)	103.00	443.82	(0.12)	166.00	578.02	(0.18)	229.00	587.28	(0.22)
41.00	208.28	(0.04)	104.00	445.91	(0.12)	167.00	579.57	(0.18)	230.00	587.54	(0.22)
42.00	209.67	(0.04)	105.00	447.86	(0.12)	168.00	580.78	(0.18)	231.00	587.95	(0.22)
43.00	212.33	(0.04)	106.00	449.65	(0.12)	169.00	581.24	(0.18)	232.00	588.42	(0.22)
44.00	214.98	(0.04)	107.00	451.46	(0.12)	170.00	582.05	(0.18)	233.00	588.85	(0.22)
45.00	217.89	(0.04)	108.00	453.48	(0.12)	171.00	582.78	(0.18)	234.00	588.97	(0.22)
46.00	224.20	(0.05)	109.00	455.88	(0.12)	172.00	583.10	(0.18)	235.00	588.96	(0.22)
47.00	230.86	(0.05)	110.00	458.65	(0.12)	173.00	583.72	(0.18)	236.00	588.53	(0.22)
48.00	237.65	(0.05)	111.00	461.66	(0.12)	174.00	584.35	(0.19)	237.00	587.81	(0.22)
49.00	244.44	(0.05)	112.00	464.72	(0.13)	175.00	585.01	(0.19)	238.00	586.92	(0.22)
50.00	251.16	(0.05)	113.00	467.76	(0.13)	176.00	585.44	(0.19)	239.00	586.07	(0.22)
51.00	257.83	(0.06)	114.00	470.72	(0.13)	177.00	586.43	(0.19)	240.00	585.47	(0.22)
52.00	264.47	(0.06)	115.00	473.58	(0.13)	178.00	587.47	(0.19)	241.00	585.07	(0.22)
53.00	271.07	(0.06)	116.00	476.30	(0.13)	179.00	588.46	(0.19)	242.00	584.76	(0.22)
54.00	277.64	(0.06)	117.00	481.47	(0.13)	180.00	588.84	(0.19)	243.00	584.51	(0.22)
55.00	284.16	(0.06)	118.00	483.96	(0.13)	181.00	589.41	(0.19)	244.00	584.31	(0.22)
56.00	290.63	(0.07)	119.00	486.37	(0.13)	182.00	589.78	(0.19)	245.00	584.23	(0.22)
57.00	297.04	(0.07)	120.00	488.69	(0.13)	183.00	589.93	(0.19)	246.00	584.23	(0.23)
58.00	309.67	(0.07)	121.00	489.80	(0.13)	184.00	589.93	(0.19)	247.00	584.32	(0.23)
59.00	312.68	(0.07)	122.00	490.81	(0.13)	185.00	589.85	(0.19)	248.00	584.47	(0.23)
60.00	318.61	(0.07)	123.00	492.68	(0.14)	186.00	589.65	(0.19)	249.00	584.78	(0.23)
61.00	324.38	(0.08)	124.00	494.47	(0.14)	187.00	589.58	(0.20)	250.00	584.91	(0.23)
62.00	330.03	(0.08)	125.00	495.38	(0.14)	188.00	589.51	(0.20)			
63.00	335.58	(0.08)	126.00	497.28	(0.14)	189.00	589.63	(0.20)			

Table 10. Settlement Vs load intensity table with skirt height 4.0m & dia. 4.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	2.08	(0.00)	64.00	225.33	(0.05)	127.00	451.81	(0.12)	190.00	623.90	(0.19)
2.00	3.96	(0.00)	65.00	228.86	(0.05)	128.00	457.37	(0.12)	191.00	625.65	(0.19)
3.00	7.44	(0.00)	66.00	235.87	(0.05)	129.00	462.93	(0.12)	192.00	627.63	(0.20)
4.00	8.95	(0.00)	67.00	242.82	(0.05)	130.00	468.49	(0.12)	193.00	629.57	(0.20)
5.00	9.67	(0.00)	68.00	246.23	(0.05)	131.00	469.89	(0.13)	194.00	631.32	(0.20)
6.00	9.81	(0.00)	69.00	253.08	(0.06)	132.00	470.93	(0.13)	195.00	632.80	(0.20)
7.00	10.09	(0.00)	70.00	259.89	(0.06)	133.00	471.59	(0.13)	196.00	633.87	(0.20)
8.00	10.64	(0.00)	71.00	266.64	(0.06)	134.00	472.75	(0.13)	197.00	634.21	(0.20)
9.00	11.80	(0.00)	72.00	269.95	(0.06)	135.00	473.54	(0.13)	198.00	634.41	(0.20)
10.00	12.48	(0.00)	73.00	273.25	(0.06)	136.00	474.59	(0.13)	199.00	634.47	(0.20)
11.00	13.20	(0.00)	74.00	276.50	(0.06)	137.00	477.03	(0.13)	200.00	634.39	(0.20)
12.00	14.63	(0.00)	75.00	278.09	(0.06)	138.00	478.60	(0.13)	201.00	634.12	(0.20)
13.00	17.34	(0.00)	76.00	281.07	(0.06)	139.00	481.82	(0.13)	202.00	634.18	(0.20)
14.00	22.45	(0.00)	77.00	282.50	(0.06)	140.00	485.05	(0.13)	203.00	634.63	(0.20)
15.00	27.55	(0.00)	78.00	285.32	(0.06)	141.00	488.27	(0.13)	204.00	635.86	(0.20)
16.00	32.63	(0.01)	79.00	286.75	(0.07)	142.00	491.38	(0.13)	205.00	637.41	(0.21)
17.00	34.00	(0.01)	80.00	288.18	(0.07)	143.00	494.28	(0.13)	206.00	639.10	(0.21)
18.00	36.74	(0.01)	81.00	289.49	(0.07)	144.00	497.01	(0.14)	207.00	640.80	(0.21)
19.00	42.15	(0.01)	82.00	290.81	(0.07)	145.00	499.63	(0.14)	208.00	641.57	(0.21)
20.00	47.32	(0.01)	83.00	293.55	(0.07)	146.00	502.09	(0.14)	209.00	642.28	(0.21)
21.00	57.49	(0.01)	84.00	295.10	(0.07)	147.00	504.42	(0.14)	210.00	642.85	(0.21)
22.00	62.48	(0.01)	85.00	298.32	(0.07)	148.00	508.84	(0.14)	211.00	643.25	(0.21)
23.00	72.35	(0.01)	86.00	300.02	(0.07)	149.00	510.97	(0.14)	212.00	643.40	(0.21)
24.00	77.17	(0.01)	87.00	303.47	(0.07)	150.00	515.15	(0.14)	213.00	643.29	(0.21)
25.00	86.70	(0.02)	88.00	306.80	(0.07)	151.00	519.37	(0.14)	214.00	643.20	(0.21)
26.00	91.40	(0.02)	89.00	310.09	(0.07)	152.00	523.71	(0.15)	215.00	643.01	(0.21)
27.00	96.12	(0.02)	90.00	313.41	(0.07)	153.00	528.22	(0.15)	216.00	642.78	(0.21)
28.00	98.48	(0.02)	91.00	319.97	(0.08)	154.00	532.81	(0.15)	217.00	642.53	(0.21)
29.00	103.07	(0.02)	92.00	323.03	(0.08)	155.00	537.47	(0.15)	218.00	642.30	(0.21)
30.00	107.40	(0.02)	93.00	329.13	(0.08)	156.00	542.19	(0.15)	219.00	642.25	(0.21)
31.00	111.58	(0.02)	94.00	335.17	(0.08)	157.00	544.60	(0.15)	220.00	642.30	(0.21)
32.00	115.71	(0.02)	95.00	341.08	(0.08)	158.00	549.47	(0.16)	221.00	642.70	(0.21)
33.00	119.97	(0.02)	96.00	346.89	(0.08)	159.00	554.46	(0.16)	222.00	643.21	(0.21)
34.00	124.26	(0.02)	97.00	349.76	(0.08)	160.00	559.48	(0.16)	223.00	644.72	(0.22)
35.00	128.58	(0.02)	98.00	355.36	(0.09)	161.00	564.46	(0.16)	224.00	646.30	(0.22)
36.00	137.08	(0.03)	99.00	360.89	(0.09)	162.00	569.32	(0.16)	225.00	647.90	(0.22)
37.00	145.44	(0.03)	100.00	363.71	(0.09)	163.00	573.95	(0.17)	226.00	649.43	(0.22)
38.00	149.59	(0.03)	101.00	369.40	(0.09)	164.00	578.39	(0.17)	227.00	650.83	(0.22)
39.00	151.68	(0.03)	102.00	372.30	(0.09)	165.00	582.67	(0.17)	228.00	652.07	(0.22)
40.00	155.80	(0.03)	103.00	373.73	(0.09)	166.00	584.81	(0.17)	229.00	653.01	(0.22)
41.00	159.75	(0.03)	104.00	374.35	(0.09)	167.00	589.09	(0.17)	230.00	653.31	(0.22)
42.00	163.63	(0.03)	105.00	374.47	(0.09)	168.00	591.23	(0.17)	231.00	653.81	(0.22)
43.00	167.46	(0.03)	106.00	374.38	(0.09)	169.00	593.40	(0.17)	232.00	654.31	(0.22)
44.00	171.28	(0.03)	107.00	374.51	(0.09)	170.00	595.56	(0.18)	233.00	654.93	(0.22)
45.00	173.20	(0.03)	108.00	375.03	(0.09)	171.00	597.64	(0.18)	234.00	655.59	(0.23)
46.00	175.06	(0.04)	109.00	376.38	(0.09)	172.00	599.65	(0.18)	235.00	656.33	(0.23)
47.00	175.82	(0.04)	110.00	378.09	(0.10)	173.00	601.57	(0.18)	236.00	656.76	(0.23)
48.00	176.20	(0.04)	111.00	381.78	(0.10)	174.00	603.42	(0.18)	237.00	657.56	(0.23)
49.00	176.58	(0.04)	112.00	385.22	(0.10)	175.00	605.21	(0.18)	238.00	657.79	(0.23)
50.00	177.03	(0.04)	113.00	388.47	(0.10)	176.00	606.92	(0.18)	239.00	657.94	(0.23)
51.00	177.71	(0.04)	114.00	391.58	(0.10)	177.00	608.54	(0.18)	240.00	657.91	(0.23)
52.00	178.65	(0.04)	115.00	394.58	(0.10)	178.00	610.10	(0.18)	241.00	657.68	(0.23)
53.00	180.91	(0.04)	116.00	397.56	(0.10)	179.00	611.57	(0.18)	242.00	657.19	(0.23)
54.00	183.17	(0.04)	117.00	400.56	(0.10)	180.00	613.03	(0.18)	243.00	656.69	(0.23)
55.00	185.36	(0.04)	118.00	403.60	(0.10)	181.00	614.46	(0.19)	244.00	656.26	(0.23)
56.00	189.50	(0.04)	119.00	409.46	(0.10)	182.00	615.76	(0.19)	245.00	655.92	(0.23)
57.00	193.38	(0.04)	120.00	415.00	(0.11)	183.00	616.75	(0.19)	246.00	655.55	(0.23)
58.00	197.07	(0.04)	121.00	420.31	(0.11)	184.00	617.62	(0.19)	247.00	655.81	(0.23)
59.00	200.71	(0.04)	122.00	425.54	(0.11)	185.00	618.44	(0.19)	248.00	656.39	(0.23)
60.00	204.26	(0.04)	123.00	430.71	(0.11)	186.00	619.25	(0.19)	249.00	657.15	(0.24)
61.00	207.79	(0.04)	124.00	435.82	(0.11)	187.00	620.12	(0.19)	250.00	657.90	(0.24)
62.00	214.83	(0.05)	125.00	441.02	(0.12)	188.00	621.17	(0.19)			
63.00	218.34	(0.05)	126.00	446.33	(0.12)	189.00	622.41	(0.19)			

Table 11. Settlement Vs load intensity table with skirt height 5.0m & dia. 4.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	2.09	(0.00)	64.00	244.33	(0.06)	127.00	458.17	(0.14)	190.00	572.10	(0.21)
2.00	2.97	(0.00)	65.00	247.17	(0.06)	128.00	462.22	(0.14)	191.00	572.93	(0.21)
3.00	4.64	(0.00)	66.00	250.17	(0.06)	129.00	466.30	(0.15)	192.00	573.82	(0.21)
4.00	6.18	(0.00)	67.00	253.25	(0.06)	130.00	470.40	(0.15)	193.00	574.83	(0.22)
5.00	7.63	(0.00)	68.00	256.31	(0.06)	131.00	472.46	(0.15)	194.00	575.95	(0.22)
6.00	9.01	(0.00)	69.00	259.34	(0.06)	132.00	474.53	(0.15)	195.00	577.16	(0.22)
7.00	11.62	(0.00)	70.00	265.33	(0.06)	133.00	476.56	(0.15)	196.00	578.44	(0.22)
8.00	12.15	(0.00)	71.00	271.29	(0.07)	134.00	478.52	(0.15)	197.00	579.78	(0.22)
9.00	12.51	(0.00)	72.00	277.27	(0.07)	135.00	482.23	(0.15)	198.00	581.20	(0.22)
10.00	12.62	(0.00)	73.00	280.28	(0.07)	136.00	483.87	(0.15)	199.00	581.95	(0.22)
11.00	12.73	(0.00)	74.00	283.32	(0.07)	137.00	486.92	(0.16)	200.00	583.47	(0.22)
12.00	12.94	(0.00)	75.00	286.39	(0.07)	138.00	489.83	(0.16)	201.00	584.93	(0.22)
13.00	13.45	(0.00)	76.00	292.43	(0.07)	139.00	491.24	(0.16)	202.00	586.32	(0.22)
14.00	13.77	(0.00)	77.00	298.36	(0.07)	140.00	492.64	(0.16)	203.00	587.61	(0.22)
15.00	14.42	(0.00)	78.00	304.30	(0.08)	141.00	494.07	(0.16)	204.00	588.79	(0.23)
16.00	15.75	(0.00)	79.00	310.24	(0.08)	142.00	495.54	(0.16)	205.00	589.81	(0.23)
17.00	17.17	(0.00)	80.00	316.16	(0.08)	143.00	497.02	(0.16)	206.00	590.68	(0.23)
18.00	20.13	(0.00)	81.00	321.88	(0.08)	144.00	498.60	(0.16)	207.00	591.44	(0.23)
19.00	23.09	(0.00)	82.00	324.57	(0.08)	145.00	501.86	(0.16)	208.00	592.23	(0.23)
20.00	26.04	(0.00)	83.00	327.07	(0.08)	146.00	503.55	(0.17)	209.00	593.09	(0.23)
21.00	28.93	(0.00)	84.00	328.22	(0.08)	147.00	507.01	(0.17)	210.00	594.03	(0.23)
22.00	31.71	(0.01)	85.00	330.35	(0.09)	148.00	508.77	(0.17)	211.00	595.03	(0.23)
23.00	34.41	(0.01)	86.00	332.33	(0.09)	149.00	510.54	(0.17)	212.00	596.05	(0.23)
24.00	36.95	(0.01)	87.00	334.23	(0.09)	150.00	511.41	(0.17)	213.00	597.08	(0.23)
25.00	41.92	(0.01)	88.00	336.12	(0.09)	151.00	513.15	(0.17)	214.00	598.06	(0.23)
26.00	46.62	(0.01)	89.00	338.04	(0.09)	152.00	514.85	(0.17)	215.00	598.50	(0.24)
27.00	51.06	(0.01)	90.00	339.09	(0.09)	153.00	516.50	(0.17)	216.00	599.32	(0.24)
28.00	55.44	(0.01)	91.00	341.27	(0.09)	154.00	519.60	(0.17)	217.00	600.07	(0.24)
29.00	59.84	(0.01)	92.00	343.64	(0.09)	155.00	521.00	(0.18)	218.00	600.77	(0.24)
30.00	64.17	(0.01)	93.00	346.12	(0.09)	156.00	522.32	(0.18)	219.00	601.45	(0.24)
31.00	68.46	(0.01)	94.00	348.71	(0.09)	157.00	523.59	(0.18)	220.00	602.13	(0.24)
32.00	72.77	(0.01)	95.00	351.42	(0.09)	158.00	524.78	(0.18)	221.00	602.49	(0.24)
33.00	77.15	(0.01)	96.00	357.07	(0.10)	159.00	525.96	(0.18)	222.00	603.25	(0.24)
34.00	86.08	(0.02)	97.00	359.94	(0.10)	160.00	527.17	(0.18)	223.00	604.10	(0.24)
35.00	90.55	(0.02)	98.00	362.84	(0.10)	161.00	528.42	(0.18)	224.00	605.01	(0.24)
36.00	94.97	(0.02)	99.00	365.65	(0.10)	162.00	529.76	(0.18)	225.00	606.02	(0.24)
37.00	99.25	(0.02)	100.00	368.27	(0.10)	163.00	531.21	(0.18)	226.00	607.10	(0.25)
38.00	103.44	(0.02)	101.00	370.63	(0.10)	164.00	532.74	(0.18)	227.00	608.33	(0.25)
39.00	111.46	(0.02)	102.00	372.74	(0.10)	165.00	534.30	(0.18)	228.00	609.64	(0.25)
40.00	119.26	(0.02)	103.00	376.69	(0.10)	166.00	535.92	(0.19)	229.00	610.98	(0.25)
41.00	127.01	(0.03)	104.00	378.46	(0.10)	167.00	537.55	(0.19)	230.00	611.59	(0.25)
42.00	134.73	(0.03)	105.00	381.96	(0.11)	168.00	539.13	(0.19)	231.00	612.79	(0.25)
43.00	138.59	(0.03)	106.00	383.78	(0.11)	169.00	540.64	(0.19)	232.00	613.75	(0.25)
44.00	146.35	(0.03)	107.00	387.64	(0.11)	170.00	543.48	(0.19)	233.00	614.50	(0.25)
45.00	154.11	(0.03)	108.00	389.75	(0.11)	171.00	544.79	(0.19)	234.00	615.06	(0.25)
46.00	157.96	(0.03)	109.00	394.07	(0.11)	172.00	547.31	(0.19)	235.00	615.23	(0.25)
47.00	161.80	(0.03)	110.00	398.58	(0.11)	173.00	548.52	(0.19)	236.00	615.34	(0.25)
48.00	169.40	(0.04)	111.00	403.32	(0.12)	174.00	550.90	(0.20)	237.00	615.47	(0.25)
49.00	176.75	(0.04)	112.00	408.20	(0.12)	175.00	552.09	(0.20)	238.00	615.63	(0.25)
50.00	183.89	(0.04)	113.00	413.12	(0.12)	176.00	554.48	(0.20)	239.00	615.80	(0.25)
51.00	190.91	(0.04)	114.00	418.04	(0.12)	177.00	555.72	(0.20)	240.00	616.00	(0.26)
52.00	197.83	(0.04)	115.00	420.42	(0.12)	178.00	557.00	(0.20)	241.00	616.23	(0.26)
53.00	204.67	(0.05)	116.00	425.03	(0.12)	179.00	558.33	(0.20)	242.00	616.56	(0.26)
54.00	211.36	(0.05)	117.00	427.12	(0.13)	180.00	559.73	(0.20)	243.00	616.99	(0.26)
55.00	217.92	(0.05)	118.00	431.19	(0.13)	181.00	562.52	(0.20)	244.00	617.57	(0.26)
56.00	221.14	(0.05)	119.00	434.99	(0.13)	182.00	563.86	(0.21)	245.00	618.26	(0.26)
57.00	227.40	(0.05)	120.00	438.46	(0.13)	183.00	565.13	(0.21)	246.00	619.00	(0.26)
58.00	230.39	(0.05)	121.00	441.74	(0.13)	184.00	566.28	(0.21)	247.00	619.72	(0.26)
59.00	231.76	(0.05)	122.00	443.39	(0.13)	185.00	567.36	(0.21)	248.00	620.36	(0.26)
60.00	234.39	(0.05)	123.00	446.77	(0.14)	186.00	568.39	(0.21)	249.00	621.40	(0.26)
61.00	236.89	(0.06)	124.00	448.55	(0.14)	187.00	569.38	(0.21)	250.00	622.17	(0.26)
62.00	239.32	(0.06)	125.00	452.25	(0.14)	188.00	570.33	(0.21)			
63.00	241.75	(0.06)	126.00	454.20	(0.14)	189.00	571.24	(0.21)			

Table 12. Settlement Vs load intensity table with skirt height 1.0m & dia. 5.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	17.52	(0.00)	64.00	310.13	(0.07)	127.00	447.49	(0.13)	190.00	451.12	(0.16)
2.00	24.66	(0.00)	65.00	316.57	(0.07)	128.00	448.35	(0.13)	191.00	450.99	(0.16)
3.00	31.27	(0.00)	66.00	322.96	(0.07)	129.00	449.04	(0.13)	192.00	450.79	(0.16)
4.00	37.26	(0.01)	67.00	329.34	(0.08)	130.00	449.51	(0.13)	193.00	450.61	(0.16)
5.00	43.12	(0.01)	68.00	332.55	(0.08)	131.00	449.57	(0.14)	194.00	450.60	(0.16)
6.00	49.06	(0.01)	69.00	338.88	(0.08)	132.00	449.58	(0.14)	195.00	450.68	(0.16)
7.00	52.02	(0.01)	70.00	344.83	(0.08)	133.00	449.50	(0.14)	196.00	450.80	(0.17)
8.00	57.77	(0.01)	71.00	350.61	(0.08)	134.00	449.29	(0.14)	197.00	450.91	(0.17)
9.00	60.59	(0.01)	72.00	356.27	(0.09)	135.00	449.30	(0.14)	198.00	451.01	(0.17)
10.00	66.08	(0.01)	73.00	361.79	(0.09)	136.00	449.49	(0.14)	199.00	451.07	(0.17)
11.00	68.83	(0.01)	74.00	367.31	(0.09)	137.00	449.73	(0.14)	200.00	451.17	(0.17)
12.00	74.21	(0.01)	75.00	372.85	(0.09)	138.00	450.40	(0.14)	201.00	451.25	(0.17)
13.00	79.38	(0.01)	76.00	378.38	(0.09)	139.00	451.09	(0.14)	202.00	451.26	(0.17)
14.00	81.84	(0.01)	77.00	383.87	(0.10)	140.00	451.74	(0.14)	203.00	451.14	(0.17)
15.00	84.13	(0.01)	78.00	389.27	(0.10)	141.00	452.30	(0.14)	204.00	451.01	(0.17)
16.00	85.16	(0.01)	79.00	394.55	(0.10)	142.00	452.64	(0.14)	205.00	450.78	(0.17)
17.00	86.04	(0.01)	80.00	399.67	(0.10)	143.00	452.67	(0.14)	206.00	450.74	(0.17)
18.00	87.76	(0.02)	81.00	404.49	(0.11)	144.00	452.61	(0.14)	207.00	450.67	(0.17)
19.00	88.68	(0.02)	82.00	409.16	(0.11)	145.00	452.50	(0.14)	208.00	450.60	(0.17)
20.00	90.70	(0.02)	83.00	413.72	(0.11)	146.00	452.45	(0.14)	209.00	450.54	(0.17)
21.00	92.93	(0.02)	84.00	418.15	(0.11)	147.00	452.41	(0.14)	210.00	450.56	(0.17)
22.00	97.67	(0.02)	85.00	422.44	(0.11)	148.00	452.45	(0.14)	211.00	450.65	(0.17)
23.00	102.56	(0.02)	86.00	424.47	(0.11)	149.00	452.51	(0.14)	212.00	450.77	(0.17)
24.00	107.48	(0.02)	87.00	426.40	(0.12)	150.00	452.57	(0.14)	213.00	450.88	(0.17)
25.00	112.37	(0.02)	88.00	427.27	(0.12)	151.00	452.67	(0.14)	214.00	450.93	(0.17)
26.00	117.26	(0.02)	89.00	428.10	(0.12)	152.00	452.77	(0.14)	215.00	450.90	(0.17)
27.00	127.02	(0.02)	90.00	428.91	(0.12)	153.00	452.84	(0.14)	216.00	450.86	(0.17)
28.00	136.68	(0.03)	91.00	429.66	(0.12)	154.00	452.81	(0.15)	217.00	450.91	(0.17)
29.00	139.04	(0.03)	92.00	430.31	(0.12)	155.00	452.70	(0.15)	218.00	451.01	(0.18)
30.00	143.64	(0.03)	93.00	430.87	(0.12)	156.00	452.54	(0.15)	219.00	451.11	(0.18)
31.00	148.15	(0.03)	94.00	431.32	(0.12)	157.00	452.31	(0.15)	220.00	451.17	(0.18)
32.00	152.59	(0.03)	95.00	431.73	(0.12)	158.00	452.06	(0.15)	221.00	451.20	(0.18)
33.00	161.56	(0.03)	96.00	432.14	(0.12)	159.00	451.98	(0.15)	222.00	451.24	(0.18)
34.00	166.19	(0.03)	97.00	432.39	(0.12)	160.00	451.88	(0.15)	223.00	451.28	(0.18)
35.00	170.80	(0.03)	98.00	432.96	(0.12)	161.00	451.89	(0.15)	224.00	451.30	(0.18)
36.00	173.12	(0.03)	99.00	433.69	(0.12)	162.00	451.90	(0.15)	225.00	451.24	(0.18)
37.00	175.49	(0.03)	100.00	434.61	(0.12)	163.00	451.95	(0.15)	226.00	451.07	(0.18)
38.00	180.26	(0.04)	101.00	435.70	(0.12)	164.00	451.97	(0.15)	227.00	451.00	(0.18)
39.00	184.97	(0.04)	102.00	436.89	(0.12)	165.00	451.95	(0.15)	228.00	450.97	(0.18)
40.00	189.42	(0.04)	103.00	438.05	(0.12)	166.00	451.91	(0.15)	229.00	451.05	(0.18)
41.00	193.82	(0.04)	104.00	439.10	(0.12)	167.00	451.81	(0.15)	230.00	451.15	(0.18)
42.00	198.25	(0.04)	105.00	439.92	(0.12)	168.00	451.64	(0.15)	231.00	451.26	(0.18)
43.00	202.70	(0.04)	106.00	440.40	(0.13)	169.00	451.39	(0.15)	232.00	451.34	(0.18)
44.00	207.15	(0.04)	107.00	440.39	(0.13)	170.00	451.15	(0.15)	233.00	451.49	(0.18)
45.00	211.60	(0.04)	108.00	440.26	(0.13)	171.00	451.08	(0.15)	234.00	451.64	(0.18)
46.00	216.07	(0.04)	109.00	440.09	(0.13)	172.00	450.99	(0.15)	235.00	451.75	(0.18)
47.00	224.94	(0.05)	110.00	439.92	(0.13)	173.00	450.93	(0.15)	236.00	451.73	(0.18)
48.00	233.13	(0.05)	111.00	439.85	(0.13)	174.00	450.89	(0.15)	237.00	451.55	(0.18)
49.00	240.87	(0.05)	112.00	439.95	(0.13)	175.00	450.77	(0.16)	238.00	451.46	(0.18)
50.00	244.53	(0.05)	113.00	440.24	(0.13)	176.00	450.71	(0.16)	239.00	451.34	(0.18)
51.00	251.72	(0.05)	114.00	440.66	(0.13)	177.00	450.61	(0.16)	240.00	451.30	(0.19)
52.00	255.33	(0.05)	115.00	441.14	(0.13)	178.00	450.54	(0.16)	241.00	451.26	(0.19)
53.00	258.91	(0.06)	116.00	441.65	(0.13)	179.00	450.48	(0.16)	242.00	451.23	(0.19)
54.00	266.05	(0.06)	117.00	442.64	(0.13)	180.00	450.40	(0.16)	243.00	451.27	(0.19)
55.00	273.16	(0.06)	118.00	443.46	(0.13)	181.00	450.34	(0.16)	244.00	451.41	(0.19)
56.00	280.30	(0.06)	119.00	443.99	(0.13)	182.00	450.37	(0.16)	245.00	451.56	(0.19)
57.00	283.78	(0.06)	120.00	444.20	(0.13)	183.00	450.51	(0.16)	246.00	451.68	(0.19)
58.00	287.24	(0.06)	121.00	444.29	(0.13)	184.00	450.74	(0.16)	247.00	451.71	(0.19)
59.00	290.67	(0.06)	122.00	444.40	(0.13)	185.00	450.95	(0.16)	248.00	451.65	(0.19)
60.00	294.03	(0.07)	123.00	444.69	(0.13)	186.00	451.10	(0.16)	249.00	451.56	(0.19)
61.00	297.32	(0.07)	124.00	445.13	(0.13)	187.00	451.16	(0.16)	250.00	451.56	(0.19)
62.00	300.54	(0.07)	125.00	445.78	(0.13)	188.00	451.20	(0.16)			
63.00	303.72	(0.07)	126.00	446.59	(0.13)	189.00	451.19	(0.16)			

Table 13. Settlement Vs load intensity table with skirt height 2.0m & dia. 5.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	8.92	(0.00)	56.00	296.75	(0.07)
2.00	12.77	(0.00)	57.00	302.99	(0.07)
3.00	20.20	(0.00)	58.00	315.53	(0.07)
4.00	26.85	(0.00)	59.00	321.92	(0.08)
5.00	33.22	(0.00)	60.00	334.75	(0.08)
6.00	39.47	(0.01)	61.00	341.16	(0.08)
7.00	42.63	(0.01)	62.00	347.48	(0.08)
8.00	48.85	(0.01)	63.00	350.55	(0.08)
9.00	51.91	(0.01)	64.00	356.68	(0.09)
10.00	57.88	(0.01)	65.00	362.64	(0.09)
11.00	63.69	(0.01)	66.00	368.43	(0.09)
12.00	69.41	(0.01)	67.00	373.99	(0.09)
13.00	75.03	(0.01)	68.00	379.29	(0.10)
14.00	80.56	(0.01)	69.00	384.39	(0.10)
15.00	83.28	(0.01)	70.00	389.38	(0.10)
16.00	85.93	(0.01)	71.00	394.36	(0.10)
17.00	88.47	(0.01)	72.00	399.34	(0.10)
18.00	90.82	(0.02)	73.00	404.35	(0.11)
19.00	95.28	(0.02)	74.00	409.30	(0.11)
20.00	97.60	(0.02)	75.00	414.18	(0.11)
21.00	102.28	(0.02)	76.00	419.04	(0.11)
22.00	107.07	(0.02)	77.00	421.43	(0.11)
23.00	111.99	(0.02)	78.00	426.17	(0.12)
24.00	116.97	(0.02)	79.00	430.90	(0.12)
25.00	121.93	(0.02)	80.00	435.59	(0.12)
26.00	126.85	(0.02)	81.00	440.24	(0.12)
27.00	129.33	(0.02)	82.00	444.78	(0.12)
28.00	134.29	(0.02)	83.00	449.12	(0.13)
29.00	139.19	(0.03)	84.00	451.18	(0.13)
30.00	143.95	(0.03)	85.00	453.21	(0.13)
31.00	148.59	(0.03)	86.00	454.13	(0.13)
32.00	153.12	(0.03)	87.00	455.00	(0.13)
33.00	157.48	(0.03)	88.00	455.25	(0.13)
34.00	161.76	(0.03)	89.00	455.08	(0.13)
35.00	166.00	(0.03)	90.00	454.74	(0.13)
36.00	174.45	(0.03)	91.00	454.12	(0.13)
37.00	182.91	(0.04)	92.00	452.57	(0.13)
38.00	187.14	(0.04)	93.00	449.06	(0.13)
39.00	191.36	(0.04)	94.00	445.93	(0.13)
40.00	199.71	(0.04)	95.00	444.90	(0.13)
41.00	207.84	(0.04)	96.00	444.84	(0.13)
42.00	211.92	(0.04)	97.00	445.28	(0.13)
43.00	219.97	(0.05)	98.00	445.91	(0.13)
44.00	224.04	(0.05)	99.00	446.72	(0.13)
45.00	232.29	(0.05)	100.00	448.54	(0.13)
46.00	236.38	(0.05)	101.00	450.45	(0.13)
47.00	240.39	(0.05)	102.00	452.30	(0.13)
48.00	244.23	(0.05)	103.00	453.77	(0.13)
49.00	251.75	(0.05)	104.00	454.96	(0.13)
50.00	259.07	(0.06)	105.00	454.67	(0.13)
51.00	266.23	(0.06)	106.00	454.14	(0.13)
52.00	273.24	(0.06)	107.00	452.90	(0.13)
53.00	280.21	(0.06)	108.00	451.45	(0.13)
54.00	286.99	(0.06)	109.00	449.60	(0.13)
55.00	293.56	(0.07)	110.00	447.72	(0.13)

Table 14. Settlement Vs load intensity table with skirt height 3.0m & dia. 5.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	16.36	(0.00)	64.00	331.55	(0.08)	127.00	539.93	(0.17)	190.00	578.03	(0.26)
2.00	29.84	(0.00)	65.00	334.61	(0.08)	128.00	541.64	(0.17)	191.00	578.16	(0.26)
3.00	35.79	(0.00)	66.00	337.65	(0.08)	129.00	543.30	(0.17)	192.00	578.42	(0.27)
4.00	41.30	(0.01)	67.00	340.71	(0.08)	130.00	544.83	(0.17)	193.00	578.90	(0.27)
5.00	46.74	(0.01)	68.00	342.27	(0.08)	131.00	546.22	(0.17)	194.00	579.56	(0.28)
6.00	52.14	(0.01)	69.00	343.80	(0.08)	132.00	548.96	(0.17)	195.00	580.38	(0.28)
7.00	54.86	(0.01)	70.00	345.23	(0.08)	133.00	551.57	(0.18)	196.00	581.23	(0.28)
8.00	60.30	(0.01)	71.00	346.55	(0.08)	134.00	552.83	(0.18)	197.00	582.00	(0.29)
9.00	65.54	(0.01)	72.00	348.96	(0.08)	135.00	555.38	(0.18)	198.00	582.43	(0.29)
10.00	70.70	(0.01)	73.00	351.20	(0.08)	136.00	557.99	(0.18)	199.00	582.34	(0.29)
11.00	76.02	(0.01)	74.00	352.34	(0.08)	137.00	560.64	(0.18)	200.00	581.99	(0.29)
12.00	81.40	(0.01)	75.00	354.75	(0.09)	138.00	563.28	(0.19)	201.00	580.73	(0.30)
13.00	86.73	(0.01)	76.00	357.42	(0.09)	139.00	564.52	(0.19)	202.00	579.08	(0.30)
14.00	97.18	(0.02)	77.00	360.26	(0.09)	140.00	566.96	(0.19)	203.00	577.25	(0.30)
15.00	102.02	(0.02)	78.00	363.16	(0.09)	141.00	569.28	(0.19)	204.00	575.32	(0.30)
16.00	104.08	(0.02)	79.00	366.10	(0.09)	142.00	571.53	(0.19)	205.00	573.60	(0.30)
17.00	105.95	(0.02)	80.00	369.05	(0.09)	143.00	573.78	(0.19)	206.00	573.14	(0.30)
18.00	107.75	(0.02)	81.00	372.01	(0.09)	144.00	576.10	(0.20)	207.00	573.28	(0.30)
19.00	109.57	(0.02)	82.00	374.92	(0.09)	145.00	578.49	(0.20)	208.00	574.31	(0.31)
20.00	111.47	(0.02)	83.00	377.72	(0.09)	146.00	580.90	(0.20)	209.00	575.76	(0.31)
21.00	113.46	(0.02)	84.00	380.43	(0.09)	147.00	583.30	(0.20)	210.00	577.38	(0.31)
22.00	117.70	(0.02)	85.00	382.97	(0.09)	148.00	584.52	(0.20)	211.00	579.11	(0.31)
23.00	122.16	(0.02)	86.00	385.39	(0.10)	149.00	586.96	(0.20)	212.00	580.88	(0.31)
24.00	126.69	(0.02)	87.00	390.09	(0.10)	150.00	588.14	(0.21)	213.00	582.59	(0.31)
25.00	135.87	(0.02)	88.00	394.77	(0.10)	151.00	589.29	(0.21)	214.00	585.72	(0.31)
26.00	145.10	(0.03)	89.00	397.15	(0.10)	152.00	590.39	(0.21)	215.00	588.34	(0.31)
27.00	154.30	(0.03)	90.00	401.99	(0.10)	153.00	591.42	(0.21)	216.00	588.51	(0.31)
28.00	163.45	(0.03)	91.00	406.90	(0.10)	154.00	592.30	(0.21)	217.00	588.27	(0.31)
29.00	172.57	(0.03)	92.00	411.88	(0.11)	155.00	593.02	(0.21)	218.00	587.47	(0.31)
30.00	177.13	(0.03)	93.00	416.92	(0.11)	156.00	593.63	(0.21)	219.00	586.21	(0.32)
31.00	181.75	(0.03)	94.00	421.89	(0.11)	157.00	594.18	(0.21)	220.00	583.50	(0.32)
32.00	184.03	(0.03)	95.00	426.72	(0.11)	158.00	594.67	(0.21)	221.00	580.84	(0.32)
33.00	186.19	(0.03)	96.00	431.38	(0.11)	159.00	595.11	(0.21)	222.00	578.53	(0.32)
34.00	190.35	(0.04)	97.00	435.96	(0.12)	160.00	595.50	(0.21)	223.00	577.94	(0.32)
35.00	194.38	(0.04)	98.00	440.49	(0.12)	161.00	595.83	(0.22)	224.00	577.64	(0.32)
36.00	198.38	(0.04)	99.00	444.89	(0.12)	162.00	596.01	(0.22)	225.00	577.82	(0.32)
37.00	200.37	(0.04)	100.00	449.19	(0.12)	163.00	595.89	(0.22)	226.00	578.45	(0.32)
38.00	202.30	(0.04)	101.00	453.44	(0.12)	164.00	595.05	(0.22)	227.00	579.22	(0.32)
39.00	204.09	(0.04)	102.00	461.98	(0.13)	165.00	593.65	(0.22)	228.00	579.99	(0.32)
40.00	205.71	(0.04)	103.00	466.21	(0.13)	166.00	591.74	(0.22)	229.00	580.65	(0.32)
41.00	207.17	(0.04)	104.00	474.61	(0.13)	167.00	589.77	(0.22)	230.00	581.16	(0.32)
42.00	209.99	(0.04)	105.00	478.59	(0.13)	168.00	587.92	(0.22)	231.00	581.85	(0.33)
43.00	211.57	(0.04)	106.00	482.45	(0.14)	169.00	586.49	(0.22)	232.00	581.98	(0.33)
44.00	214.77	(0.04)	107.00	486.16	(0.14)	170.00	585.56	(0.22)	233.00	581.59	(0.33)
45.00	218.04	(0.04)	108.00	489.77	(0.14)	171.00	585.17	(0.22)	234.00	580.99	(0.33)
46.00	221.27	(0.04)	109.00	493.35	(0.14)	172.00	584.95	(0.23)	235.00	580.29	(0.33)
47.00	227.60	(0.05)	110.00	496.89	(0.14)	173.00	584.75	(0.23)	236.00	579.65	(0.34)
48.00	230.70	(0.05)	111.00	503.86	(0.15)	174.00	584.42	(0.23)	237.00	579.18	(0.34)
49.00	236.93	(0.05)	112.00	507.25	(0.15)	175.00	583.91	(0.23)	238.00	578.89	(0.34)
50.00	243.27	(0.05)	113.00	510.62	(0.15)	176.00	583.09	(0.23)	239.00	579.13	(0.34)
51.00	249.75	(0.05)	114.00	513.95	(0.15)	177.00	581.89	(0.23)	240.00	579.74	(0.34)
52.00	256.32	(0.05)	115.00	517.29	(0.15)	178.00	580.44	(0.23)	241.00	580.49	(0.34)
53.00	262.94	(0.06)	116.00	520.60	(0.16)	179.00	577.22	(0.23)	242.00	581.40	(0.34)
54.00	269.54	(0.06)	117.00	522.22	(0.16)	180.00	575.82	(0.23)	243.00	582.46	(0.34)
55.00	276.09	(0.06)	118.00	525.45	(0.16)	181.00	573.71	(0.24)	244.00	583.64	(0.35)
56.00	282.44	(0.06)	119.00	526.94	(0.16)	182.00	573.51	(0.24)	245.00	586.17	(0.35)
57.00	288.68	(0.06)	120.00	528.29	(0.16)	183.00	573.68	(0.24)	246.00	588.59	(0.35)
58.00	294.87	(0.07)	121.00	529.50	(0.16)	184.00	574.32	(0.24)	247.00	590.73	(0.35)
59.00	301.03	(0.07)	122.00	530.70	(0.16)	185.00	575.70	(0.24)	248.00	592.62	(0.35)
60.00	307.17	(0.07)	123.00	533.28	(0.17)	186.00	576.91	(0.25)	249.00	594.20	(0.35)
61.00	313.27	(0.07)	124.00	534.81	(0.17)	187.00	577.27	(0.25)	250.00	594.37	(0.35)
62.00	319.37	(0.07)	125.00	536.43	(0.17)	188.00	577.77	(0.25)			
63.00	325.46	(0.08)	126.00	538.19	(0.17)	189.00	577.96	(0.26)			

Table 15. Settlement Vs load intensity table with skirt height 4.0m & dia. 5.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	2.22	(0.00)	64.00	243.27	(0.05)	127.00	521.32	(0.16)	190.00	650.46	(0.29)
2.00	4.30	(0.00)	65.00	250.70	(0.06)	128.00	522.83	(0.16)	191.00	651.22	(0.29)
3.00	6.30	(0.00)	66.00	254.40	(0.06)	129.00	524.33	(0.17)	192.00	651.96	(0.29)
4.00	6.49	(0.00)	67.00	258.12	(0.06)	130.00	525.82	(0.17)	193.00	653.48	(0.30)
5.00	6.91	(0.00)	68.00	261.85	(0.06)	131.00	528.82	(0.17)	194.00	654.28	(0.30)
6.00	7.06	(0.00)	69.00	265.49	(0.06)	132.00	530.36	(0.17)	195.00	655.94	(0.30)
7.00	7.35	(0.00)	70.00	268.98	(0.06)	133.00	533.53	(0.17)	196.00	656.83	(0.30)
8.00	7.90	(0.00)	71.00	272.28	(0.06)	134.00	536.74	(0.17)	197.00	657.78	(0.31)
9.00	8.86	(0.00)	72.00	275.48	(0.06)	135.00	539.97	(0.17)	198.00	658.76	(0.31)
10.00	10.73	(0.00)	73.00	281.62	(0.06)	136.00	543.19	(0.18)	199.00	659.75	(0.31)
11.00	14.20	(0.00)	74.00	284.59	(0.06)	137.00	546.32	(0.18)	200.00	660.73	(0.31)
12.00	17.53	(0.00)	75.00	287.50	(0.07)	138.00	547.80	(0.18)	201.00	661.70	(0.31)
13.00	23.98	(0.00)	76.00	290.36	(0.07)	139.00	550.71	(0.18)	202.00	662.65	(0.32)
14.00	30.23	(0.00)	77.00	296.03	(0.07)	140.00	553.51	(0.18)	203.00	663.55	(0.32)
15.00	36.29	(0.01)	78.00	301.65	(0.07)	141.00	556.24	(0.19)	204.00	663.98	(0.32)
16.00	39.18	(0.01)	79.00	307.26	(0.07)	142.00	558.89	(0.19)	205.00	664.82	(0.32)
17.00	41.93	(0.01)	80.00	312.87	(0.07)	143.00	561.48	(0.19)	206.00	665.57	(0.32)
18.00	47.46	(0.01)	81.00	318.49	(0.08)	144.00	562.75	(0.19)	207.00	666.28	(0.32)
19.00	53.11	(0.01)	82.00	324.16	(0.08)	145.00	565.33	(0.19)	208.00	667.01	(0.33)
20.00	58.72	(0.01)	83.00	329.88	(0.08)	146.00	567.97	(0.19)	209.00	667.77	(0.33)
21.00	64.37	(0.01)	84.00	335.61	(0.08)	147.00	573.26	(0.20)	210.00	668.64	(0.33)
22.00	70.04	(0.01)	85.00	341.34	(0.08)	148.00	575.79	(0.20)	211.00	669.68	(0.33)
23.00	75.74	(0.01)	86.00	347.02	(0.09)	149.00	580.71	(0.20)	212.00	670.38	(0.33)
24.00	81.42	(0.01)	87.00	352.64	(0.09)	150.00	583.06	(0.21)	213.00	671.19	(0.33)
25.00	92.52	(0.02)	88.00	358.19	(0.09)	151.00	585.39	(0.21)	214.00	672.06	(0.34)
26.00	97.95	(0.02)	89.00	363.69	(0.09)	152.00	587.63	(0.21)	215.00	672.97	(0.34)
27.00	103.30	(0.02)	90.00	369.11	(0.09)	153.00	589.81	(0.21)	216.00	673.91	(0.34)
28.00	108.39	(0.02)	91.00	374.47	(0.10)	154.00	591.97	(0.21)	217.00	674.89	(0.34)
29.00	113.23	(0.02)	92.00	379.77	(0.10)	155.00	594.10	(0.22)	218.00	675.94	(0.34)
30.00	117.85	(0.02)	93.00	385.02	(0.10)	156.00	596.20	(0.22)	219.00	678.03	(0.34)
31.00	122.26	(0.02)	94.00	387.64	(0.10)	157.00	598.26	(0.22)	220.00	680.02	(0.34)
32.00	126.57	(0.02)	95.00	390.27	(0.10)	158.00	600.23	(0.22)	221.00	681.79	(0.35)
33.00	130.81	(0.02)	96.00	392.89	(0.10)	159.00	602.11	(0.22)	222.00	683.14	(0.35)
34.00	135.04	(0.02)	97.00	398.14	(0.11)	160.00	603.95	(0.23)	223.00	683.54	(0.35)
35.00	139.28	(0.03)	98.00	403.35	(0.11)	161.00	605.76	(0.23)	224.00	683.94	(0.35)
36.00	143.55	(0.03)	99.00	408.49	(0.11)	162.00	607.58	(0.23)	225.00	683.89	(0.35)
37.00	147.82	(0.03)	100.00	411.01	(0.11)	163.00	609.43	(0.23)	226.00	683.69	(0.35)
38.00	152.15	(0.03)	101.00	416.01	(0.11)	164.00	611.33	(0.23)	227.00	683.17	(0.35)
39.00	154.36	(0.03)	102.00	420.94	(0.11)	165.00	613.26	(0.24)	228.00	682.52	(0.36)
40.00	158.76	(0.03)	103.00	425.87	(0.12)	166.00	615.22	(0.24)	229.00	681.80	(0.36)
41.00	163.04	(0.03)	104.00	430.79	(0.12)	167.00	619.10	(0.24)	230.00	681.01	(0.36)
42.00	167.22	(0.03)	105.00	435.66	(0.12)	168.00	620.90	(0.24)	231.00	679.70	(0.36)
43.00	171.29	(0.03)	106.00	440.49	(0.12)	169.00	622.57	(0.25)	232.00	676.99	(0.36)
44.00	175.25	(0.03)	107.00	445.23	(0.12)	170.00	624.07	(0.25)	233.00	671.30	(0.36)
45.00	179.08	(0.03)	108.00	449.90	(0.13)	171.00	625.48	(0.25)	234.00	665.45	(0.36)
46.00	182.79	(0.04)	109.00	454.49	(0.13)	172.00	626.74	(0.25)	235.00	659.56	(0.36)
47.00	186.38	(0.04)	110.00	458.93	(0.13)	173.00	627.94	(0.25)	236.00	653.61	(0.37)
48.00	189.83	(0.04)	111.00	463.28	(0.13)	174.00	629.23	(0.26)	237.00	647.68	(0.37)
49.00	191.43	(0.04)	112.00	467.53	(0.13)	175.00	630.56	(0.26)	238.00	636.31	(0.37)
50.00	194.50	(0.04)	113.00	471.66	(0.14)	176.00	632.00	(0.26)	239.00	631.42	(0.37)
51.00	196.00	(0.04)	114.00	475.71	(0.14)	177.00	633.56	(0.26)	240.00	622.55	(0.37)
52.00	196.70	(0.04)	115.00	479.67	(0.14)	178.00	635.22	(0.26)	241.00	624.01	(0.37)
53.00	198.03	(0.04)	116.00	483.54	(0.14)	179.00	636.98	(0.27)	242.00	625.33	(0.37)
54.00	199.29	(0.04)	117.00	487.36	(0.14)	180.00	638.80	(0.27)	243.00	628.04	(0.37)
55.00	200.51	(0.04)	118.00	491.14	(0.15)	181.00	640.62	(0.27)	244.00	633.31	(0.37)
56.00	203.31	(0.04)	119.00	494.88	(0.15)	182.00	642.37	(0.27)	245.00	638.03	(0.37)
57.00	206.58	(0.04)	120.00	498.61	(0.15)	183.00	643.95	(0.27)	246.00	642.26	(0.37)
58.00	210.00	(0.04)	121.00	502.35	(0.15)	184.00	645.36	(0.28)	247.00	646.19	(0.37)
59.00	213.61	(0.05)	122.00	506.06	(0.15)	185.00	646.52	(0.28)	248.00	647.71	(0.37)
60.00	221.01	(0.05)	123.00	509.68	(0.16)	186.00	647.45	(0.28)	249.00	650.64	(0.37)
61.00	228.47	(0.05)	124.00	513.18	(0.16)	187.00	648.17	(0.28)	250.00	656.37	(0.38)
62.00	232.18	(0.05)	125.00	516.54	(0.16)	188.00	648.89	(0.28)			
63.00	239.56	(0.05)	126.00	519.78	(0.16)	189.00	649.67	(0.29)			

Table 16. Settlement Vs load intensity table with skirt height 5.0m & dia. 5.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	2.33	(0.00)	64.00	306.01	(0.07)	127.00	521.28	(0.17)	190.00	621.31	(0.24)
2.00	3.40	(0.00)	65.00	308.63	(0.07)	128.00	525.07	(0.17)	191.00	622.54	(0.24)
3.00	5.46	(0.00)	66.00	311.24	(0.08)	129.00	528.87	(0.17)	192.00	623.87	(0.24)
4.00	9.31	(0.00)	67.00	313.85	(0.08)	130.00	530.76	(0.17)	193.00	624.63	(0.25)
5.00	10.95	(0.00)	68.00	316.46	(0.08)	131.00	534.56	(0.17)	194.00	626.18	(0.25)
6.00	13.91	(0.00)	69.00	319.08	(0.08)	132.00	536.43	(0.17)	195.00	627.72	(0.25)
7.00	16.84	(0.00)	70.00	321.77	(0.08)	133.00	538.29	(0.18)	196.00	629.20	(0.25)
8.00	19.79	(0.00)	71.00	324.59	(0.08)	134.00	540.12	(0.18)	197.00	630.59	(0.25)
9.00	22.86	(0.00)	72.00	327.52	(0.08)	135.00	541.91	(0.18)	198.00	631.89	(0.25)
10.00	26.03	(0.00)	73.00	330.47	(0.08)	136.00	545.38	(0.18)	199.00	633.12	(0.25)
11.00	29.33	(0.00)	74.00	331.95	(0.08)	137.00	548.68	(0.18)	200.00	634.32	(0.25)
12.00	31.01	(0.00)	75.00	334.92	(0.08)	138.00	551.82	(0.18)	201.00	635.53	(0.25)
13.00	32.68	(0.01)	76.00	337.82	(0.09)	139.00	553.24	(0.19)	202.00	637.94	(0.26)
14.00	36.00	(0.01)	77.00	343.50	(0.09)	140.00	554.64	(0.19)	203.00	640.20	(0.26)
15.00	39.10	(0.01)	78.00	346.28	(0.09)	141.00	557.37	(0.19)	204.00	641.20	(0.26)
16.00	45.18	(0.01)	79.00	349.02	(0.09)	142.00	558.71	(0.19)	205.00	642.14	(0.26)
17.00	51.06	(0.01)	80.00	350.32	(0.09)	143.00	561.38	(0.19)	206.00	642.60	(0.26)
18.00	56.77	(0.01)	81.00	351.58	(0.09)	144.00	562.72	(0.19)	207.00	643.04	(0.26)
19.00	67.78	(0.01)	82.00	352.75	(0.09)	145.00	564.04	(0.19)	208.00	643.78	(0.26)
20.00	73.10	(0.01)	83.00	353.85	(0.09)	146.00	565.42	(0.19)	209.00	644.33	(0.26)
21.00	78.39	(0.01)	84.00	354.92	(0.09)	147.00	566.88	(0.20)	210.00	644.45	(0.26)
22.00	83.67	(0.01)	85.00	357.06	(0.09)	148.00	568.47	(0.20)	211.00	644.25	(0.26)
23.00	88.84	(0.02)	86.00	358.24	(0.09)	149.00	570.12	(0.20)	212.00	643.69	(0.27)
24.00	93.92	(0.02)	87.00	359.54	(0.09)	150.00	573.47	(0.20)	213.00	643.23	(0.27)
25.00	98.92	(0.02)	88.00	360.98	(0.09)	151.00	575.10	(0.20)	214.00	643.19	(0.27)
26.00	108.78	(0.02)	89.00	364.05	(0.10)	152.00	576.72	(0.20)	215.00	643.63	(0.27)
27.00	118.40	(0.02)	90.00	367.09	(0.10)	153.00	577.46	(0.20)	216.00	644.37	(0.27)
28.00	127.82	(0.02)	91.00	370.02	(0.10)	154.00	578.87	(0.20)	217.00	645.30	(0.27)
29.00	137.10	(0.03)	92.00	372.85	(0.10)	155.00	580.23	(0.20)	218.00	646.40	(0.27)
30.00	146.30	(0.03)	93.00	375.63	(0.10)	156.00	581.62	(0.21)	219.00	647.63	(0.27)
31.00	155.40	(0.03)	94.00	381.06	(0.10)	157.00	582.92	(0.21)	220.00	649.00	(0.27)
32.00	159.86	(0.03)	95.00	386.37	(0.10)	158.00	583.97	(0.21)	221.00	650.46	(0.27)
33.00	168.62	(0.03)	96.00	388.94	(0.10)	159.00	584.75	(0.21)	222.00	651.99	(0.28)
34.00	172.91	(0.03)	97.00	391.44	(0.11)	160.00	585.50	(0.21)	223.00	653.54	(0.28)
35.00	181.41	(0.04)	98.00	393.83	(0.11)	161.00	586.26	(0.21)	224.00	654.28	(0.28)
36.00	189.78	(0.04)	99.00	396.17	(0.11)	162.00	587.10	(0.21)	225.00	655.00	(0.28)
37.00	197.97	(0.04)	100.00	398.49	(0.11)	163.00	589.22	(0.21)	226.00	656.25	(0.28)
38.00	206.09	(0.04)	101.00	403.14	(0.11)	164.00	590.62	(0.21)	227.00	657.30	(0.28)
39.00	210.20	(0.04)	102.00	407.83	(0.11)	165.00	592.11	(0.22)	228.00	658.27	(0.28)
40.00	214.31	(0.04)	103.00	410.19	(0.11)	166.00	593.66	(0.22)	229.00	659.25	(0.28)
41.00	216.38	(0.04)	104.00	414.95	(0.12)	167.00	595.29	(0.22)	230.00	660.23	(0.28)
42.00	220.47	(0.05)	105.00	419.74	(0.12)	168.00	596.96	(0.22)	231.00	661.23	(0.28)
43.00	224.40	(0.05)	106.00	424.55	(0.12)	169.00	598.63	(0.22)	232.00	662.36	(0.28)
44.00	228.19	(0.05)	107.00	429.34	(0.12)	170.00	600.28	(0.22)	233.00	663.15	(0.29)
45.00	231.82	(0.05)	108.00	434.14	(0.12)	171.00	601.88	(0.22)	234.00	664.04	(0.29)
46.00	235.22	(0.05)	109.00	438.95	(0.13)	172.00	603.45	(0.22)	235.00	664.86	(0.29)
47.00	238.56	(0.05)	110.00	443.77	(0.13)	173.00	604.96	(0.22)	236.00	665.46	(0.29)
48.00	241.88	(0.05)	111.00	448.57	(0.13)	174.00	606.38	(0.22)	237.00	665.92	(0.29)
49.00	245.14	(0.05)	112.00	458.16	(0.13)	175.00	609.07	(0.23)	238.00	666.22	(0.29)
50.00	248.38	(0.05)	113.00	467.60	(0.14)	176.00	611.56	(0.23)	239.00	666.38	(0.29)
51.00	251.61	(0.05)	114.00	472.10	(0.14)	177.00	612.66	(0.23)	240.00	666.45	(0.29)
52.00	254.81	(0.06)	115.00	476.44	(0.14)	178.00	613.67	(0.23)	241.00	666.55	(0.29)
53.00	261.17	(0.06)	116.00	480.56	(0.15)	179.00	614.16	(0.23)	242.00	666.58	(0.29)
54.00	267.42	(0.06)	117.00	484.62	(0.15)	180.00	615.08	(0.23)	243.00	666.53	(0.29)
55.00	273.67	(0.06)	118.00	488.63	(0.15)	181.00	615.91	(0.23)	244.00	666.31	(0.29)
56.00	279.93	(0.06)	119.00	492.62	(0.15)	182.00	616.70	(0.23)	245.00	665.97	(0.29)
57.00	286.16	(0.07)	120.00	496.56	(0.15)	183.00	617.38	(0.24)	246.00	665.58	(0.29)
58.00	289.21	(0.07)	121.00	500.47	(0.16)	184.00	617.58	(0.24)	247.00	665.23	(0.29)
59.00	292.23	(0.07)	122.00	504.33	(0.16)	185.00	617.78	(0.24)	248.00	664.94	(0.29)
60.00	295.15	(0.07)	123.00	508.14	(0.16)	186.00	618.07	(0.24)	249.00	664.81	(0.29)
61.00	297.98	(0.07)	124.00	511.92	(0.16)	187.00	618.53	(0.24)	250.00	665.01	(0.29)
62.00	300.74	(0.07)	125.00	515.66	(0.16)	188.00	619.24	(0.24)			
63.00	303.39	(0.07)	126.00	517.52	(0.16)	189.00	620.20	(0.24)			

Table 17. Settlement Vs load intensity table with skirt height 1.0m & dia. 6.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	17.65	(0.00)	64.00	377.34	(0.09)	127.00	443.85	(0.22)
2.00	31.95	(0.00)	65.00	382.09	(0.10)	128.00	443.87	(0.23)
3.00	37.62	(0.01)	66.00	386.75	(0.10)	129.00	443.93	(0.24)
4.00	40.25	(0.01)	67.00	391.39	(0.10)	130.00	444.09	(0.24)
5.00	42.82	(0.01)	68.00	396.12	(0.10)	131.00	444.38	(0.25)
6.00	45.60	(0.01)	69.00	400.93	(0.11)	132.00	444.80	(0.26)
7.00	51.56	(0.01)	70.00	405.74	(0.11)	133.00	445.31	(0.27)
8.00	57.86	(0.01)	71.00	410.54	(0.11)	134.00	445.92	(0.28)
9.00	64.22	(0.01)	72.00	415.32	(0.11)	135.00	446.60	(0.29)
10.00	70.55	(0.01)	73.00	420.03	(0.11)	136.00	446.97	(0.29)
11.00	76.74	(0.01)	74.00	422.26	(0.11)	137.00	447.74	(0.30)
12.00	79.73	(0.01)	75.00	426.50	(0.12)	138.00	448.52	(0.31)
13.00	82.61	(0.01)	76.00	428.37	(0.12)	139.00	449.29	(0.32)
14.00	88.07	(0.01)	77.00	430.10	(0.12)	140.00	450.01	(0.32)
15.00	93.43	(0.02)	78.00	431.69	(0.12)	141.00	451.29	(0.34)
16.00	98.75	(0.02)	79.00	433.24	(0.12)	142.00	452.43	(0.36)
17.00	104.10	(0.02)	80.00	434.80	(0.12)	143.00	453.41	(0.37)
18.00	109.53	(0.02)	81.00	436.37	(0.12)	144.00	454.26	(0.39)
19.00	114.96	(0.02)	82.00	437.93	(0.12)	145.00	454.59	(0.40)
20.00	120.32	(0.02)	83.00	439.53	(0.13)	146.00	455.09	(0.42)
21.00	125.67	(0.02)	84.00	441.16	(0.13)	147.00	455.54	(0.43)
22.00	131.04	(0.02)	85.00	442.75	(0.13)	148.00	455.98	(0.45)
23.00	136.41	(0.02)	86.00	444.13	(0.13)	149.00	456.43	(0.47)
24.00	141.74	(0.02)	87.00	444.57	(0.13)	150.00	456.64	(0.47)
25.00	147.04	(0.03)	88.00	444.87	(0.13)	151.00	457.07	(0.49)
26.00	149.62	(0.03)	89.00	445.11	(0.13)	152.00	457.59	(0.51)
27.00	154.56	(0.03)	90.00	445.30	(0.13)	153.00	458.22	(0.53)
28.00	159.19	(0.03)	91.00	445.50	(0.13)	154.00	458.61	(0.53)
29.00	163.73	(0.03)	92.00	445.85	(0.13)	155.00	459.47	(0.55)
30.00	168.36	(0.03)	93.00	446.39	(0.13)	156.00	460.45	(0.57)
31.00	172.95	(0.03)	94.00	447.04	(0.13)	157.00	461.48	(0.58)
32.00	177.38	(0.03)	95.00	447.73	(0.13)	158.00	462.56	(0.60)
33.00	181.69	(0.03)	96.00	448.38	(0.13)	159.00	463.66	(0.62)
34.00	190.12	(0.04)	97.00	448.87	(0.13)	160.00	464.76	(0.63)
35.00	198.02	(0.04)	98.00	449.20	(0.13)	161.00	465.86	(0.65)
36.00	205.65	(0.04)	99.00	449.57	(0.14)	162.00	468.17	(0.69)
37.00	209.38	(0.04)	100.00	449.63	(0.14)	163.00	470.47	(0.72)
38.00	216.79	(0.04)	101.00	449.62	(0.14)	164.00	472.74	(0.75)
39.00	220.53	(0.04)	102.00	449.37	(0.14)	165.00	473.81	(0.77)
40.00	228.01	(0.05)	103.00	449.06	(0.14)	166.00	475.99	(0.80)
41.00	235.58	(0.05)	104.00	448.74	(0.14)	167.00	477.02	(0.82)
42.00	243.24	(0.05)	105.00	448.46	(0.14)	168.00	478.03	(0.84)
43.00	250.85	(0.05)	106.00	448.26	(0.14)	169.00	478.48	(0.85)
44.00	258.44	(0.05)	107.00	448.15	(0.14)	170.00	479.37	(0.86)
45.00	266.00	(0.06)	108.00	448.06	(0.14)	171.00	480.24	(0.88)
46.00	269.75	(0.06)	109.00	447.96	(0.15)	172.00	481.08	(0.90)
47.00	273.49	(0.06)	110.00	447.84	(0.15)	173.00	481.28	(0.90)
48.00	280.82	(0.06)	111.00	447.67	(0.15)			
49.00	287.92	(0.06)	112.00	447.47	(0.15)			
50.00	294.83	(0.07)	113.00	446.97	(0.15)			
51.00	308.43	(0.07)	114.00	446.43	(0.15)			
52.00	315.01	(0.07)	115.00	445.90	(0.16)			
53.00	321.33	(0.07)	116.00	445.40	(0.16)			
54.00	324.30	(0.07)	117.00	444.97	(0.16)			
55.00	330.15	(0.08)	118.00	444.31	(0.16)			
56.00	335.83	(0.08)	119.00	443.95	(0.17)			
57.00	341.53	(0.08)	120.00	443.77	(0.17)			
58.00	347.26	(0.08)	121.00	443.70	(0.18)			
59.00	353.00	(0.09)	122.00	443.71	(0.18)			
60.00	358.64	(0.09)	123.00	443.81	(0.19)			
61.00	364.23	(0.09)	124.00	443.82	(0.19)			
62.00	369.73	(0.09)	125.00	443.84	(0.20)			
63.00	372.35	(0.09)	126.00	443.84	(0.21)			

Table 18. Settlement Vs load intensity table with skirt height 2.0m & dia. 6.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	9.05	(0.00)	64.00	282.36	(0.06)	127.00	446.85	(0.13)	190.00	492.33	(0.16)
2.00	24.54	(0.00)	65.00	285.81	(0.06)	128.00	447.83	(0.13)	191.00	493.65	(0.16)
3.00	30.84	(0.00)	66.00	289.17	(0.06)	129.00	448.48	(0.13)	192.00	494.20	(0.16)
4.00	32.79	(0.00)	67.00	295.69	(0.07)	130.00	448.81	(0.13)	193.00	495.19	(0.17)
5.00	33.54	(0.01)	68.00	298.91	(0.07)	131.00	448.87	(0.13)	194.00	495.50	(0.17)
6.00	33.72	(0.01)	69.00	302.14	(0.07)	132.00	448.95	(0.13)	195.00	495.65	(0.17)
7.00	33.89	(0.01)	70.00	303.74	(0.07)	133.00	449.22	(0.13)	196.00	495.66	(0.17)
8.00	34.17	(0.01)	71.00	306.86	(0.07)	134.00	449.85	(0.13)	197.00	495.46	(0.17)
9.00	34.40	(0.01)	72.00	308.42	(0.07)	135.00	450.98	(0.13)	198.00	494.98	(0.17)
10.00	34.90	(0.01)	73.00	309.97	(0.07)	136.00	452.30	(0.13)	199.00	494.57	(0.17)
11.00	35.45	(0.01)	74.00	311.54	(0.07)	137.00	454.98	(0.13)	200.00	493.68	(0.17)
12.00	36.79	(0.01)	75.00	313.13	(0.07)	138.00	457.55	(0.14)	201.00	492.67	(0.17)
13.00	39.71	(0.01)	76.00	316.32	(0.07)	139.00	458.80	(0.14)	202.00	491.58	(0.17)
14.00	42.68	(0.01)	77.00	317.86	(0.07)	140.00	460.02	(0.14)	203.00	490.45	(0.17)
15.00	45.69	(0.01)	78.00	319.28	(0.07)	141.00	461.29	(0.14)	204.00	489.34	(0.17)
16.00	51.80	(0.01)	79.00	320.59	(0.08)	142.00	462.52	(0.14)	205.00	488.43	(0.17)
17.00	57.90	(0.01)	80.00	321.78	(0.08)	143.00	463.66	(0.14)	206.00	487.83	(0.17)
18.00	63.99	(0.01)	81.00	324.02	(0.08)	144.00	464.62	(0.14)	207.00	487.95	(0.17)
19.00	70.05	(0.01)	82.00	325.13	(0.08)	145.00	465.12	(0.14)	208.00	488.46	(0.17)
20.00	76.02	(0.01)	83.00	326.21	(0.08)	146.00	465.11	(0.14)	209.00	489.34	(0.17)
21.00	78.93	(0.01)	84.00	327.27	(0.08)	147.00	464.97	(0.14)	210.00	491.39	(0.17)
22.00	81.79	(0.01)	85.00	329.37	(0.08)	148.00	464.76	(0.14)	211.00	492.21	(0.17)
23.00	84.64	(0.01)	86.00	331.62	(0.08)	149.00	464.52	(0.14)	212.00	493.43	(0.18)
24.00	87.36	(0.02)	87.00	334.04	(0.08)	150.00	464.87	(0.14)	213.00	493.29	(0.18)
25.00	92.54	(0.02)	88.00	336.51	(0.08)	151.00	465.38	(0.14)	214.00	492.70	(0.18)
26.00	97.63	(0.02)	89.00	339.04	(0.08)	152.00	466.53	(0.14)	215.00	491.72	(0.18)
27.00	102.85	(0.02)	90.00	341.59	(0.09)	153.00	467.80	(0.14)	216.00	491.07	(0.18)
28.00	108.12	(0.02)	91.00	346.70	(0.09)	154.00	469.06	(0.14)	217.00	490.30	(0.18)
29.00	113.43	(0.02)	92.00	351.77	(0.09)	155.00	470.28	(0.14)	218.00	488.71	(0.18)
30.00	118.74	(0.02)	93.00	356.83	(0.09)	156.00	471.50	(0.14)	219.00	487.70	(0.18)
31.00	124.00	(0.02)	94.00	359.33	(0.09)	157.00	472.71	(0.14)	220.00	487.64	(0.18)
32.00	126.61	(0.02)	95.00	364.34	(0.09)	158.00	473.86	(0.15)	221.00	488.26	(0.18)
33.00	129.26	(0.02)	96.00	366.90	(0.10)	159.00	474.98	(0.15)	222.00	489.25	(0.18)
34.00	134.46	(0.02)	97.00	369.51	(0.10)	160.00	476.01	(0.15)	223.00	490.45	(0.18)
35.00	139.58	(0.03)	98.00	372.14	(0.10)	161.00	476.86	(0.15)	224.00	491.65	(0.18)
36.00	144.68	(0.03)	99.00	374.76	(0.10)	162.00	477.54	(0.15)	225.00	492.69	(0.18)
37.00	149.78	(0.03)	100.00	377.34	(0.10)	163.00	477.81	(0.15)	226.00	493.20	(0.18)
38.00	159.94	(0.03)	101.00	382.33	(0.10)	164.00	477.76	(0.15)	227.00	493.13	(0.18)
39.00	164.82	(0.03)	102.00	387.35	(0.10)	165.00	477.60	(0.15)	228.00	492.51	(0.18)
40.00	169.36	(0.03)	103.00	392.36	(0.11)	166.00	477.30	(0.15)	229.00	491.59	(0.18)
41.00	173.27	(0.03)	104.00	397.23	(0.11)	167.00	477.29	(0.15)	230.00	490.56	(0.18)
42.00	177.04	(0.03)	105.00	401.97	(0.11)	168.00	477.86	(0.15)	231.00	489.44	(0.19)
43.00	180.83	(0.04)	106.00	404.27	(0.11)	169.00	478.92	(0.15)	232.00	488.36	(0.19)
44.00	184.70	(0.04)	107.00	406.64	(0.11)	170.00	480.06	(0.15)	233.00	487.51	(0.19)
45.00	188.75	(0.04)	108.00	407.96	(0.11)	171.00	481.26	(0.15)	234.00	487.12	(0.19)
46.00	192.91	(0.04)	109.00	409.36	(0.11)	172.00	483.61	(0.15)	235.00	487.19	(0.19)
47.00	197.09	(0.04)	110.00	412.11	(0.11)	173.00	484.78	(0.15)	236.00	487.76	(0.19)
48.00	205.39	(0.04)	111.00	414.67	(0.12)	174.00	485.92	(0.15)	237.00	488.60	(0.19)
49.00	213.57	(0.04)	112.00	417.13	(0.12)	175.00	486.94	(0.15)	238.00	489.68	(0.19)
50.00	221.66	(0.05)	113.00	418.32	(0.12)	176.00	487.86	(0.15)	239.00	490.84	(0.19)
51.00	229.61	(0.05)	114.00	420.71	(0.12)	177.00	488.49	(0.16)	240.00	491.99	(0.19)
52.00	233.53	(0.05)	115.00	423.13	(0.12)	178.00	488.85	(0.16)	241.00	492.98	(0.19)
53.00	241.40	(0.05)	116.00	424.46	(0.12)	179.00	488.86	(0.16)	242.00	493.53	(0.19)
54.00	245.39	(0.05)	117.00	427.10	(0.12)	180.00	488.67	(0.16)	243.00	493.41	(0.19)
55.00	249.38	(0.05)	118.00	429.77	(0.12)	181.00	488.19	(0.16)	244.00	493.07	(0.19)
56.00	253.27	(0.05)	119.00	431.16	(0.12)	182.00	487.82	(0.16)	245.00	492.54	(0.19)
57.00	257.03	(0.06)	120.00	434.05	(0.12)	183.00	487.63	(0.16)	246.00	491.84	(0.19)
58.00	260.69	(0.06)	121.00	436.84	(0.12)	184.00	487.63	(0.16)	247.00	490.13	(0.19)
59.00	264.27	(0.06)	122.00	439.53	(0.13)	185.00	487.83	(0.16)	248.00	489.29	(0.19)
60.00	267.89	(0.06)	123.00	442.06	(0.13)	186.00	488.36	(0.16)	249.00	487.73	(0.19)
61.00	271.54	(0.06)	124.00	443.27	(0.13)	187.00	489.12	(0.16)	250.00	487.37	(0.19)
62.00	275.19	(0.06)	125.00	444.45	(0.13)	188.00	489.93	(0.16)			
63.00	278.82	(0.06)	126.00	445.67	(0.13)	189.00	490.76	(0.16)			

Table 19. Settlement Vs load intensity table with skirt height 3.0m & dia. 6.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	8.97	(0.00)	64.00	285.15	(0.06)	127.00	439.71	(0.13)	190.00	502.96	(0.17)
2.00	12.82	(0.00)	65.00	288.76	(0.07)	128.00	440.63	(0.13)	191.00	502.95	(0.17)
3.00	20.24	(0.00)	66.00	292.33	(0.07)	129.00	441.64	(0.13)	192.00	503.08	(0.17)
4.00	26.43	(0.00)	67.00	295.87	(0.07)	130.00	442.59	(0.13)	193.00	503.43	(0.17)
5.00	29.12	(0.00)	68.00	297.65	(0.07)	131.00	443.02	(0.13)	194.00	504.18	(0.17)
6.00	30.34	(0.00)	69.00	298.27	(0.07)	132.00	443.47	(0.13)	195.00	505.15	(0.17)
7.00	32.78	(0.01)	70.00	298.12	(0.07)	133.00	443.93	(0.13)	196.00	506.22	(0.17)
8.00	34.14	(0.01)	71.00	297.68	(0.07)	134.00	444.76	(0.13)	197.00	507.38	(0.17)
9.00	35.45	(0.01)	72.00	297.22	(0.07)	135.00	445.58	(0.13)	198.00	508.55	(0.17)
10.00	36.74	(0.01)	73.00	297.08	(0.07)	136.00	446.45	(0.13)	199.00	509.73	(0.17)
11.00	39.25	(0.01)	74.00	296.86	(0.07)	137.00	447.38	(0.13)	200.00	510.97	(0.17)
12.00	41.75	(0.01)	75.00	296.88	(0.07)	138.00	448.24	(0.13)	201.00	512.25	(0.17)
13.00	44.43	(0.01)	76.00	297.15	(0.07)	139.00	449.03	(0.13)	202.00	513.50	(0.17)
14.00	47.32	(0.01)	77.00	297.56	(0.07)	140.00	449.91	(0.14)	203.00	514.60	(0.17)
15.00	50.34	(0.01)	78.00	298.10	(0.07)	141.00	450.92	(0.14)	204.00	515.54	(0.17)
16.00	56.55	(0.01)	79.00	298.67	(0.07)	142.00	452.18	(0.14)	205.00	516.20	(0.17)
17.00	68.96	(0.01)	80.00	299.91	(0.07)	143.00	454.92	(0.14)	206.00	516.28	(0.18)
18.00	75.05	(0.01)	81.00	301.26	(0.07)	144.00	457.67	(0.14)	207.00	515.92	(0.18)
19.00	80.99	(0.01)	82.00	302.72	(0.07)	145.00	460.47	(0.14)	208.00	515.63	(0.18)
20.00	83.77	(0.01)	83.00	305.78	(0.07)	146.00	463.31	(0.14)	209.00	515.04	(0.18)
21.00	89.13	(0.02)	84.00	308.88	(0.08)	147.00	466.15	(0.14)	210.00	515.01	(0.18)
22.00	99.56	(0.02)	85.00	311.95	(0.08)	148.00	468.94	(0.14)	211.00	515.10	(0.18)
23.00	104.61	(0.02)	86.00	315.07	(0.08)	149.00	471.61	(0.14)	212.00	515.66	(0.18)
24.00	107.08	(0.02)	87.00	318.19	(0.08)	150.00	472.81	(0.14)	213.00	516.49	(0.18)
25.00	109.58	(0.02)	88.00	321.32	(0.08)	151.00	473.84	(0.15)	214.00	517.47	(0.18)
26.00	112.21	(0.02)	89.00	327.55	(0.08)	152.00	474.71	(0.15)	215.00	518.54	(0.18)
27.00	117.54	(0.02)	90.00	333.61	(0.08)	153.00	475.41	(0.15)	216.00	519.65	(0.18)
28.00	123.00	(0.02)	91.00	339.49	(0.09)	154.00	476.31	(0.15)	217.00	520.81	(0.18)
29.00	128.50	(0.02)	92.00	345.21	(0.09)	155.00	476.44	(0.15)	218.00	522.03	(0.18)
30.00	133.89	(0.02)	93.00	350.70	(0.09)	156.00	476.50	(0.15)	219.00	523.28	(0.18)
31.00	144.33	(0.03)	94.00	353.28	(0.09)	157.00	476.61	(0.15)	220.00	524.49	(0.18)
32.00	154.08	(0.03)	95.00	358.33	(0.09)	158.00	476.95	(0.15)	221.00	525.57	(0.18)
33.00	158.73	(0.03)	96.00	363.36	(0.10)	159.00	477.72	(0.15)	222.00	526.48	(0.18)
34.00	163.30	(0.03)	97.00	365.84	(0.10)	160.00	478.66	(0.15)	223.00	527.06	(0.18)
35.00	167.86	(0.03)	98.00	370.79	(0.10)	161.00	479.67	(0.15)	224.00	527.25	(0.18)
36.00	172.33	(0.03)	99.00	375.68	(0.10)	162.00	481.86	(0.15)	225.00	527.06	(0.19)
37.00	176.72	(0.03)	100.00	380.58	(0.10)	163.00	483.06	(0.15)	226.00	526.60	(0.19)
38.00	181.05	(0.04)	101.00	385.53	(0.10)	164.00	484.37	(0.15)	227.00	526.18	(0.19)
39.00	185.26	(0.04)	102.00	390.51	(0.11)	165.00	485.77	(0.15)	228.00	525.96	(0.19)
40.00	189.25	(0.04)	103.00	393.00	(0.11)	166.00	487.17	(0.15)	229.00	526.14	(0.19)
41.00	193.17	(0.04)	104.00	397.94	(0.11)	167.00	488.50	(0.15)	230.00	526.58	(0.19)
42.00	200.98	(0.04)	105.00	400.42	(0.11)	168.00	489.66	(0.16)	231.00	527.23	(0.19)
43.00	208.94	(0.04)	106.00	402.83	(0.11)	169.00	490.54	(0.16)	232.00	528.01	(0.19)
44.00	212.92	(0.04)	107.00	407.59	(0.11)	170.00	491.06	(0.16)	233.00	528.87	(0.19)
45.00	216.90	(0.04)	108.00	410.04	(0.12)	171.00	491.05	(0.16)	234.00	529.79	(0.19)
46.00	218.88	(0.05)	109.00	412.52	(0.12)	172.00	490.89	(0.16)	235.00	530.74	(0.19)
47.00	222.71	(0.05)	110.00	413.77	(0.12)	173.00	490.50	(0.16)	236.00	531.76	(0.19)
48.00	230.08	(0.05)	111.00	416.31	(0.12)	174.00	490.41	(0.16)	237.00	532.84	(0.19)
49.00	233.98	(0.05)	112.00	418.85	(0.12)	175.00	490.67	(0.16)	238.00	533.97	(0.19)
50.00	241.80	(0.05)	113.00	421.39	(0.12)	176.00	491.41	(0.16)	239.00	535.12	(0.19)
51.00	245.63	(0.05)	114.00	423.98	(0.12)	177.00	492.33	(0.16)	240.00	536.23	(0.19)
52.00	249.39	(0.05)	115.00	426.58	(0.12)	178.00	493.36	(0.16)	241.00	537.18	(0.19)
53.00	252.93	(0.05)	116.00	429.18	(0.12)	179.00	494.48	(0.16)	242.00	537.84	(0.19)
54.00	254.64	(0.06)	117.00	431.76	(0.12)	180.00	495.68	(0.16)	243.00	538.22	(0.19)
55.00	258.02	(0.06)	118.00	433.06	(0.13)	181.00	496.96	(0.16)	244.00	538.18	(0.20)
56.00	261.41	(0.06)	119.00	435.69	(0.13)	182.00	498.18	(0.16)	245.00	537.92	(0.20)
57.00	263.14	(0.06)	120.00	436.94	(0.13)	183.00	499.32	(0.16)	246.00	537.26	(0.20)
58.00	266.57	(0.06)	121.00	438.12	(0.13)	184.00	501.24	(0.16)	247.00	536.77	(0.20)
59.00	269.87	(0.06)	122.00	438.51	(0.13)	185.00	502.00	(0.16)	248.00	536.57	(0.20)
60.00	273.17	(0.06)	123.00	438.65	(0.13)	186.00	502.54	(0.16)	249.00	536.80	(0.20)
61.00	276.48	(0.06)	124.00	438.67	(0.13)	187.00	502.84	(0.17)	250.00	537.25	(0.20)
62.00	279.80	(0.06)	125.00	438.74	(0.13)	188.00	502.95	(0.17)			
63.00	281.58	(0.06)	126.00	439.01	(0.13)	189.00	502.98	(0.17)			

Table 20. Settlement Vs load intensity table with skirt height 4.0m & dia. 6.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	4.59	(0.00)	64.00	201.90	(0.04)	127.00	442.61	(0.12)	190.00	581.22	(0.21)
2.00	6.68	(0.00)	65.00	205.85	(0.04)	128.00	445.25	(0.12)	191.00	581.37	(0.21)
3.00	6.83	(0.00)	66.00	209.54	(0.04)	129.00	447.87	(0.13)	192.00	581.59	(0.21)
4.00	7.22	(0.00)	67.00	213.12	(0.04)	130.00	450.47	(0.13)	193.00	581.85	(0.21)
5.00	7.54	(0.00)	68.00	216.76	(0.04)	131.00	453.02	(0.13)	194.00	582.17	(0.21)
6.00	8.13	(0.00)	69.00	220.56	(0.04)	132.00	455.46	(0.13)	195.00	582.61	(0.22)
7.00	9.18	(0.00)	70.00	224.45	(0.05)	133.00	456.60	(0.13)	196.00	582.61	(0.22)
8.00	10.01	(0.00)	71.00	228.43	(0.05)	134.00	458.76	(0.13)	197.00	582.38	(0.22)
9.00	11.72	(0.00)	72.00	232.47	(0.05)	135.00	460.84	(0.13)	198.00	581.82	(0.22)
10.00	11.97	(0.00)	73.00	236.51	(0.05)	136.00	462.83	(0.13)	199.00	581.06	(0.22)
11.00	12.43	(0.00)	74.00	244.35	(0.05)	137.00	464.73	(0.13)	200.00	580.01	(0.22)
12.00	12.68	(0.00)	75.00	251.94	(0.05)	138.00	466.53	(0.13)	201.00	576.98	(0.22)
13.00	13.14	(0.00)	76.00	259.31	(0.05)	139.00	467.39	(0.13)	202.00	573.32	(0.22)
14.00	14.03	(0.00)	77.00	266.56	(0.06)	140.00	468.24	(0.14)	203.00	569.21	(0.22)
15.00	15.79	(0.00)	78.00	273.73	(0.06)	141.00	469.05	(0.14)	204.00	564.90	(0.22)
16.00	15.85	(0.00)	79.00	280.90	(0.06)	142.00	470.68	(0.14)	205.00	560.61	(0.22)
17.00	16.06	(0.00)	80.00	288.07	(0.06)	143.00	472.55	(0.14)	206.00	556.74	(0.22)
18.00	16.18	(0.00)	81.00	295.23	(0.07)	144.00	474.68	(0.14)	207.00	553.27	(0.23)
19.00	16.42	(0.00)	82.00	302.38	(0.07)	145.00	476.86	(0.14)	208.00	550.45	(0.23)
20.00	16.90	(0.00)	83.00	305.94	(0.07)	146.00	479.13	(0.14)	209.00	549.93	(0.23)
21.00	17.82	(0.00)	84.00	309.51	(0.07)	147.00	481.46	(0.14)	210.00	551.06	(0.23)
22.00	19.61	(0.00)	85.00	316.49	(0.07)	148.00	483.83	(0.14)	211.00	553.30	(0.23)
23.00	19.98	(0.00)	86.00	323.13	(0.07)	149.00	486.19	(0.14)	212.00	557.89	(0.23)
24.00	20.71	(0.00)	87.00	329.48	(0.08)	150.00	488.53	(0.15)	213.00	566.75	(0.23)
25.00	22.27	(0.00)	88.00	335.68	(0.08)	151.00	490.85	(0.15)	214.00	569.94	(0.23)
26.00	23.96	(0.00)	89.00	341.83	(0.08)	152.00	493.08	(0.15)	215.00	570.85	(0.23)
27.00	27.36	(0.00)	90.00	348.00	(0.08)	153.00	495.19	(0.15)	216.00	572.48	(0.23)
28.00	34.11	(0.00)	91.00	351.01	(0.08)	154.00	497.16	(0.15)	217.00	575.34	(0.23)
29.00	36.92	(0.01)	92.00	356.82	(0.09)	155.00	498.93	(0.15)	218.00	579.87	(0.23)
30.00	37.89	(0.01)	93.00	359.56	(0.09)	156.00	500.59	(0.15)	219.00	580.69	(0.23)
31.00	39.87	(0.01)	94.00	362.23	(0.09)	157.00	503.75	(0.15)	220.00	581.15	(0.24)
32.00	41.21	(0.01)	95.00	364.88	(0.09)	158.00	506.84	(0.16)	221.00	581.30	(0.24)
33.00	44.01	(0.01)	96.00	367.56	(0.09)	159.00	509.94	(0.16)	222.00	581.86	(0.24)
34.00	47.00	(0.01)	97.00	373.01	(0.09)	160.00	513.13	(0.16)	223.00	582.63	(0.24)
35.00	53.15	(0.01)	98.00	378.44	(0.09)	161.00	514.84	(0.16)	224.00	583.29	(0.24)
36.00	59.33	(0.01)	99.00	383.76	(0.10)	162.00	518.48	(0.16)	225.00	584.35	(0.24)
37.00	65.47	(0.01)	100.00	389.07	(0.10)	163.00	520.40	(0.16)	226.00	585.50	(0.24)
38.00	71.52	(0.01)	101.00	394.37	(0.10)	164.00	524.30	(0.17)	227.00	586.63	(0.24)
39.00	74.54	(0.01)	102.00	399.65	(0.10)	165.00	528.14	(0.17)	228.00	588.74	(0.24)
40.00	80.50	(0.01)	103.00	404.82	(0.10)	166.00	531.94	(0.17)	229.00	590.53	(0.24)
41.00	86.03	(0.01)	104.00	407.22	(0.11)	167.00	535.66	(0.17)	230.00	591.80	(0.25)
42.00	91.25	(0.02)	105.00	408.30	(0.11)	168.00	539.21	(0.17)	231.00	591.63	(0.25)
43.00	93.91	(0.02)	106.00	409.33	(0.11)	169.00	540.84	(0.18)	232.00	590.94	(0.25)
44.00	99.26	(0.02)	107.00	410.32	(0.11)	170.00	543.78	(0.18)	233.00	588.70	(0.25)
45.00	104.80	(0.02)	108.00	412.30	(0.11)	171.00	545.11	(0.18)	234.00	584.03	(0.25)
46.00	110.34	(0.02)	109.00	414.30	(0.11)	172.00	547.66	(0.18)	235.00	574.70	(0.25)
47.00	115.86	(0.02)	110.00	416.37	(0.11)	173.00	550.02	(0.18)	236.00	570.49	(0.25)
48.00	121.38	(0.02)	111.00	417.51	(0.11)	174.00	552.26	(0.19)	237.00	562.25	(0.25)
49.00	126.80	(0.02)	112.00	419.94	(0.11)	175.00	554.42	(0.19)	238.00	554.77	(0.25)
50.00	131.98	(0.02)	113.00	422.40	(0.11)	176.00	556.49	(0.19)	239.00	548.21	(0.25)
51.00	137.01	(0.02)	114.00	424.85	(0.11)	177.00	558.44	(0.19)	240.00	543.28	(0.25)
52.00	142.00	(0.03)	115.00	427.25	(0.11)	178.00	559.39	(0.19)	241.00	541.68	(0.25)
53.00	147.00	(0.03)	116.00	429.58	(0.12)	179.00	561.32	(0.19)	242.00	539.31	(0.25)
54.00	151.97	(0.03)	117.00	431.81	(0.12)	180.00	562.38	(0.20)	243.00	537.62	(0.25)
55.00	156.91	(0.03)	118.00	433.96	(0.12)	181.00	563.60	(0.20)	244.00	536.29	(0.25)
56.00	161.72	(0.03)	119.00	434.99	(0.12)	182.00	566.20	(0.20)	245.00	534.27	(0.25)
57.00	166.38	(0.03)	120.00	435.43	(0.12)	183.00	568.95	(0.20)	246.00	532.70	(0.25)
58.00	170.99	(0.03)	121.00	436.24	(0.12)	184.00	571.72	(0.20)	247.00	531.58	(0.25)
59.00	175.41	(0.03)	122.00	437.03	(0.12)	185.00	574.43	(0.21)	248.00	530.77	(0.25)
60.00	179.83	(0.03)	123.00	438.54	(0.12)	186.00	577.01	(0.21)	249.00	529.29	(0.25)
61.00	184.30	(0.03)	124.00	439.37	(0.12)	187.00	579.32	(0.21)	250.00	528.24	(0.25)
62.00	188.83	(0.04)	125.00	440.27	(0.12)	188.00	580.25	(0.21)			
63.00	193.32	(0.04)	126.00	441.35	(0.12)	189.00	581.01	(0.21)			

Table 21. Settlement Vs load intensity table with skirt height 5.0m & dia. 6.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	4.67	(0.00)	64.00	261.47	(0.06)	127.00	429.82	(0.12)	190.00	510.19	(0.17)
2.00	6.75	(0.00)	65.00	265.21	(0.06)	128.00	430.01	(0.12)	191.00	510.77	(0.17)
3.00	10.72	(0.00)	66.00	268.90	(0.06)	129.00	429.91	(0.12)	192.00	510.79	(0.17)
4.00	17.83	(0.00)	67.00	276.18	(0.06)	130.00	429.54	(0.12)	193.00	510.66	(0.17)
5.00	24.17	(0.00)	68.00	283.29	(0.06)	131.00	428.79	(0.12)	194.00	510.46	(0.17)
6.00	27.21	(0.00)	69.00	286.78	(0.07)	132.00	428.60	(0.12)	195.00	510.23	(0.17)
7.00	30.15	(0.00)	70.00	293.66	(0.07)	133.00	428.27	(0.13)	196.00	510.39	(0.17)
8.00	33.21	(0.01)	71.00	297.06	(0.07)	134.00	428.40	(0.13)	197.00	511.00	(0.17)
9.00	36.37	(0.01)	72.00	298.80	(0.07)	135.00	429.04	(0.13)	198.00	511.80	(0.17)
10.00	39.34	(0.01)	73.00	302.22	(0.07)	136.00	429.91	(0.13)	199.00	512.76	(0.17)
11.00	40.69	(0.01)	74.00	305.44	(0.07)	137.00	430.84	(0.13)	200.00	513.79	(0.17)
12.00	41.81	(0.01)	75.00	308.58	(0.07)	138.00	431.81	(0.13)	201.00	514.91	(0.17)
13.00	43.92	(0.01)	76.00	311.64	(0.07)	139.00	433.84	(0.13)	202.00	516.18	(0.17)
14.00	45.17	(0.01)	77.00	313.16	(0.07)	140.00	434.90	(0.13)	203.00	517.52	(0.18)
15.00	47.79	(0.01)	78.00	314.68	(0.08)	141.00	436.99	(0.13)	204.00	518.82	(0.18)
16.00	50.77	(0.01)	79.00	315.42	(0.08)	142.00	439.08	(0.13)	205.00	520.00	(0.18)
17.00	56.88	(0.01)	80.00	316.06	(0.08)	143.00	441.18	(0.13)	206.00	521.04	(0.18)
18.00	63.01	(0.01)	81.00	317.18	(0.08)	144.00	443.30	(0.13)	207.00	521.90	(0.18)
19.00	69.09	(0.01)	82.00	318.19	(0.08)	145.00	445.41	(0.13)	208.00	522.51	(0.18)
20.00	75.08	(0.01)	83.00	319.04	(0.08)	146.00	449.63	(0.14)	209.00	522.59	(0.18)
21.00	78.06	(0.01)	84.00	319.33	(0.08)	147.00	451.77	(0.14)	210.00	522.53	(0.18)
22.00	81.02	(0.01)	85.00	319.53	(0.08)	148.00	452.86	(0.14)	211.00	522.40	(0.18)
23.00	83.80	(0.01)	86.00	319.92	(0.08)	149.00	455.05	(0.14)	212.00	522.22	(0.18)
24.00	89.07	(0.02)	87.00	320.26	(0.08)	150.00	457.17	(0.14)	213.00	522.29	(0.18)
25.00	94.13	(0.02)	88.00	321.04	(0.08)	151.00	459.26	(0.14)	214.00	522.63	(0.18)
26.00	99.17	(0.02)	89.00	321.58	(0.08)	152.00	463.50	(0.14)	215.00	523.26	(0.18)
27.00	101.69	(0.02)	90.00	322.68	(0.08)	153.00	465.68	(0.14)	216.00	524.17	(0.18)
28.00	104.26	(0.02)	91.00	323.88	(0.08)	154.00	466.88	(0.15)	217.00	525.36	(0.18)
29.00	106.89	(0.02)	92.00	325.13	(0.08)	155.00	467.57	(0.15)	218.00	526.76	(0.18)
30.00	109.40	(0.02)	93.00	326.41	(0.08)	156.00	468.82	(0.15)	219.00	528.26	(0.18)
31.00	111.91	(0.02)	94.00	328.97	(0.08)	157.00	469.96	(0.15)	220.00	529.65	(0.18)
32.00	114.48	(0.02)	95.00	331.49	(0.08)	158.00	472.05	(0.15)	221.00	532.11	(0.18)
33.00	119.64	(0.02)	96.00	333.91	(0.08)	159.00	473.92	(0.15)	222.00	534.18	(0.19)
34.00	124.88	(0.02)	97.00	336.26	(0.09)	160.00	474.72	(0.15)	223.00	535.67	(0.19)
35.00	130.24	(0.02)	98.00	341.02	(0.09)	161.00	475.46	(0.15)	224.00	536.78	(0.19)
36.00	135.54	(0.03)	99.00	346.05	(0.09)	162.00	476.32	(0.15)	225.00	537.71	(0.19)
37.00	140.71	(0.03)	100.00	351.35	(0.09)	163.00	477.29	(0.15)	226.00	538.08	(0.19)
38.00	145.65	(0.03)	101.00	354.09	(0.09)	164.00	479.54	(0.15)	227.00	538.70	(0.19)
39.00	150.41	(0.03)	102.00	359.61	(0.10)	165.00	480.78	(0.15)	228.00	538.99	(0.19)
40.00	155.14	(0.03)	103.00	365.05	(0.10)	166.00	483.37	(0.15)	229.00	539.50	(0.19)
41.00	159.78	(0.03)	104.00	370.44	(0.10)	167.00	484.63	(0.15)	230.00	539.79	(0.19)
42.00	164.34	(0.03)	105.00	375.74	(0.10)	168.00	487.19	(0.16)	231.00	540.20	(0.19)
43.00	173.32	(0.03)	106.00	380.91	(0.10)	169.00	489.64	(0.16)	232.00	540.56	(0.20)
44.00	177.64	(0.04)	107.00	383.43	(0.11)	170.00	490.75	(0.16)	233.00	540.82	(0.20)
45.00	181.70	(0.04)	108.00	384.78	(0.11)	171.00	491.77	(0.16)	234.00	540.93	(0.20)
46.00	185.61	(0.04)	109.00	385.60	(0.11)	172.00	492.71	(0.16)	235.00	541.04	(0.20)
47.00	189.46	(0.04)	110.00	387.25	(0.11)	173.00	494.46	(0.16)	236.00	541.17	(0.20)
48.00	193.25	(0.04)	111.00	388.89	(0.11)	174.00	495.31	(0.16)	237.00	541.34	(0.20)
49.00	197.00	(0.04)	112.00	390.45	(0.11)	175.00	496.85	(0.16)	238.00	542.05	(0.20)
50.00	200.65	(0.04)	113.00	393.36	(0.11)	176.00	497.54	(0.16)	239.00	542.79	(0.20)
51.00	204.24	(0.04)	114.00	396.20	(0.11)	177.00	498.15	(0.16)	240.00	544.61	(0.20)
52.00	207.83	(0.04)	115.00	397.73	(0.11)	178.00	498.64	(0.16)	241.00	546.75	(0.20)
53.00	211.45	(0.04)	116.00	400.94	(0.11)	179.00	499.16	(0.16)	242.00	548.97	(0.20)
54.00	215.15	(0.05)	117.00	404.20	(0.11)	180.00	499.73	(0.16)	243.00	551.18	(0.20)
55.00	218.92	(0.05)	118.00	407.42	(0.11)	181.00	500.35	(0.16)	244.00	553.31	(0.21)
56.00	222.85	(0.05)	119.00	410.50	(0.11)	182.00	501.09	(0.16)	245.00	555.13	(0.21)
57.00	224.94	(0.05)	120.00	413.54	(0.12)	183.00	501.92	(0.17)	246.00	556.64	(0.21)
58.00	229.18	(0.05)	121.00	416.57	(0.12)	184.00	502.81	(0.17)	247.00	557.95	(0.21)
59.00	233.43	(0.05)	122.00	419.48	(0.12)	185.00	503.88	(0.17)	248.00	559.02	(0.21)
60.00	237.64	(0.05)	123.00	422.25	(0.12)	186.00	505.10	(0.17)	249.00	559.82	(0.21)
61.00	241.75	(0.05)	124.00	424.82	(0.12)	187.00	505.77	(0.17)	250.00	560.11	(0.21)
62.00	245.77	(0.05)	125.00	426.99	(0.12)	188.00	507.03	(0.17)			
63.00	253.70	(0.06)	126.00	428.97	(0.12)	189.00	508.20	(0.17)			

Table 22. Settlement Vs load intensity table with skirt height 1.0m & dia. 7.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	17.71	(0.00)	64.00	411.96	(0.11)	127.00	453.94	(0.20)	190.00	441.64	(0.24)
2.00	32.61	(0.00)	65.00	416.62	(0.11)	128.00	450.35	(0.20)	191.00	441.63	(0.24)
3.00	46.07	(0.01)	66.00	421.22	(0.11)	129.00	446.51	(0.20)	192.00	441.85	(0.24)
4.00	52.15	(0.01)	67.00	423.37	(0.11)	130.00	444.74	(0.20)	193.00	442.49	(0.24)
5.00	57.85	(0.01)	68.00	427.57	(0.12)	131.00	443.37	(0.20)	194.00	443.36	(0.24)
6.00	63.43	(0.01)	69.00	431.53	(0.12)	132.00	442.41	(0.20)	195.00	445.41	(0.24)
7.00	69.22	(0.01)	70.00	435.23	(0.12)	133.00	442.30	(0.20)	196.00	447.38	(0.24)
8.00	81.21	(0.01)	71.00	436.98	(0.12)	134.00	442.54	(0.20)	197.00	449.17	(0.24)
9.00	87.22	(0.01)	72.00	437.81	(0.12)	135.00	443.55	(0.20)	198.00	450.65	(0.25)
10.00	93.03	(0.01)	73.00	439.44	(0.12)	136.00	444.66	(0.20)	199.00	451.77	(0.25)
11.00	98.53	(0.02)	74.00	440.99	(0.12)	137.00	445.69	(0.20)	200.00	452.56	(0.25)
12.00	103.69	(0.02)	75.00	441.66	(0.12)	138.00	446.00	(0.21)	201.00	452.84	(0.25)
13.00	108.63	(0.02)	76.00	442.25	(0.12)	139.00	446.15	(0.21)	202.00	452.93	(0.25)
14.00	113.52	(0.02)	77.00	442.61	(0.13)	140.00	445.84	(0.21)	203.00	453.01	(0.25)
15.00	118.43	(0.02)	78.00	442.71	(0.13)	141.00	445.27	(0.21)	204.00	452.91	(0.25)
16.00	123.40	(0.02)	79.00	442.64	(0.13)	142.00	443.63	(0.21)	205.00	452.84	(0.25)
17.00	133.46	(0.02)	80.00	442.07	(0.13)	143.00	441.73	(0.21)	206.00	452.76	(0.25)
18.00	143.60	(0.02)	81.00	441.17	(0.13)	144.00	439.83	(0.21)	207.00	452.58	(0.25)
19.00	153.83	(0.03)	82.00	440.01	(0.13)	145.00	439.12	(0.21)	208.00	452.41	(0.25)
20.00	158.90	(0.03)	83.00	437.24	(0.13)	146.00	439.06	(0.21)	209.00	452.52	(0.25)
21.00	168.88	(0.03)	84.00	434.41	(0.13)	147.00	439.42	(0.21)	210.00	453.21	(0.25)
22.00	173.70	(0.03)	85.00	431.86	(0.14)	148.00	440.63	(0.21)	211.00	453.77	(0.25)
23.00	183.00	(0.03)	86.00	431.03	(0.14)	149.00	443.42	(0.21)	212.00	455.02	(0.25)
24.00	191.77	(0.04)	87.00	430.44	(0.14)	150.00	446.22	(0.21)	213.00	456.26	(0.25)
25.00	200.49	(0.04)	88.00	430.35	(0.14)	151.00	448.76	(0.21)	214.00	458.39	(0.25)
26.00	204.95	(0.04)	89.00	430.74	(0.14)	152.00	450.92	(0.22)	215.00	458.61	(0.25)
27.00	213.85	(0.04)	90.00	431.36	(0.14)	153.00	451.44	(0.22)	216.00	458.52	(0.25)
28.00	222.60	(0.04)	91.00	432.16	(0.14)	154.00	452.13	(0.22)	217.00	458.22	(0.25)
29.00	226.88	(0.04)	92.00	433.91	(0.14)	155.00	452.47	(0.22)	218.00	456.98	(0.26)
30.00	235.43	(0.05)	93.00	435.48	(0.15)	156.00	452.59	(0.22)	219.00	455.35	(0.26)
31.00	243.62	(0.05)	94.00	436.84	(0.15)	157.00	452.47	(0.22)	220.00	453.12	(0.26)
32.00	251.66	(0.05)	95.00	438.04	(0.15)	158.00	452.29	(0.22)	221.00	450.71	(0.26)
33.00	255.52	(0.05)	96.00	439.13	(0.15)	159.00	451.99	(0.22)	222.00	448.31	(0.26)
34.00	263.07	(0.05)	97.00	440.09	(0.15)	160.00	451.62	(0.22)	223.00	446.10	(0.26)
35.00	266.70	(0.05)	98.00	440.99	(0.16)	161.00	451.22	(0.22)	224.00	444.39	(0.26)
36.00	273.74	(0.06)	99.00	441.86	(0.16)	162.00	450.39	(0.22)	225.00	443.38	(0.26)
37.00	280.37	(0.06)	100.00	442.62	(0.16)	163.00	449.73	(0.22)	226.00	443.02	(0.26)
38.00	286.80	(0.06)	101.00	442.91	(0.16)	164.00	449.67	(0.22)	227.00	443.23	(0.26)
39.00	293.27	(0.06)	102.00	443.42	(0.16)	165.00	449.93	(0.22)	228.00	443.63	(0.26)
40.00	299.76	(0.06)	103.00	443.78	(0.17)	166.00	450.75	(0.22)	229.00	444.60	(0.26)
41.00	302.95	(0.07)	104.00	444.01	(0.17)	167.00	451.18	(0.22)	230.00	445.45	(0.26)
42.00	309.30	(0.07)	105.00	444.13	(0.17)	168.00	452.01	(0.22)	231.00	445.92	(0.26)
43.00	312.40	(0.07)	106.00	444.02	(0.18)	169.00	452.58	(0.22)	232.00	446.12	(0.26)
44.00	315.46	(0.07)	107.00	443.74	(0.18)	170.00	452.48	(0.22)	233.00	445.93	(0.27)
45.00	318.45	(0.07)	108.00	443.47	(0.18)	171.00	452.19	(0.22)	234.00	445.30	(0.27)
46.00	324.32	(0.07)	109.00	442.87	(0.19)	172.00	451.10	(0.22)	235.00	444.50	(0.27)
47.00	330.08	(0.07)	110.00	442.92	(0.19)	173.00	450.13	(0.23)	236.00	444.20	(0.27)
48.00	335.75	(0.08)	111.00	443.05	(0.19)	174.00	447.99	(0.23)	237.00	444.20	(0.27)
49.00	341.34	(0.08)	112.00	443.37	(0.19)	175.00	445.70	(0.23)	238.00	444.34	(0.27)
50.00	344.09	(0.08)	113.00	443.76	(0.19)	176.00	443.41	(0.23)	239.00	444.82	(0.27)
51.00	349.50	(0.08)	114.00	444.59	(0.19)	177.00	441.36	(0.23)	240.00	445.48	(0.27)
52.00	354.82	(0.08)	115.00	445.23	(0.19)	178.00	439.80	(0.23)	241.00	446.29	(0.27)
53.00	360.04	(0.09)	116.00	446.07	(0.19)	179.00	438.98	(0.23)	242.00	448.06	(0.28)
54.00	365.07	(0.09)	117.00	447.01	(0.19)	180.00	439.04	(0.23)	243.00	449.80	(0.28)
55.00	369.95	(0.09)	118.00	448.92	(0.19)	181.00	439.63	(0.23)	244.00	451.48	(0.28)
56.00	374.70	(0.09)	119.00	449.87	(0.19)	182.00	440.34	(0.23)	245.00	453.04	(0.28)
57.00	379.36	(0.09)	120.00	451.91	(0.19)	183.00	441.88	(0.23)	246.00	454.47	(0.28)
58.00	384.02	(0.10)	121.00	452.93	(0.19)	184.00	443.08	(0.23)	247.00	455.74	(0.28)
59.00	388.68	(0.10)	122.00	453.95	(0.19)	185.00	443.72	(0.23)	248.00	456.15	(0.28)
60.00	393.33	(0.10)	123.00	455.85	(0.20)	186.00	443.85	(0.23)	249.00	456.22	(0.28)
61.00	397.98	(0.10)	124.00	456.07	(0.20)	187.00	443.58	(0.24)	250.00	456.04	(0.28)
62.00	402.61	(0.10)	125.00	455.92	(0.20)	188.00	443.12	(0.24)			
63.00	407.27	(0.11)	126.00	455.43	(0.20)	189.00	442.03	(0.24)			

Table 23. Settlement Vs load intensity table with skirt height 2.0m & dia.7.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	9.21	(0.00)	64.00	365.23	(0.09)	127.00	479.53	(0.15)	190.00	482.06	(0.19)
2.00	25.13	(0.00)	65.00	367.90	(0.09)	128.00	480.01	(0.15)	191.00	482.09	(0.19)
3.00	32.06	(0.00)	66.00	373.19	(0.09)	129.00	481.26	(0.16)	192.00	482.27	(0.19)
4.00	38.50	(0.01)	67.00	375.76	(0.09)	130.00	482.59	(0.16)	193.00	482.75	(0.19)
5.00	44.75	(0.01)	68.00	378.33	(0.09)	131.00	483.93	(0.16)	194.00	482.97	(0.19)
6.00	47.94	(0.01)	69.00	383.38	(0.10)	132.00	485.19	(0.16)	195.00	482.63	(0.19)
7.00	54.17	(0.01)	70.00	388.37	(0.10)	133.00	486.37	(0.16)	196.00	482.11	(0.19)
8.00	57.28	(0.01)	71.00	393.35	(0.10)	134.00	488.52	(0.16)	197.00	481.38	(0.19)
9.00	63.40	(0.01)	72.00	398.27	(0.10)	135.00	490.40	(0.16)	198.00	480.51	(0.19)
10.00	69.47	(0.01)	73.00	403.16	(0.10)	136.00	492.09	(0.16)	199.00	479.57	(0.19)
11.00	75.57	(0.01)	74.00	408.03	(0.11)	137.00	493.55	(0.16)	200.00	478.61	(0.19)
12.00	81.63	(0.01)	75.00	410.36	(0.11)	138.00	494.14	(0.16)	201.00	477.82	(0.19)
13.00	87.43	(0.01)	76.00	414.93	(0.11)	139.00	494.65	(0.16)	202.00	477.38	(0.19)
14.00	92.83	(0.01)	77.00	419.31	(0.11)	140.00	495.07	(0.16)	203.00	477.48	(0.19)
15.00	97.91	(0.02)	78.00	423.61	(0.11)	141.00	495.39	(0.16)	204.00	478.06	(0.19)
16.00	102.91	(0.02)	79.00	427.85	(0.12)	142.00	495.56	(0.16)	205.00	479.78	(0.19)
17.00	107.94	(0.02)	80.00	429.95	(0.12)	143.00	495.58	(0.17)	206.00	481.65	(0.19)
18.00	113.00	(0.02)	81.00	434.15	(0.12)	144.00	495.45	(0.17)	207.00	483.36	(0.19)
19.00	115.52	(0.02)	82.00	438.29	(0.12)	145.00	495.13	(0.17)	208.00	484.54	(0.19)
20.00	120.48	(0.02)	83.00	440.32	(0.12)	146.00	494.63	(0.17)	209.00	484.65	(0.20)
21.00	125.37	(0.02)	84.00	442.33	(0.12)	147.00	493.97	(0.17)	210.00	484.34	(0.20)
22.00	130.48	(0.02)	85.00	444.28	(0.12)	148.00	492.95	(0.17)	211.00	483.40	(0.20)
23.00	135.80	(0.02)	86.00	446.19	(0.13)	149.00	492.27	(0.17)	212.00	482.80	(0.20)
24.00	141.15	(0.03)	87.00	448.08	(0.13)	150.00	490.71	(0.17)	213.00	481.62	(0.20)
25.00	146.47	(0.03)	88.00	451.76	(0.13)	151.00	489.33	(0.17)	214.00	481.23	(0.20)
26.00	151.65	(0.03)	89.00	453.48	(0.13)	152.00	488.20	(0.17)	215.00	481.02	(0.20)
27.00	154.08	(0.03)	90.00	456.93	(0.13)	153.00	488.13	(0.17)	216.00	481.26	(0.20)
28.00	158.85	(0.03)	91.00	458.63	(0.13)	154.00	488.82	(0.17)	217.00	482.18	(0.20)
29.00	163.40	(0.03)	92.00	459.46	(0.13)	155.00	490.10	(0.17)	218.00	483.16	(0.20)
30.00	167.87	(0.03)	93.00	461.05	(0.14)	156.00	491.65	(0.17)	219.00	483.65	(0.20)
31.00	172.26	(0.03)	94.00	461.76	(0.14)	157.00	493.24	(0.17)	220.00	484.46	(0.20)
32.00	176.66	(0.03)	95.00	462.39	(0.14)	158.00	493.97	(0.17)	221.00	484.53	(0.20)
33.00	181.15	(0.03)	96.00	462.87	(0.14)	159.00	495.23	(0.17)	222.00	484.32	(0.20)
34.00	190.20	(0.04)	97.00	463.12	(0.14)	160.00	496.00	(0.17)	223.00	483.85	(0.20)
35.00	199.19	(0.04)	98.00	463.10	(0.14)	161.00	496.35	(0.17)	224.00	483.01	(0.20)
36.00	203.65	(0.04)	99.00	463.03	(0.14)	162.00	496.12	(0.17)	225.00	482.02	(0.20)
37.00	208.10	(0.04)	100.00	462.94	(0.14)	163.00	495.62	(0.17)	226.00	480.92	(0.20)
38.00	216.75	(0.04)	101.00	462.76	(0.14)	164.00	494.95	(0.18)	227.00	478.72	(0.20)
39.00	225.13	(0.04)	102.00	462.81	(0.14)	165.00	493.92	(0.18)	228.00	477.88	(0.20)
40.00	233.30	(0.05)	103.00	463.04	(0.14)	166.00	492.78	(0.18)	229.00	477.32	(0.20)
41.00	237.29	(0.05)	104.00	463.40	(0.14)	167.00	491.67	(0.18)	230.00	477.28	(0.20)
42.00	245.08	(0.05)	105.00	463.97	(0.14)	168.00	490.62	(0.18)	231.00	477.51	(0.20)
43.00	248.88	(0.05)	106.00	464.72	(0.14)	169.00	489.59	(0.18)	232.00	478.02	(0.20)
44.00	252.64	(0.05)	107.00	465.64	(0.14)	170.00	488.56	(0.18)	233.00	479.60	(0.20)
45.00	256.35	(0.05)	108.00	467.76	(0.14)	171.00	488.02	(0.18)	234.00	481.38	(0.20)
46.00	263.79	(0.06)	109.00	469.98	(0.14)	172.00	486.76	(0.18)	235.00	483.07	(0.20)
47.00	271.16	(0.06)	110.00	472.16	(0.14)	173.00	485.30	(0.18)	236.00	484.50	(0.21)
48.00	278.41	(0.06)	111.00	474.36	(0.15)	174.00	483.60	(0.18)	237.00	485.53	(0.21)
49.00	285.46	(0.06)	112.00	475.40	(0.15)	175.00	482.76	(0.18)	238.00	485.89	(0.21)
50.00	288.94	(0.06)	113.00	477.35	(0.15)	176.00	481.14	(0.18)	239.00	485.72	(0.21)
51.00	292.42	(0.06)	114.00	478.15	(0.15)	177.00	480.09	(0.18)	240.00	485.23	(0.21)
52.00	295.83	(0.07)	115.00	478.86	(0.15)	178.00	480.11	(0.18)	241.00	484.46	(0.21)
53.00	299.12	(0.07)	116.00	479.45	(0.15)	179.00	480.73	(0.18)	242.00	483.52	(0.21)
54.00	305.47	(0.07)	117.00	479.89	(0.15)	180.00	481.85	(0.18)	243.00	483.13	(0.21)
55.00	311.76	(0.07)	118.00	480.08	(0.15)	181.00	483.33	(0.18)	244.00	482.82	(0.21)
56.00	318.31	(0.07)	119.00	480.03	(0.15)	182.00	484.88	(0.18)	245.00	482.64	(0.21)
57.00	324.98	(0.07)	120.00	479.80	(0.15)	183.00	486.07	(0.18)	246.00	482.93	(0.21)
58.00	331.68	(0.08)	121.00	479.63	(0.15)	184.00	486.59	(0.19)	247.00	483.66	(0.21)
59.00	338.32	(0.08)	122.00	479.27	(0.15)	185.00	486.32	(0.19)	248.00	484.42	(0.21)
60.00	344.86	(0.08)	123.00	479.02	(0.15)	186.00	485.69	(0.19)	249.00	484.78	(0.21)
61.00	347.98	(0.08)	124.00	478.85	(0.15)	187.00	484.85	(0.19)	250.00	485.35	(0.21)
62.00	354.01	(0.08)	125.00	478.85	(0.15)	188.00	483.82	(0.19)			
63.00	359.74	(0.09)	126.00	478.99	(0.15)	189.00	482.78	(0.19)			

Table 24. Settlement Vs load intensity table with skirt height 3.0m & dia. 7.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	9.07	(0.00)	64.00	319.07	(0.08)	127.00	480.17	(0.15)	190.00	475.28	(0.21)
2.00	17.22	(0.00)	65.00	324.90	(0.08)	128.00	481.86	(0.15)	191.00	475.92	(0.21)
3.00	24.40	(0.00)	66.00	330.72	(0.08)	129.00	483.28	(0.16)	192.00	477.28	(0.21)
4.00	27.37	(0.00)	67.00	336.60	(0.08)	130.00	483.77	(0.16)	193.00	479.90	(0.21)
5.00	30.12	(0.00)	68.00	342.63	(0.08)	131.00	484.15	(0.16)	194.00	482.11	(0.21)
6.00	31.48	(0.00)	69.00	348.77	(0.09)	132.00	484.44	(0.16)	195.00	482.86	(0.21)
7.00	34.21	(0.01)	70.00	361.12	(0.09)	133.00	484.72	(0.16)	196.00	482.99	(0.21)
8.00	37.31	(0.01)	71.00	367.22	(0.09)	134.00	485.05	(0.16)	197.00	483.17	(0.21)
9.00	40.45	(0.01)	72.00	379.27	(0.10)	135.00	485.92	(0.16)	198.00	483.19	(0.21)
10.00	43.60	(0.01)	73.00	384.95	(0.10)	136.00	486.56	(0.16)	199.00	483.14	(0.21)
11.00	46.70	(0.01)	74.00	387.65	(0.10)	137.00	488.00	(0.16)	200.00	483.08	(0.21)
12.00	49.75	(0.01)	75.00	390.27	(0.10)	138.00	488.82	(0.16)	201.00	483.45	(0.21)
13.00	52.72	(0.01)	76.00	391.44	(0.10)	139.00	489.64	(0.16)	202.00	484.27	(0.21)
14.00	55.67	(0.01)	77.00	393.56	(0.10)	140.00	491.22	(0.16)	203.00	485.52	(0.21)
15.00	58.66	(0.01)	78.00	395.47	(0.10)	141.00	492.61	(0.16)	204.00	488.14	(0.21)
16.00	61.70	(0.01)	79.00	397.42	(0.10)	142.00	493.71	(0.16)	205.00	490.96	(0.21)
17.00	64.73	(0.01)	80.00	399.51	(0.11)	143.00	494.59	(0.17)	206.00	496.79	(0.22)
18.00	70.67	(0.01)	81.00	401.81	(0.11)	144.00	495.35	(0.17)	207.00	502.42	(0.22)
19.00	76.55	(0.01)	82.00	404.24	(0.11)	145.00	495.70	(0.17)	208.00	507.42	(0.22)
20.00	82.34	(0.01)	83.00	406.69	(0.11)	146.00	496.41	(0.17)	209.00	509.46	(0.22)
21.00	87.78	(0.01)	84.00	409.12	(0.11)	147.00	496.84	(0.17)	210.00	513.21	(0.22)
22.00	90.29	(0.02)	85.00	411.45	(0.11)	148.00	497.74	(0.17)	211.00	516.52	(0.23)
23.00	91.44	(0.02)	86.00	413.67	(0.11)	149.00	498.75	(0.17)	212.00	518.64	(0.23)
24.00	93.54	(0.02)	87.00	415.78	(0.11)	150.00	499.86	(0.17)	213.00	518.29	(0.23)
25.00	95.57	(0.02)	88.00	417.80	(0.11)	151.00	501.04	(0.17)	214.00	517.51	(0.23)
26.00	97.61	(0.02)	89.00	419.77	(0.12)	152.00	502.42	(0.17)	215.00	516.52	(0.23)
27.00	99.73	(0.02)	90.00	421.74	(0.12)	153.00	503.89	(0.18)	216.00	514.39	(0.23)
28.00	102.03	(0.02)	91.00	423.81	(0.12)	154.00	505.37	(0.18)	217.00	509.96	(0.23)
29.00	104.51	(0.02)	92.00	425.97	(0.12)	155.00	506.79	(0.18)	218.00	505.38	(0.23)
30.00	109.76	(0.02)	93.00	427.05	(0.12)	156.00	508.07	(0.18)	219.00	503.07	(0.23)
31.00	115.08	(0.02)	94.00	429.18	(0.12)	157.00	509.15	(0.18)	220.00	500.79	(0.23)
32.00	125.77	(0.02)	95.00	431.21	(0.12)	158.00	510.07	(0.18)	221.00	496.52	(0.23)
33.00	136.21	(0.03)	96.00	433.20	(0.12)	159.00	510.90	(0.18)	222.00	494.79	(0.23)
34.00	141.19	(0.03)	97.00	435.16	(0.12)	160.00	511.63	(0.18)	223.00	493.49	(0.23)
35.00	146.08	(0.03)	98.00	439.01	(0.13)	161.00	512.27	(0.18)	224.00	491.00	(0.23)
36.00	150.89	(0.03)	99.00	440.87	(0.13)	162.00	513.43	(0.19)	225.00	490.25	(0.23)
37.00	155.67	(0.03)	100.00	442.71	(0.13)	163.00	514.54	(0.19)	226.00	489.83	(0.23)
38.00	160.21	(0.03)	101.00	444.52	(0.13)	164.00	515.04	(0.19)	227.00	489.07	(0.23)
39.00	169.00	(0.03)	102.00	446.30	(0.13)	165.00	516.10	(0.19)	228.00	487.60	(0.23)
40.00	177.65	(0.03)	103.00	448.04	(0.13)	166.00	516.64	(0.19)	229.00	484.72	(0.23)
41.00	181.96	(0.04)	104.00	449.75	(0.13)	167.00	517.75	(0.19)	230.00	481.43	(0.23)
42.00	190.73	(0.04)	105.00	450.53	(0.13)	168.00	518.85	(0.20)	231.00	474.72	(0.23)
43.00	195.34	(0.04)	106.00	452.04	(0.13)	169.00	519.88	(0.20)	232.00	471.47	(0.23)
44.00	199.94	(0.04)	107.00	453.51	(0.13)	170.00	520.33	(0.20)	233.00	465.26	(0.23)
45.00	204.43	(0.04)	108.00	455.01	(0.14)	171.00	520.62	(0.20)	234.00	462.46	(0.23)
46.00	213.19	(0.04)	109.00	456.55	(0.14)	172.00	520.33	(0.20)	235.00	457.02	(0.23)
47.00	221.63	(0.05)	110.00	458.16	(0.14)	173.00	519.74	(0.20)	236.00	454.66	(0.23)
48.00	229.90	(0.05)	111.00	459.03	(0.14)	174.00	519.03	(0.20)	237.00	450.13	(0.23)
49.00	238.02	(0.05)	112.00	460.79	(0.14)	175.00	517.47	(0.20)	238.00	446.56	(0.23)
50.00	245.81	(0.05)	113.00	462.55	(0.14)	176.00	516.32	(0.20)	239.00	445.50	(0.23)
51.00	249.63	(0.05)	114.00	464.27	(0.14)	177.00	513.48	(0.20)	240.00	444.32	(0.23)
52.00	257.22	(0.05)	115.00	465.94	(0.14)	178.00	510.33	(0.20)	241.00	443.97	(0.23)
53.00	260.89	(0.06)	116.00	467.53	(0.14)	179.00	503.90	(0.20)	242.00	444.99	(0.23)
54.00	264.52	(0.06)	117.00	468.21	(0.14)	180.00	500.73	(0.20)	243.00	447.22	(0.23)
55.00	271.76	(0.06)	118.00	468.84	(0.14)	181.00	494.31	(0.20)	244.00	451.70	(0.23)
56.00	275.38	(0.06)	119.00	469.99	(0.15)	182.00	491.28	(0.20)	245.00	455.75	(0.23)
57.00	282.57	(0.06)	120.00	471.14	(0.15)	183.00	488.54	(0.20)	246.00	457.65	(0.23)
58.00	289.38	(0.06)	121.00	472.35	(0.15)	184.00	485.93	(0.20)	247.00	461.38	(0.23)
59.00	292.54	(0.07)	122.00	473.64	(0.15)	185.00	484.96	(0.20)	248.00	464.78	(0.23)
60.00	298.61	(0.07)	123.00	475.06	(0.15)	186.00	484.13	(0.21)	249.00	471.35	(0.24)
61.00	301.57	(0.07)	124.00	476.61	(0.15)	187.00	482.60	(0.21)	250.00	477.24	(0.24)
62.00	307.41	(0.07)	125.00	477.47	(0.15)	188.00	479.76	(0.21)			
63.00	313.22	(0.07)	126.00	479.29	(0.15)	189.00	477.19	(0.21)			

Table 25. Settlement Vs load intensity table with skirt height 4.0m & dia. 7.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	4.79	(0.00)	64.00	333.92	(0.08)	127.00	491.17	(0.15)	190.00	503.31	(0.18)
2.00	9.18	(0.00)	65.00	340.13	(0.08)	128.00	492.99	(0.15)	191.00	503.80	(0.18)
3.00	17.13	(0.00)	66.00	346.39	(0.08)	129.00	493.70	(0.15)	192.00	505.15	(0.18)
4.00	24.46	(0.00)	67.00	349.46	(0.08)	130.00	494.13	(0.15)	193.00	506.55	(0.18)
5.00	31.25	(0.00)	68.00	355.55	(0.08)	131.00	494.37	(0.16)	194.00	509.36	(0.18)
6.00	37.89	(0.01)	69.00	361.49	(0.09)	132.00	494.49	(0.16)	195.00	514.79	(0.18)
7.00	44.63	(0.01)	70.00	367.27	(0.09)	133.00	494.60	(0.16)	196.00	523.78	(0.18)
8.00	48.07	(0.01)	71.00	372.84	(0.09)	134.00	494.68	(0.16)	197.00	526.79	(0.18)
9.00	51.48	(0.01)	72.00	375.54	(0.09)	135.00	494.76	(0.16)	198.00	525.39	(0.18)
10.00	54.75	(0.01)	73.00	380.89	(0.09)	136.00	494.88	(0.16)	199.00	523.89	(0.18)
11.00	61.02	(0.01)	74.00	383.50	(0.10)	137.00	495.03	(0.16)	200.00	522.63	(0.19)
12.00	67.12	(0.01)	75.00	386.08	(0.10)	138.00	495.27	(0.16)	201.00	521.81	(0.19)
13.00	73.19	(0.01)	76.00	387.37	(0.10)	139.00	495.57	(0.16)	202.00	521.22	(0.19)
14.00	76.20	(0.01)	77.00	389.95	(0.10)	140.00	495.82	(0.16)	203.00	520.99	(0.19)
15.00	82.27	(0.01)	78.00	392.35	(0.10)	141.00	496.36	(0.16)	204.00	520.97	(0.19)
16.00	85.31	(0.01)	79.00	394.70	(0.10)	142.00	496.94	(0.16)	205.00	521.09	(0.19)
17.00	91.23	(0.01)	80.00	399.43	(0.10)	143.00	497.55	(0.16)	206.00	521.18	(0.19)
18.00	96.96	(0.02)	81.00	404.30	(0.10)	144.00	498.24	(0.16)	207.00	521.18	(0.19)
19.00	102.50	(0.02)	82.00	409.23	(0.11)	145.00	499.22	(0.16)	208.00	521.10	(0.19)
20.00	105.06	(0.02)	83.00	411.67	(0.11)	146.00	500.28	(0.16)	209.00	520.83	(0.19)
21.00	107.55	(0.02)	84.00	416.63	(0.11)	147.00	502.54	(0.16)	210.00	520.40	(0.19)
22.00	108.73	(0.02)	85.00	421.58	(0.11)	148.00	504.80	(0.17)	211.00	519.60	(0.19)
23.00	110.87	(0.02)	86.00	426.46	(0.11)	149.00	506.96	(0.17)	212.00	517.96	(0.19)
24.00	112.93	(0.02)	87.00	431.22	(0.12)	150.00	507.96	(0.17)	213.00	516.30	(0.19)
25.00	115.20	(0.02)	88.00	435.80	(0.12)	151.00	508.76	(0.17)	214.00	515.02	(0.19)
26.00	120.10	(0.02)	89.00	440.19	(0.12)	152.00	509.44	(0.17)	215.00	513.89	(0.19)
27.00	125.33	(0.02)	90.00	442.29	(0.12)	153.00	509.82	(0.17)	216.00	511.84	(0.19)
28.00	130.67	(0.02)	91.00	444.33	(0.12)	154.00	510.02	(0.17)	217.00	511.02	(0.19)
29.00	135.99	(0.02)	92.00	445.27	(0.12)	155.00	509.98	(0.17)	218.00	510.72	(0.19)
30.00	141.24	(0.03)	93.00	447.06	(0.12)	156.00	509.82	(0.17)	219.00	510.14	(0.19)
31.00	151.70	(0.03)	94.00	447.92	(0.13)	157.00	509.29	(0.17)	220.00	509.60	(0.19)
32.00	161.90	(0.03)	95.00	449.57	(0.13)	158.00	508.64	(0.17)	221.00	509.19	(0.19)
33.00	166.90	(0.03)	96.00	450.33	(0.13)	159.00	508.35	(0.17)	222.00	509.00	(0.19)
34.00	171.87	(0.03)	97.00	451.87	(0.13)	160.00	507.67	(0.17)	223.00	508.99	(0.19)
35.00	176.72	(0.03)	98.00	452.71	(0.13)	161.00	507.18	(0.17)	224.00	509.35	(0.19)
36.00	181.48	(0.03)	99.00	454.50	(0.13)	162.00	507.11	(0.17)	225.00	510.11	(0.19)
37.00	190.65	(0.04)	100.00	455.53	(0.13)	163.00	507.15	(0.17)	226.00	510.98	(0.19)
38.00	195.06	(0.04)	101.00	457.62	(0.13)	164.00	507.25	(0.17)	227.00	512.54	(0.19)
39.00	203.88	(0.04)	102.00	459.76	(0.13)	165.00	507.36	(0.17)	228.00	512.85	(0.19)
40.00	212.69	(0.04)	103.00	460.89	(0.13)	166.00	507.46	(0.17)	229.00	512.67	(0.19)
41.00	217.24	(0.04)	104.00	463.11	(0.13)	167.00	507.76	(0.17)	230.00	512.34	(0.19)
42.00	221.83	(0.04)	105.00	465.25	(0.14)	168.00	508.10	(0.17)	231.00	512.01	(0.19)
43.00	226.31	(0.04)	106.00	467.31	(0.14)	169.00	509.04	(0.17)	232.00	511.29	(0.19)
44.00	230.67	(0.05)	107.00	468.25	(0.14)	170.00	510.12	(0.18)	233.00	510.56	(0.19)
45.00	234.93	(0.05)	108.00	470.06	(0.14)	171.00	511.25	(0.18)	234.00	510.21	(0.19)
46.00	243.20	(0.05)	109.00	470.86	(0.14)	172.00	512.35	(0.18)	235.00	509.36	(0.19)
47.00	251.15	(0.05)	110.00	472.39	(0.14)	173.00	513.36	(0.18)	236.00	509.03	(0.19)
48.00	259.08	(0.05)	111.00	473.01	(0.14)	174.00	514.21	(0.18)	237.00	508.30	(0.19)
49.00	263.03	(0.05)	112.00	473.57	(0.14)	175.00	514.85	(0.18)	238.00	507.31	(0.19)
50.00	266.95	(0.06)	113.00	474.06	(0.14)	176.00	515.03	(0.18)	239.00	505.38	(0.19)
51.00	270.75	(0.06)	114.00	474.53	(0.14)	177.00	514.96	(0.18)	240.00	504.59	(0.19)
52.00	274.34	(0.06)	115.00	475.07	(0.14)	178.00	514.74	(0.18)	241.00	503.89	(0.19)
53.00	281.32	(0.06)	116.00	475.64	(0.14)	179.00	514.30	(0.18)	242.00	503.43	(0.19)
54.00	288.21	(0.06)	117.00	476.20	(0.14)	180.00	513.87	(0.18)	243.00	502.85	(0.19)
55.00	294.96	(0.06)	118.00	477.31	(0.14)	181.00	513.35	(0.18)	244.00	501.96	(0.19)
56.00	301.71	(0.07)	119.00	478.02	(0.14)	182.00	511.95	(0.18)	245.00	501.23	(0.19)
57.00	305.07	(0.07)	120.00	479.58	(0.15)	183.00	509.03	(0.18)	246.00	500.70	(0.19)
58.00	308.44	(0.07)	121.00	481.32	(0.15)	184.00	506.40	(0.18)	247.00	500.49	(0.19)
59.00	311.76	(0.07)	122.00	482.25	(0.15)	185.00	504.18	(0.18)	248.00	500.93	(0.19)
60.00	315.05	(0.07)	123.00	484.17	(0.15)	186.00	503.46	(0.18)	249.00	501.87	(0.19)
61.00	318.30	(0.07)	124.00	486.16	(0.15)	187.00	503.04	(0.18)	250.00	503.80	(0.20)
62.00	324.64	(0.07)	125.00	488.17	(0.15)	188.00	503.01	(0.18)			
63.00	330.82	(0.08)	126.00	489.17	(0.15)	189.00	502.96	(0.18)			

Table 26. Settlement Vs load intensity table with skirt height 5.0m & dia. 7.0m

point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]	point	Fy [kN/rad]	|U| [m]
1.00	2.47	(0.00)	64.00	153.88	(0.03)	127.00	437.83	(0.12)	190.00	499.33	(0.17)
2.00	3.63	(0.00)	65.00	158.66	(0.03)	128.00	438.41	(0.13)	191.00	499.78	(0.17)
3.00	5.90	(0.00)	66.00	163.43	(0.03)	129.00	439.15	(0.13)	192.00	500.22	(0.17)
4.00	9.85	(0.00)	67.00	168.18	(0.03)	130.00	440.07	(0.13)	193.00	500.56	(0.17)
5.00	13.62	(0.00)	68.00	172.84	(0.03)	131.00	441.07	(0.13)	194.00	500.84	(0.17)
6.00	17.24	(0.00)	69.00	182.05	(0.04)	132.00	442.08	(0.13)	195.00	501.18	(0.17)
7.00	19.04	(0.00)	70.00	191.25	(0.04)	133.00	443.10	(0.13)	196.00	501.63	(0.17)
8.00	22.60	(0.00)	71.00	200.28	(0.04)	134.00	444.22	(0.13)	197.00	502.17	(0.17)
9.00	24.38	(0.00)	72.00	209.16	(0.04)	135.00	445.38	(0.13)	198.00	503.33	(0.18)
10.00	27.82	(0.00)	73.00	213.63	(0.04)	136.00	446.58	(0.13)	199.00	503.99	(0.18)
11.00	28.58	(0.00)	74.00	222.59	(0.05)	137.00	448.94	(0.13)	200.00	505.45	(0.18)
12.00	28.85	(0.00)	75.00	227.09	(0.05)	138.00	451.10	(0.13)	201.00	506.26	(0.18)
13.00	29.44	(0.00)	76.00	231.66	(0.05)	139.00	452.00	(0.13)	202.00	507.87	(0.18)
14.00	30.22	(0.00)	77.00	240.66	(0.05)	140.00	452.71	(0.13)	203.00	509.31	(0.18)
15.00	31.18	(0.00)	78.00	244.96	(0.05)	141.00	453.28	(0.13)	204.00	510.52	(0.18)
16.00	31.37	(0.00)	79.00	253.40	(0.05)	142.00	453.80	(0.13)	205.00	511.51	(0.18)
17.00	31.55	(0.00)	80.00	261.35	(0.06)	143.00	454.34	(0.13)	206.00	512.31	(0.18)
18.00	31.72	(0.00)	81.00	268.95	(0.06)	144.00	454.91	(0.14)	207.00	512.82	(0.18)
19.00	31.86	(0.00)	82.00	272.62	(0.06)	145.00	455.50	(0.14)	208.00	513.16	(0.19)
20.00	31.91	(0.00)	83.00	276.25	(0.06)	146.00	456.68	(0.14)	209.00	513.43	(0.19)
21.00	32.03	(0.00)	84.00	283.47	(0.06)	147.00	457.30	(0.14)	210.00	513.68	(0.19)
22.00	32.25	(0.00)	85.00	290.48	(0.06)	148.00	457.97	(0.14)	211.00	513.94	(0.19)
23.00	32.70	(0.00)	86.00	297.35	(0.07)	149.00	458.76	(0.14)	212.00	514.23	(0.19)
24.00	33.58	(0.00)	87.00	304.10	(0.07)	150.00	459.65	(0.14)	213.00	514.54	(0.19)
25.00	35.34	(0.01)	88.00	310.83	(0.07)	151.00	461.64	(0.14)	214.00	514.94	(0.19)
26.00	38.80	(0.01)	89.00	317.43	(0.07)	152.00	463.72	(0.14)	215.00	515.23	(0.19)
27.00	39.19	(0.01)	90.00	320.57	(0.07)	153.00	465.83	(0.14)	216.00	515.98	(0.19)
28.00	39.96	(0.01)	91.00	323.69	(0.08)	154.00	466.77	(0.14)	217.00	516.58	(0.19)
29.00	41.54	(0.01)	92.00	325.23	(0.08)	155.00	467.62	(0.14)	218.00	517.89	(0.20)
30.00	42.38	(0.01)	93.00	328.29	(0.08)	156.00	468.38	(0.14)	219.00	518.57	(0.20)
31.00	42.80	(0.01)	94.00	331.28	(0.08)	157.00	469.05	(0.14)	220.00	519.84	(0.20)
32.00	43.22	(0.01)	95.00	334.25	(0.08)	158.00	469.67	(0.15)	221.00	520.31	(0.20)
33.00	44.05	(0.01)	96.00	337.24	(0.08)	159.00	470.27	(0.15)	222.00	520.39	(0.20)
34.00	44.28	(0.01)	97.00	340.30	(0.08)	160.00	471.46	(0.15)	223.00	520.38	(0.20)
35.00	44.72	(0.01)	98.00	343.39	(0.08)	161.00	472.57	(0.15)	224.00	520.09	(0.20)
36.00	45.60	(0.01)	99.00	349.55	(0.08)	162.00	473.06	(0.15)	225.00	519.58	(0.20)
37.00	47.31	(0.01)	100.00	352.57	(0.09)	163.00	474.03	(0.15)	226.00	517.95	(0.20)
38.00	47.64	(0.01)	101.00	358.41	(0.09)	164.00	474.56	(0.15)	227.00	514.52	(0.20)
39.00	48.33	(0.01)	102.00	361.21	(0.09)	165.00	475.15	(0.15)	228.00	507.61	(0.20)
40.00	48.77	(0.01)	103.00	366.70	(0.09)	166.00	476.45	(0.15)	229.00	500.97	(0.20)
41.00	49.66	(0.01)	104.00	369.39	(0.09)	167.00	479.35	(0.15)	230.00	494.88	(0.20)
42.00	51.39	(0.01)	105.00	374.81	(0.09)	168.00	481.04	(0.16)	231.00	492.61	(0.20)
43.00	54.65	(0.01)	106.00	377.51	(0.10)	169.00	484.75	(0.16)	232.00	489.50	(0.20)
44.00	61.04	(0.01)	107.00	382.97	(0.10)	170.00	486.72	(0.16)	233.00	488.61	(0.20)
45.00	64.07	(0.01)	108.00	388.43	(0.10)	171.00	487.69	(0.16)	234.00	487.84	(0.20)
46.00	65.47	(0.01)	109.00	393.89	(0.10)	172.00	488.62	(0.16)	235.00	487.05	(0.20)
47.00	68.01	(0.01)	110.00	399.27	(0.10)	173.00	489.51	(0.16)	236.00	485.29	(0.20)
48.00	69.19	(0.01)	111.00	404.42	(0.11)	174.00	491.13	(0.16)	237.00	483.41	(0.20)
49.00	71.58	(0.01)	112.00	409.33	(0.11)	175.00	492.40	(0.16)	238.00	479.68	(0.21)
50.00	74.11	(0.01)	113.00	411.63	(0.11)	176.00	492.83	(0.16)	239.00	478.45	(0.21)
51.00	76.75	(0.01)	114.00	416.13	(0.11)	177.00	492.93	(0.16)	240.00	477.23	(0.21)
52.00	79.56	(0.01)	115.00	420.51	(0.11)	178.00	493.00	(0.16)	241.00	478.71	(0.21)
53.00	85.33	(0.01)	116.00	422.65	(0.12)	179.00	493.00	(0.16)	242.00	481.78	(0.21)
54.00	90.98	(0.02)	117.00	424.80	(0.12)	180.00	493.04	(0.16)	243.00	487.74	(0.21)
55.00	96.49	(0.02)	118.00	426.95	(0.12)	181.00	493.20	(0.17)	244.00	490.40	(0.21)
56.00	101.92	(0.02)	119.00	429.07	(0.12)	182.00	493.49	(0.17)	245.00	495.66	(0.21)
57.00	107.30	(0.02)	120.00	431.16	(0.12)	183.00	493.92	(0.17)	246.00	500.27	(0.21)
58.00	118.16	(0.02)	121.00	433.19	(0.12)	184.00	494.57	(0.17)	247.00	503.97	(0.21)
59.00	128.92	(0.02)	122.00	435.13	(0.12)	185.00	495.48	(0.17)	248.00	505.02	(0.21)
60.00	134.21	(0.02)	123.00	436.03	(0.12)	186.00	496.45	(0.17)	249.00	505.44	(0.21)
61.00	139.37	(0.03)	124.00	436.42	(0.12)	187.00	497.34	(0.17)	250.00	505.69	(0.21)
62.00	144.37	(0.03)	125.00	436.75	(0.12)	188.00	498.13	(0.17)			
63.00	149.18	(0.03)	126.00	437.28	(0.12)	189.00	498.82	(0.17)			