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IDENTIFICATION OF MODULUS OF SUBGRADE REACTION OF SOILS AT PILE/SOIL INTERFACE

by

Dejan Sekulovic

A Thesis

submitted to the Faculty of Graduate Studies and Research through

Civil and Environmental Engineering

in Partial Fulfillment of the requirements for the

Degree of Master of Applied Science at the

University of Windsor

Windsor, Ontario, Canada

1998

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Abstract

This thesis deals with the determination of modulus of subgrade reaction for sandy and clayey soils surrounding laterally loaded short piles. The initial value of modulus of subgrade reaction determined in the laboratory is based on Terzaghi's method. The differences in lateral displacement of laboratory models and their numerical equivalents are associated with inaccurately determined values of modulus of subgrade reaction. The rectification of k which guaranties the same value of horizontal displacement of top pile point in laboratory experiment and its numerical equivalent is performed in the scope of sensitivity theory.

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To my family

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Nomenclature

B	Pile width
E	Young's modulus
H	Pile length
H_1	Pile length above the soil level
H_2	Pile length from the soil level to the point of rotation
H_3	Pile length between point of rotation and bottom of the pile
I	Moment of inertia
k	Horizontal modulus of subgrade reaction
k_h	Modulus of subgrade reaction
M	Bending moment
$\overline{M^p}$	Bending moment of the adjoint structure
n_h	Constant of modulus of horizontal subgrade reaction
q	Lateral load
Q	Shear
r	Soil reaction
$\overline{r^p}$	Soil reaction of the adjoint structure
V	Concentrated lateral load at the top cross section of pile
w	Lateral displacement
w_1	Lateral displacement on the top cross section
w_a	Lateral displacement at arbitrary cross section $z = z_a$

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$\overline{w^p}$ **Lateral displacement of the adjoint structure**

z Soil depth

Greek Symbols

α *characteristic pile length coefficient*

λ *characteristic pile length*

θ *slope*

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CHAPTER I

Introduction

The purpose of any foundation is to transmit loads or forces to the ground without excessive settlement. When it is necessary to carry the load to an underlying bedrock through a layer of weak soil or through water, a pile foundation is used. The following is the list of conditions that require pile foundations:

1. When the upper soil layer is highly compressible and too weak to support the load transmitted by the structure, piles are used to transmit the load to underlying bedrock or a stronger soil layer.
2. When subjected to horizontal forces, pile foundations resist by bending while supporting the vertical load transmitted by the structure.
3. In many cases, expansive and collapsible soils may be present at the site of proposed structure. These soils may extend to a great depth below the ground surface. Pile foundations should be considered as an alternative when piles are extended beyond the active zone, which swells and shrinks.
4. Piles are sometimes used to resist the uplifting forces of transmission towers, offshore platforms, and basement mats below the water table.

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5. Bridge abutments and piers are usually constructed over pile foundations to avoid the possible loss of bearing capacity that a shallow foundation might suffer because of soil erosion at the ground surface.

When designing pile foundations to resist lateral loads, the criterion for design for most of the cases is not the ultimate lateral capacity of the piles, but the maximum deflection of the piles. The allowable deflection may be relatively large for temporary structures or tied retaining walls, but only small movements can be tolerated in structures such as tied abutments to bridges, or in the foundations of tall structures. Theoretical approaches for predicting lateral movements have been developed extensively. Two approaches have generally been employed:

1. The subgrade-reaction approach, in which the continuous nature of soil is ignored and the pile reaction at a point is simply related to the deflection at that point,
2. The elastic approach, which assumes the soil to be an ideal elastic continuum.

The subgrade-reaction model, which was originally proposed by Winkler in 1867, characterizes the soil as a series of unconnected linearly-elastic springs, so that the deformation occurs only where loading exists. The lack of continuity is the obvious disadvantage of this soil model. In reality soil is at least to some extent continuous, since the displacement at a point is influenced by stresses and forces at other points within the soil. A further disadvantage is that the spring modulus of

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the model (the modulus of the subgrade-reaction k_h) is dependent on the size of the foundation. In spite of these disadvantages, the subgrade-reaction approach has been widely used in foundation design because it provides a relatively simple means of analysis.

In this research, values of k_h were determined (Terzaghi's method) as a first approximation for sample model piles embedded in sandy and clayey soils. It is worth adding that Terzaghi's modulus of subgrade reaction k_h is defined as the tangent modulus of subgrade reaction. This means that it has constant value and is applicable in analysis of elastic behavior of piles subjected to bending. These values were used in analysis of set of model pile structures. It was found that the results obtained were very inaccurate since they did not account for the change of k_h due to the change of lateral force as well as the pile length.

The objective of this research is to develop a method of identification of modulus of subgrade reaction for piles laterally loaded embedded in homogeneous sandy and clayey soil. The method developed enables one to evaluate the correct value of modulus of subgrade reaction based on its initial value determined in laboratory in approximate way. It is postulated that inaccuracy in the behavior of experimental and computational model is associated with inaccurately determined characteristics of the soil medium which is represented in numerical analysis by means of system of springs with constant value of k_h. The identification of the correct value of k_h

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is performed in the framework of sensitivity theory formulated with respect to the unknown physical parameter k_h of the soil medium. The condition which is used in determination of true value of k_h requires that behavior of experimental and numerical models is identical. The analysis of pile behavior is performed for entire range of variability of load and displacement of the pile structures embedded in homogeneous soil. Consequently, it is possible to determine the variable values of k_h which are the function of the applied load. The identification of k_h employs the discrete points located on the load-displacement curve. The detailed sensitivity analysis indicates that the identified values of k_h represent secant modulus of subgrade reaction.

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CHAPTER II

Formulation of the Problem

2.1 Modeling of a pile as a beam on elastic foundation

A pile structure of the length L is embedded in homogeneous soil and subjected to bending. It is modeled as one dimensional beam element having bending stiffness EI, where E is the Young's modulus and I stands for moment of inertia. The response of the surrounding soil medium is simulated by means of system of springs characterized with constant k_h or modulus of subgrade reaction.

The bending of the pile is caused by the lateral force V_1 applied at its top cross section. The behavior of the pile structure is analyzed in the coordinate system z, w permanently attached to the top cross section of the pile. The variable z defines spatial variable, while w denotes lateral displacement of the pile structure.

The soil reaction r is related by the following relationship:

$$r = k_h w \tag{2.1}$$

Employing the relationship of the mechanics, the equilibrium equation for an infinite small beam element resting on elastic foundation results in the following differential equation of the problem:

$$EI\frac{d^4 w}{dz^4} + kw = q \tag{2.2}$$

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where w, $\frac{d^4 w}{dz^4}$ are generalized lateral displacement, k $[kN/m^2]$ means the modulus of subgrade reaction acting an the beam of width b, and q denotes the lateral load. Closed-form solutions of this differential equation for an infinite beam on an elastic foundation subjected to a concentrated load V_1 at the end were found to be:

$$w = \frac{2V_1\lambda}{k} D_{\lambda x} \tag{2.3}$$

$$\theta = \frac{-2V_1\lambda^2}{k} A_{\lambda x} \tag{2.4}$$

$$M = \frac{-V_1}{\lambda} B_{\lambda x} \tag{2.5}$$

$$Q = -V_1 C_{\lambda x} \tag{2.6}$$

where: w represents the displacement, θ denotes the slope, M is the moment and

Q is shear.

In the case of an elastic beam foundation subjected to a bending moment M_1 applied at the top cross section of the pile structure shown in Fig. 2.1, solutions to the differential equation (2.2) were found to be:

$$w = \frac{-2M_1\lambda^2}{k} C_{\lambda x} \tag{2.7}$$

$$\theta = \frac{4M_1\lambda^3}{k} D_{\lambda x} \tag{2.8}$$

$$M = M_1 A_{\lambda x} \tag{2.9}$$

$$Q = -2M_1\lambda B_{\lambda x} \tag{2.10}$$

where: y, θ, M and Q have the same meaning as in Eqs. (2.3), (2.4), (2.5), (2.6) and

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λ (characteristic length of the pile) is found to be:

$$\lambda = \sqrt[4]{\frac{EI}{k_h}} \tag{2.11}$$

and the coefficients $A_{\lambda x}$, $B_{\lambda x}$ $C_{\lambda x}$ and $D_{\lambda x}$ are:

$$A_{\lambda x} = e^{-\lambda x}(\cos\lambda x + \sin\lambda x) \tag{2.12}$$

$$B_{\lambda x} = e^{-\lambda x}\sin\lambda x \tag{2.13}$$

$$C_{\lambda x} = e^{-\lambda x}(\cos\lambda x - \sin\lambda x) \tag{2.14}$$

$$D_{\lambda x} = e^{-\lambda x}\cos\lambda x \tag{2.15}$$

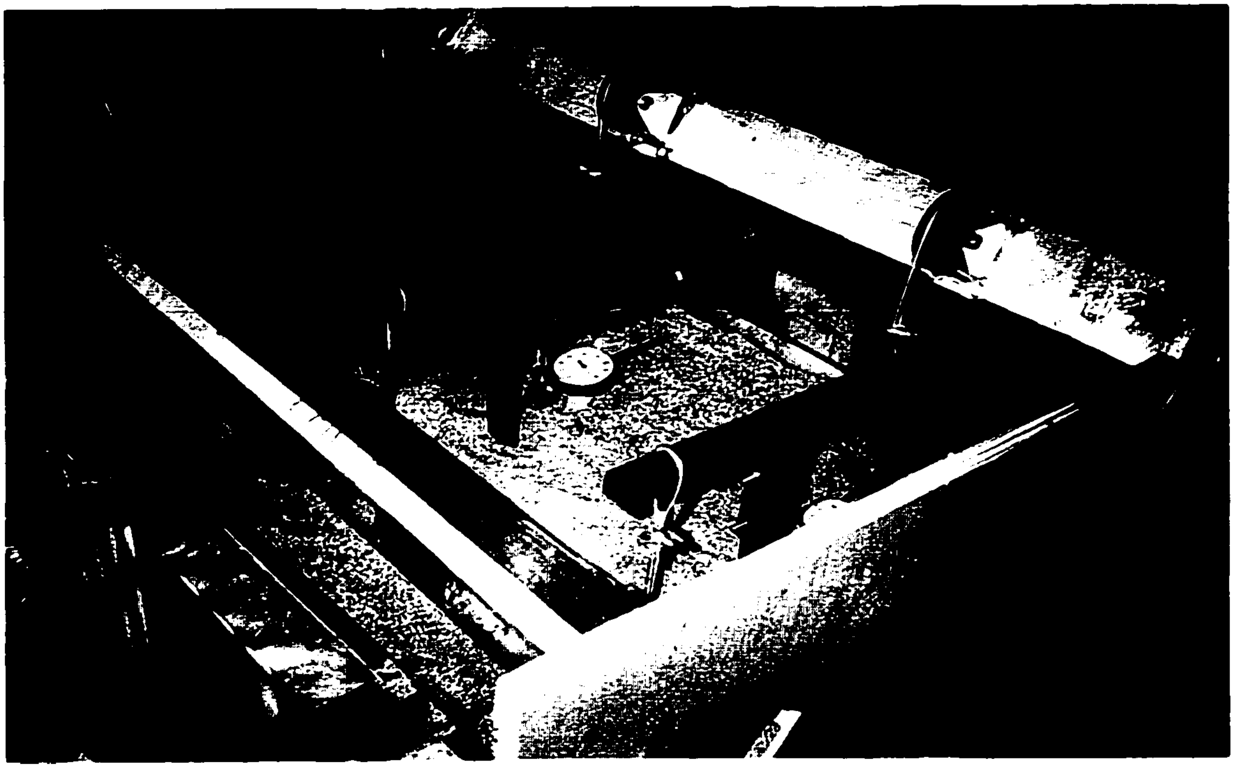

Fig. 2.1 Piles Embedded in Sandy Soil Subjected to Bending Moments

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The soil medium surrounding the bent pile (shown in Figs. 2.3 and 2.4) represented by system of springs with constant value of modulus of subgrade reaction k_h is the proper representation of soil only for some types of soil like clay. However, the other soils like sands in the analogous situations develop the modulus of horizontal subgrade reaction k_h which varies linearly along the depth of the pile. This means that in such a case, the modulus of subgrade reaction k_h satisfies the following relationship:

$$k_h = n_h \frac{z}{B} \tag{2.16}$$

where:

n_h - is the constant of modulus of subgrade reaction

It is worth adding that equation of beam on elastic foundation (Eq. 2.2) is valid within small displacement theory. This means that it describes the behavior of the structure as long as the linearly increasing load produces linearly increasing displacement.

The determination of modulus of horizontal subgrade reaction k_h for the soils characterized by its constant value (clays) as well as varying in linear fashion (sands) was proposed by Terzaghi (1995). Terzaghi's method employed the following assumptions:

1. The laterally loaded pile deforms in rapid way (through rotation about unknown point O located along the pile axis).

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2. The induced soil reaction (lateral contact pressure) is of linear type for the soil described by constant value of modulus of subgrade reaction k_h.
3. The induced soil reaction (lateral contact pressure) is of parabolic type for soil having linearly varying modulus of subgrade reaction.

Terzaghi published values of k_h determined by him for different type of clays and n_h for sands. The factor that affects the k_h for clayey soils is the state of their consistency. The constant modulus of subgrade reaction n_h for sandy soils depend on their degree of densification. If a vertical pile was surrounded by sand, the coefficient of horizontal subgrade reaction (k_h) at the given depth z below the surface depends on the width, B, of the pile measured at right angles to the direction of the displacement, the effective unit weight γ of the sand, and the relative density of the sand.

Based on Terzaghi's method, the constant of modulus of subgrade reaction n_h for sandy soil was determined in laboratory. It employed application of the testing pile structure which was 0.53 m long (length embedded in soil). The analysis of the results determined during initial testing is presented below.

A typical graph which has three different curves to describe the behavior of the same pile is shown in Fig. 2.2, Load vs. Displacement Graph.

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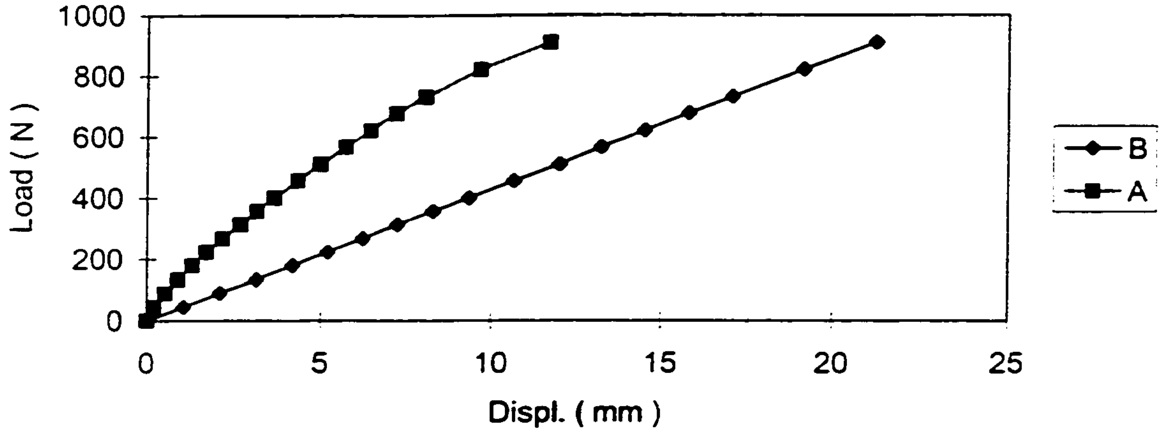

Fig. 2.2 Load vs Displacement Graph For Laterally Loaded Piles Embedded in Sandy Soil

The curve denoted A represents the real behavior of a pile foundation. This curve was obtained by testing a pile in the lab It can be approximated by means of two tangent lines C and D. This is in agreement with Terzaghi's method which assumes linear relationship between force and displacement of the pile. In order to determine the value of the constant of horizontal subgrade reaction, n_h, the point E of intersection of the tangent line C drawn to the linear portion of curve A and the tangent line D drawn to the non-linear portion of curve A was found. The values of load and displacement which correspond to this point of intersection were used in Terzaghi's method in order to obtain the initial value of n_h. This procedure is explained in detail in sections 2.2 and 2.3 for sandy soil and clayey soil, respectively. Once the initial value of n_h was determined, it was possible to obtain the characteristic length of the pile foundation, λ.

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The characteristic length λ of the laterally loaded pile embedded in a soil with linearly varying n_h is defined as:

$$\lambda = \sqrt[5]{\frac{EI}{n_h}} \qquad (2.17)$$

Thus, the initially evaluated n_h value enabled one to determine the characteristic length λ which was then used in defining of the length for the set of short pile models. It is worth adding that bent pile behaves as rigid if its length is less than 5λ, otherwise it is called flexible. The prepared set of short pile models was subjected to lateral load tests in laboratory.

To verify the experimental model with its analytical equivalent, the initially determined value of n_h was used in numerical example solved by means of BESPO program which is dealing with analysis of beam on elastic foundation by the finite element method. It resulted in curve B which does not coincide with curve A. Comparison of curves A and B leads to the determination of the correction factor, delta n_h. Having determined delta n_h obtained from analysis of A and B, we can determine true value of n_h, which assures such displacement, which will be located on the real load-displacement curve A. The true n_h obtained from comparison of B and A gives the secant load-displacement line S which joins the origin with the point on curve A which coincides with the applied load, P_i. Line S is variable and depends on the applied load P_i. It defines variable n_h as a finite value. This is connected with the fact that the analysis is performed with respect to line B which is set up uniquely at the beginning.

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However, a variable delta n_h, which depends on the magnitude of the applied load P, should be used since the value of n_h changes as the applied load increases (as shown in Appendix A and B for sandy soil and for clayey soil).

2.2 Determination of n_h for the Sandy Soils Surrounding Laterally Loaded Piles by Terzaghi's Method

The procedure for the determination of n_h for the pile embedded in sandy soil (Fig. 2.2) and subjected to a horizontal load as purposed by Terzaghi is explained below. Consider a pile structure with given length $H = H_1 + H_2 + H_3$, as shown in Fig. 2.3. The pile is embedded in a sandy soil along the depth ($H_2 + H_3$) such that H_1 is above the soil. The pile is loaded by a lateral force, Q applied at the top cross section, which was increased slowly in a linear fashion.

The analyzed pile satisfies Terzaghi's assumptions, that is:

1. the deformation of the pile is rigid,
2. the deformations are linear,
3. the induced soil reaction/lateral contact pressure has parabolic distribution

The unknown values are:

1. n_h
2. H_2 which defines the location of zero value of soil pressure as well as point of rotation O which defines deformation of the pile structure.

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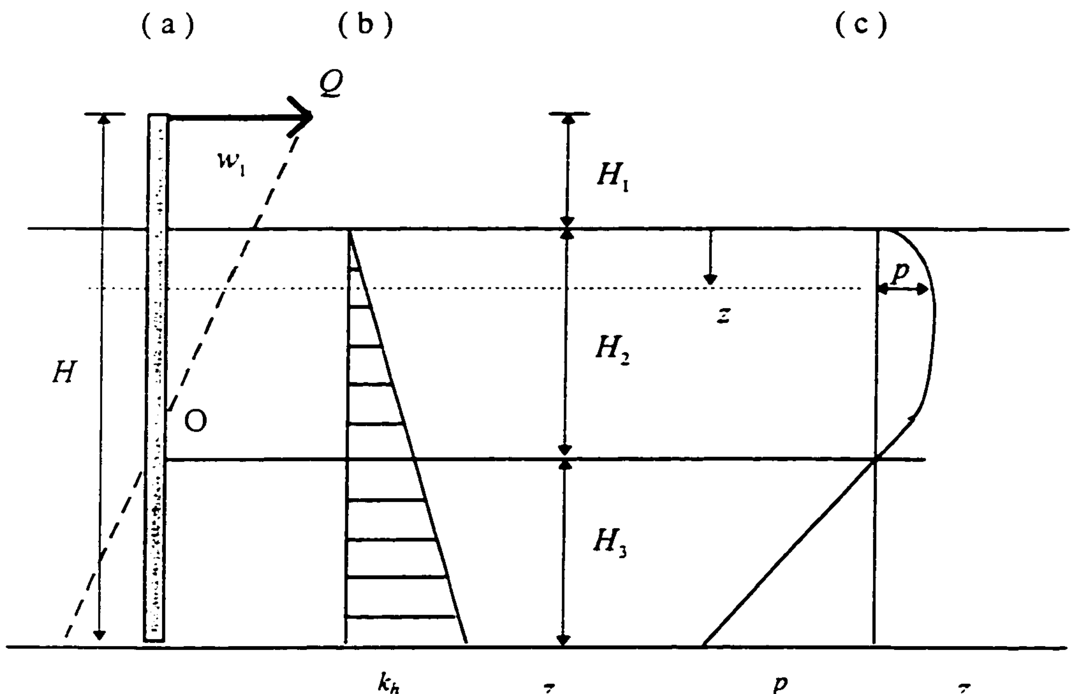
The modeling of the laterally loaded pile structure embedded in sandy soil is shown in Fig. 2.3.



$$k_h = n_h \frac{z}{B}$$

$$p = wn_h \frac{z}{B}$$

$$p = w_1 n_h \frac{1}{B} \frac{z(H_2 - z)}{H_1 + H_2}$$

$$p = \frac{w_1}{B} \frac{n_h}{H_1 + H_2}(zH_2 - z^2)$$

Fig. 2.3 Pile Embedded in Sandy Soil Subjected to Horizontal Load

Based on Terzaghi's assumptions, the soil reaction p at arbitrary point z can be defined as:

$$p = wn_h \frac{z}{B} \tag{2.18}$$

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Due to assumed rigid rotation of the pile, the soil reaction p of Eq. (2.18) can be related to the displacement w_1 of the top point A of the pile by means of proportionality law, which results in the following relationship:

$$p = w_1 n_h \frac{1}{B} \frac{z(H_2 - z)}{H_1 + H_2} \tag{2.19}$$

or slightly modified as:

$$p = \frac{w_1}{B} \frac{n_h}{H_1 + H_2} (zH_2 - z^2) \tag{2.20}$$

The two unknowns H_2 and n_h can be determined from two equilibrium equations. Taking sum of the moments about the pile structure at the point of application of the load Q gives:

$$\sum M_Q = 0$$

$$\left(\frac{2}{3} p_{max} H_2\right)\left(H_1 + \frac{H_2}{2}\right) - \left(\frac{1}{3} p_{bot} H_3\right)\left(H_1 + H_2 + \frac{3}{4} H_3\right) = 0 \tag{2.21}$$

where:

$$p_{max} = \frac{w_1 n_h}{B(H_1 + H_2)} \frac{H_2^2}{4} \tag{2.22}$$

$$p_{bot} = \frac{w_1 n_h}{B(H_1 + H_2)} \left(H^2 - 2HH_1 + H_1^2 - HH_2 + H_1 H_2\right) \tag{2.23}$$

The unknown H_3 in Eq. (2.21) can be expressed in terms of H, H_1 and H_2 using the following relationship:

$$H = H_1 + H_2 + H_3 \tag{2.24}$$

Then, Eq. (2.21) becomes:

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$$\frac{H_2^3}{2}\left(H_1+\frac{H_2}{2}\right)-\left(H^2-2HH_1+H_1^2-HH_2+H_1H_2\right)\left(H-H_1-H_2\right)\cdot$$
$$\cdot\left(H_1+H_2+\frac{3}{4}\left(H-H_1-H_2\right)\right)=0 \quad (2.25)$$

It is interesting to note that Eq. (2.25) is independent of the material characteristics and contains only geometric quantities of the problem.

The second equation of equilibrium provides the following relationship:

$$\sum F_x = 0 \quad (2.26)$$

$$Q-\frac{2}{3}p_{max}H_2+\frac{1}{3}p_{bot}\left(H-H_1-H_2\right)=0 \quad (2.27)$$

Substitution of the relationships (2.22) and (2.23) into (2.27)gives:

$$Q-\frac{1}{3}\frac{w_1 n_h}{B\left(H_1+H_2\right)}\left(\frac{H_2^3}{2}+H^2-2HH_1+H_1^2-HH_2+H_1H_2\right)H_3=0 \quad (2.28)$$

By solving equations (2.25) and (2.28), the unknowns H_2 and n_h can be determined.

2.3 Determination of k_h for the Clayey Soils Surrounding Laterally Loaded Piles by Terzaghi's Method

The following explains the procedure for the determination of k_h proposed by Terzaghi for the pile embedded in clayey soil shown in Fig. 2.4, and subjected to a horizontal load Q.

Consider a pile structure with length $H = H_1 + H_2 + H_3$, as shown in Fig. 2.4. The pile is embedded in clayey soil along the depth H_2 + H_3 and H_1 is above the

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soil. The pile is loaded by a lateral force, Q, which was increased linearly from zero to its final value.

The analyzed pile satisfies Terzaghi's assumptions, that is:

1. the deformation of the pile is rigid,
2. the deformations are linear,
3. the induced soil reaction/lateral contact pressure has linear distribution

The unknown values are:

1. k_h
2. H_2 which defines the location of zero value of soil pressure as well as point of rotation O which defines deformation of the pile structure.

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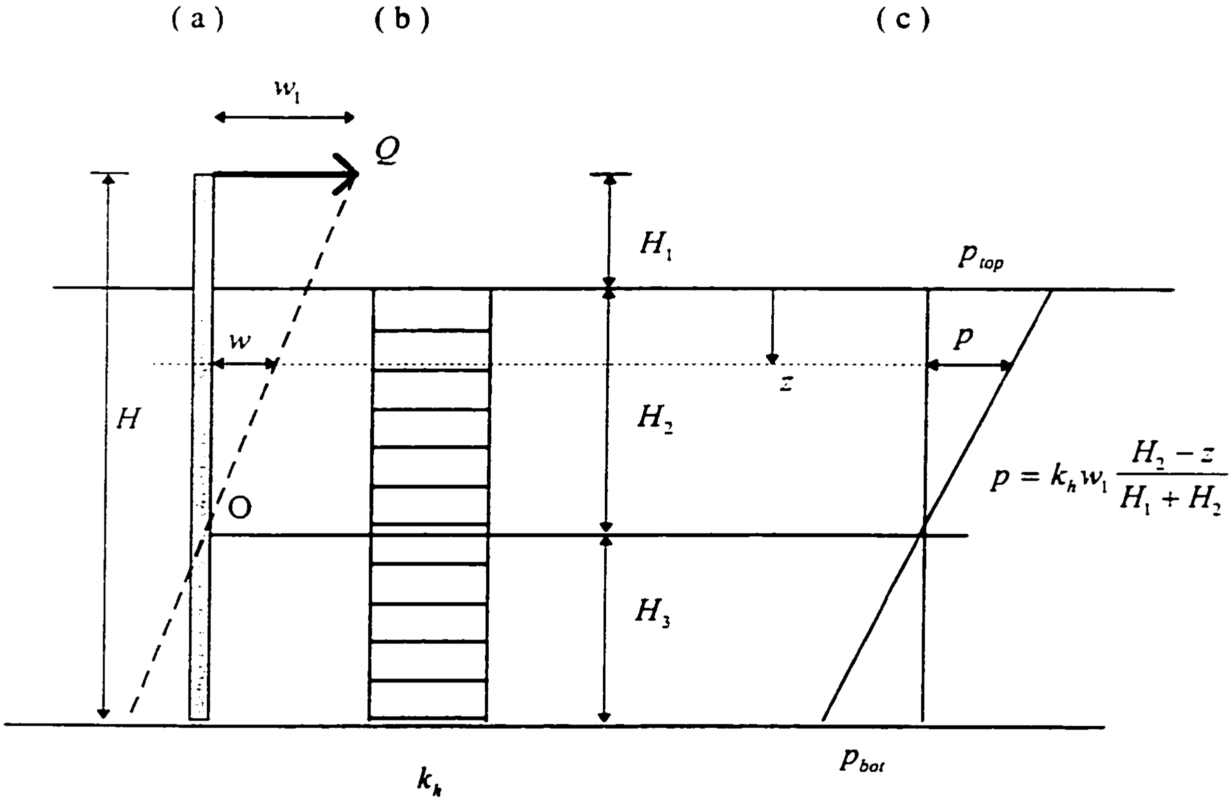

Figure 2.4 Pile Embedded in Clayey Soil Subjected to Horizontal Load

For clayey soil, it is assumed that the coefficient of modulus of subgrade reaction, k_h, as shown in Fig. (2.4) has a constant value from the ground level to the end of the pile.

At arbitrary point z below the surface, the lateral soil pressure p can be expressed as:

$$p = k_h w \tag{2.29}$$

where:

w - is the lateral displacement at arbitrary point z

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Employing the rigid deformation assumptions, Eq. (2.29) can be modified with account for lateral displacement w_1 of the top pile point. Thus another form of the lateral soil pressure p is as follows:

$$p = k_h w_1 \frac{H_2 - z}{H_1 + H_2} \tag{2.30}$$

The unknown quantities k_h and H_2 can be next determined based on the equilibrium requirements. This means that the sum of the moments, taken about the pile structure at the point of application of the load Q should be equal to zero:

$$\sum M_Q = 0 \tag{2.31}$$

Employing the postulated distribution of soil reaction given by Eq. (2.30), the equilibrium equation (Eq. 2.31) results:

$$Q(H_1 + H_2) - \frac{1}{2} p_{top} H_2 \frac{2}{3} H_2 - \frac{1}{2} p_{bot} (H - H_1 - H_2) \frac{2}{3} (H - H_1 - H_2) = 0 \tag{2.32}$$

where:

$$p_{top} = k_h w_1 \frac{H_2}{H_1 + H_2} \tag{2.33}$$

$$p_{bot} = k_h w_1 \frac{H - H_1}{H_1 + H_2} \tag{2.34}$$

The next equation of equilibrium required to be used is the following:

$$\sum F_x = 0 \tag{2.35}$$

$$Q - \frac{1}{2} p_{top} H_2 + \frac{1}{2} p_{bot} (H - H_1 - H_2) = 0 \tag{2.36}$$

By solving equations (2.32) and (2.36) we can determine the unknowns H_2 and k_h.

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2.4 Calculation of the Characteristic Pile Length (λ) for Sandy Soil

The derived Eqs. (2.25 and 2.28) constitute the starting point for determination of initial value of n_h in laboratory for the pile embedded in sandy soil. The given values required by Eqs. (2.25 and 2.28) were taken as:

$$H = 0.53\ m \tag{2.37}$$

$$Q = 170\ N \tag{2.38}$$

$$w_1 = 0.00027\ m \tag{2.39}$$

$$H_1 = 0.0762\ m \tag{2.40}$$

$$E = 207000 \cdot 10^6 \frac{N}{m^2} \tag{2.41}$$

$$I = 0.018 \cdot 10^{-6} m^4 \tag{2.42}$$

The laboratory experiment resulted in the following initial value for n_h:

$$n_h = 7300\ kN/m^3 \qquad / \tag{2.43}$$

The behavior of the laterally loaded pile structure depends on its length which can be expressed in terms of characteristic length λ. Consequently the characteristic length is the function of the type of soil and the bending stiffness of the pile structure EI. For linear variability of k_h, λ is given by the following formula

$$\lambda = \sqrt[5]{\frac{EI}{n_h}} \tag{2.44}$$

Substituting experimental data, we have:

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$$\lambda=\sqrt[5]{\frac{(207000\cdot10^{6}\frac{N}{m^{2}})(0.018\cdot10^{-6}m^{4})}{7.3\cdot10^{6}\frac{N}{m^{3}}}}=0.220\ m \tag{2.45}$$

2.5 Calculation of the Characteristic Pile Length (λ) for Clayey Soil

The characteristic length of the pile structure with bending stiffness EI embedded in soil with $k_h = const$ is given by the following formula:

$$\lambda=\sqrt[4]{\frac{EI}{k_h}} \tag{2.46}$$

The initial value of k_h determined in laboratory was:

$$k_h=224.5\ kN/m^2 \tag{2.47}$$

Based on Eq. (2.41), (2.42), (2.46) and (2.47) the characteristic length of pile embedded in clayey soil was calculated to be:

$$\lambda=\sqrt[4]{\frac{(207000\cdot10^{6}\frac{N}{m^{2}})(0.018\cdot10^{-6}m^{4})}{224500\frac{N}{m^{2}}}}=0.360\ m \tag{2.48}$$

2.6 Different Pile Length Cases Tested

Based on Eq. (2.43), piles having the following lengths were selected for laboratory testing in the case of sandy soil. They are specified below as:

$1.0\lambda=0.220\ m$

$1.2\lambda=0.264\ m$

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$1.4\lambda=0.308\ m$

$2.0\lambda=0.440\ m$

$2.2\lambda=0.484\ m$

$2.4\lambda=0.528\ m$

For clayey soil, Eq. (2.48) provided basis for determination of the lengths of piles to be tested in the laboratory. They are taken as follows:

$1.0\lambda=0.360\ m$

$1.2\lambda=0.432\ m$

$1.4\lambda=0.504\ m$

$1.6\lambda=0.576\ m$

$1.8\lambda=0.648\ m$

$2.0\lambda=0.720\ m$

$2.4\lambda=0.864\ m$

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CHAPTER III

Literature review

The review of research on various aspects of laterally loaded pile is presented below.

Budhu and Davies (1987) presented the results of a numerical analysis of single laterally loaded piles embedded in cohesionless soils by taking soil yielding into account. The input parameters for the soil were the angle of internal friction and a parameter characterizing the increase in soil stiffness with depth and they were assumed to be linear. The analysis showed that soil yielding greatly increases the displacements, rotations, and bending moments of laterally loaded piles.

Meyerhoff and Ghosh (1989) determined under various combinations of eccentricity and inclination of the load varying in direction from vertical to horizontal the ultimate bearing capacity of flexible single model piles as well as small pile groups of timber and nylon in loose sand and soft clay. They presented the results of the load tests in the form of polar bearing capacity diagrams and compared them with theoretical estimates based on the concept on an effective embedment depth in terms of the behavior of equivalent rigid piles. The results of model tests on single flexible piles under eccentric inclined loads in loose sand and

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clay showed that the eccentricity and inclination of the load significantly influenced the ultimate bearing capacity of flexible piles. The vertical component of ultimate eccentric inclined load for flexible piles and pile groups in sand can be approximately obtained by multiplying the ultimate axial bearing capacity of piles and pile groups with an eccentric inclination factor.

Joshi, Sharma and Sparrow (1989) presented research on the instrumented model piles which were loaded to failure using slow-maintained-load (Slow-ML), quick-maintained-load, and constant-rate-of-penetration (CRP) methods of loading. The piles were driven in a prepared dry-sand bed. The applied load, point load, and shaft resistance were measured using load cells and strain gauges, and axial force distribution was determined. Conclusions made were:

1. If the pile load test is performed to determine the ultimate pile capacity, it does not matter which test method is selected. If time is constraint, then CRP test method is recommended.
2. When the load versus displacement curve is desired for conditions occurring during the construction process, the Slow-ML test method is the most realistic procedure.
3. Axial force distribution and shaft resistance distribution along the pile are identical regardless of pile test method.

Behavior of flexible piles under inclined loads was considered by Sastry and Meyerhoff (1990). Research was done on the lateral soil pressures, bending

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moments, pile displacements at ground surface, and bearing capacity of instrumented vertical single flexible model piles in homogeneous loose sand and soft clay under central inclined loads. The axial pile capacity of a flexible pile will be unchanged from that of a rigid pile, whereas under lateral load, the capacity of a flexible pile can be estimated using the concept of an " effective embedment depth " of an equivalent rigid pile.

The bearing capacity of flexible model piles and small pile groups under axial, lateral, and various combinations of eccentric and inclined loads in layered soil consisting of clay overlying sand was investigated by Yalcin and Meyerhoff (1991). It was found that in absence of structural pile failure the ultimate loads depend not only on the eccentricity and inclination of the load but also on the ratio of the upper clay soil layer thickness to pile embedment. The results showed that the ultimate bearing capacity varies with load eccentricity and inclination and with the ratio of upper soil thickness to pile embedment in a similar way to that of single piles.

Yan and Byrne (1992) published a paper on lateral pile response to monotonic pile head loading. This paper presented results from series of model tests of single vertical piles subjected to lateral monotonic pile head loading. Model tests were carried out in sand under a simulated field stress conditions using the hydraulic gradient similitude technique. The focus of studies was on examining various factors that affect the soil-pile interaction in terms of P-y curves. The tests showed

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that experimental P-y curves are nonlinear and stress dependent. Comparison was made between experimental P-y curves and those recommended by the American Petroleum Institute. The proposed parabolic P-y curves can better resemble experimental P-y curves and give a better prediction of pile response for both free- and fixed-head conditions.

Investigation was done by Sastry and Meyerhoff (1994) on the lateral soil pressures, bending moments, pile displacements at ground surface, and bearing capacity of instrumented vertical single flexible model pile in layered sands consisting of loose sand overlying compact sand under vertical eccentric and central loads. The results of these load tests were compared with theoretical estimates based on the concept of an effective embedment depth of equivalent rigid piles.

Effect of pile driving on adjacent piles in clay was studied by Poulos (1994). While driving a pile into clay, horizontal and vertical movements are developed in the surrounding soil. These movements tend to develop axial forces and bending moments in neighboring piles that have already been installed. Guidelines suggested were: (*i*) avoiding very close spacing of piles; (*ii*) preboring to reduce the induced free-field soil movements; (*iii*) planning of the sequence of pile driving so that cumulative soil movements in the same direction are avoided; (*iv*) re-driving piles that have been observed to have excessively after installation of the surrounding piles; (*v*) avoiding the provision of restraint to the pile heads until all

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the piles within the area of influence (e.g., within at least 10 diameters) have been driven.

Behavior of flexible piles in layered clays under eccentric and inclined loads was studied by Sastry and Meyerhoff (1995). Investigation was done on the lateral soil pressure, bending moments, pile displacements at the ground surface, and the bearing capacity of instrumented vertical single flexible model piles in layered clay system consisting of medium clay overlying soft clay under eccentric and central inclined loads. The lateral soil pressures on the upper portion of the pile shaft of a flexible pile under pure moment and lateral load can be estimated from those on an equivalent rigid pile.

Meyerhoff (1995) reevaluated previous analysis of the ultimate resistance and displacements of flexible piles under lateral loads in cohesionless soils by using correlations based on standard penetration tests. He concluded that for cohesionless soils preliminary estimates of the behavior of piles under lateral loads can, as in case of vertical loads, also be made from the results of standard penetration tests.

Disagreeing with classical Winkler's model to represent an elastic continuum, Vlasov and Leont'ev developed a two-parameter model for a beam on an elastic foundation. In their paper Vallabhan and Das (1991) reached the following conclusions.

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1. It is shown that the value of the modulus of subgrade reaction depends on the depth of the soil, distribution of loading, and stiffness of the beam and the soil.
2. The writers have verified that the loading is either uniform or even linearly varying on the entire beam.
3. The elastic material properties of the soil are employed.
4. The modified Vlasov model can be very easily modified to consider variation of material properties with depth.

The main objective of the work presented in the paper by Anagnostopoulos and Georgiadis (1993) was to investigate experimentally any possible effects of lateral loading on axial pile displacements and stresses as well as the influence of axial loads on the lateral pile response. They concluded:

1. The lateral load increased the axial pile displacement. The amount of increase was dependent on the value of the lateral load and on the level of the axial load.
2. The lateral load caused a small reduction of the axial pile stresses near the ground surface and appeared to have rather limited effects on the ultimate axial load.
3. The effect of axial loading on the lateral pile response was rather limited.
4. The interaction between axial and lateral pile response can be studied with a nonlinear finite-element analysis.

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Prakash and Kumar (1996) developed a method to predict the load-displacement relationship for single piles subjected to lateral load, embedded in sand, considering soil nonlinearity using subgrade reaction. The following conclusions were drawn:

1. For a given relative density of sand, the modulus of horizontal subgrade reaction is an exponential function of strain.
2. Modulus of horizontal subgrade reaction depends on the relative density of sands and the position of the ground-water table.
3. A range of $k_{h,\max}$ values for sands have been proposed for different relative densities for use in practice. Pile type and pile diameter have little effects on $k_{h,\max}$ values.
4. A design procedure has been proposed to predict the load-deflection curve considering soil nonlinearity.
5. For piles in dense sands, the maximum variation in predicting load using the P-y method is approximately two times that of the proposed method. For medium sands, both methods predict reasonably close loads, but the proposed method is more rational and easy to use.
6. The maximum variation in the load-deflection plot using this method for loose sands is about 80%. Therefore, more data for piles in loose sands need to be analyzed to narrow the range of $k_{h,\max}$ values.

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The greatest advantage of the proposed method is that it predicts upper- and lower-bound load-deflection curves, which are valuable guides to making engineering decisions.

In their study Prasad and Rao (1996) investigated the behavior of helical piles under lateral loads in clayey soils. They concluded that lateral capacity of helical piles increases with embedment depth and shear strength of the soil. The capacity of a helical pile is greater than the capacity of a single pile shaft and increases with the number of helical plates. The capacity of helical piles is 1.2-1.5 times the capacity of a single straight pile shaft without plates.

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CHAPTER IV

Sensitivity Analysis of Laterally Loaded Piles Embedded in Homogeneous Soil

Consider a pile embedded in a homogeneous soil as shown in Fig. 4.1. The pile is subjected to lateral load which can be a horizontal force P_0 and/or bending moment M_0 applied at the top cross section. The pile structure is modeled as a beam element with the bending stiffness *EI*.

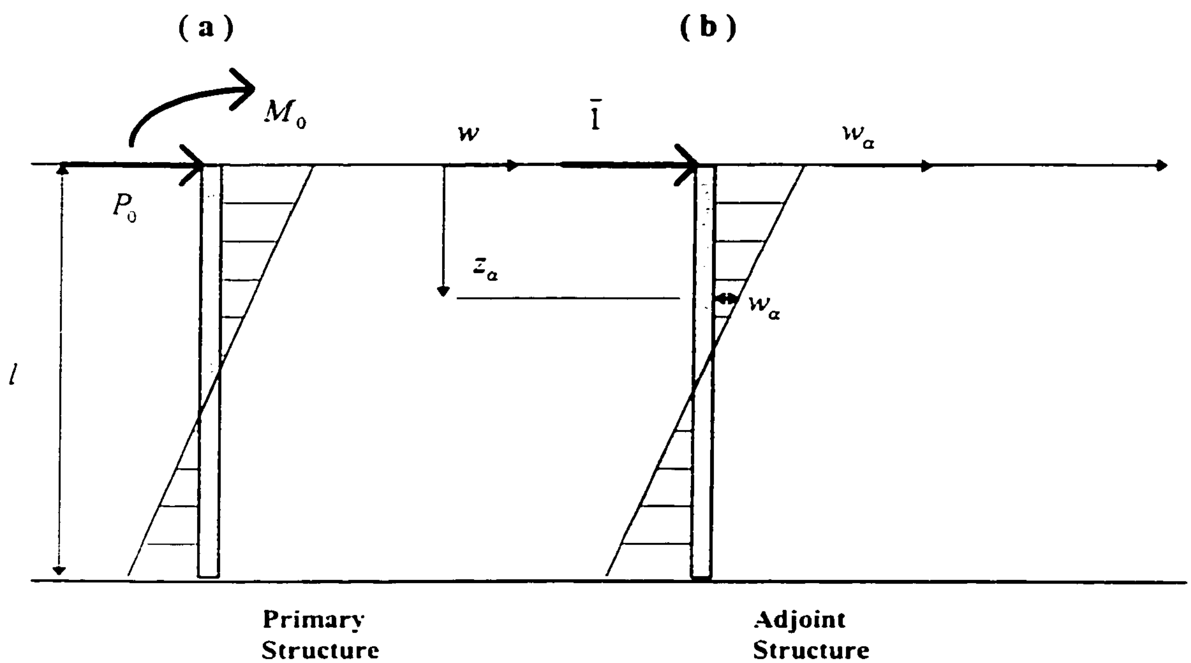

Figure 4.1 Primary and Adjoint Structures

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The response of the surrounding soil is simulated as the Winkler foundation having the modulus of subgrade reaction equal to k_h. In this way defined structure is called the primary structure. The behavior of that structure is analyzed in coordinate system z, w (shown in the Fig. 4.1) permanently attached to the top cross section of the pile. The z variable defines spatial variable, while w denotes variable lateral displacement. The determination of the lateral displacement w_α at arbitrary cross-section $z = z_\alpha$ can be obtained by means of virtual work theorem with an aid of the adjoint structure concept proposed by Budkowska and Szymczak (1992), which is made of the same material as the primary structure, has the same dimensions and boundary conditions as the primary structure and subject to unit load $\bar{1}$ applied at the top cross-section, Thus,

$$\bar{1} \cdot w_\alpha = \int_0^l \left(\overline{M}^p \cdot w'' - \bar{r}^p \cdot w \right) \cdot dz \tag{4.1}$$

where:

w, w'' - denote the generalized lateral displacements of primary structure,

$\overline{M}^p, \bar{r}^p$ - stand for the bending moment and the soil reaction of the adjoint structure obtained as the result of the application unit force $\bar{1}$ (shown in the Fig. 4.1) at the cross-section $z = z_\alpha$

Next, consider the primary structure which is subjected to the same load conditions, however having slightly different EI and k_h which are considered to be the design

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variables. At the same point $z = z_\alpha$, the lateral displacement will be $w_{\alpha 1}$. The virtual work theorem allows us to write the following equation which employs the adjoint structure concept.

$$\bar{1} \cdot w_{\alpha 1} = \int_0^l \left(\overline{M}_1^p \cdot w_1^{\cdot\cdot} - \bar{r}_1^p \cdot w_1 \right) \cdot dz \tag{4.2}$$

where:

$\overline{M}_1^p, \bar{r}_1^p$ - are the bending moment and soil reaction of primary structure subject to unit force $\bar{1}$,

$w_1, w_1^{\cdot\cdot}$ - stand for generalized lateral displacement of primary structure.

Assuming small displacement theory, the following relationships exist for the primary structures:

$$M_1 = M + \delta(M) \tag{4.3}$$

$$w_1 = w + \delta(w) \tag{4.4}$$

$$r_1 = r + \delta(r) \tag{4.5}$$

$$w_1^{\cdot\cdot} = w^{\cdot\cdot} + \delta(w^{\cdot\cdot}) \tag{4.6}$$

where:

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$\delta(\ldots)$ - denotes the first variation of specified quantity, (i.e. linear part of small changes of indicated quantity)

Similar relationships can be written for the adjoint structures:

$$\overline{M}_1^p = \overline{M}^p + \delta(\overline{M}) \tag{4.7}$$

$$\overline{w}_1 = \overline{w}^p + \delta(\overline{w}) \tag{4.8}$$

$$\overline{r}_1^p = \overline{r}^p + \delta(\overline{r}^p) \tag{4.9}$$

$$\overline{w}_1^{p''} = \overline{w}^{p''} + \delta(\overline{w}^{p''}) \tag{4.10}$$

The primary structure as well as the adjoint structure satisfy the following constitutive relationships

$$EI \cdot w'' = -M \tag{4.11}$$

$$k_h \cdot w = r \tag{4.12}$$

For the adjoint structure, we can write similarly, that is :

$$EI \cdot \overline{w}^{p''} = -\overline{M}^p \tag{4.13}$$

$$k_h \cdot \overline{w}^p = \overline{r}^p \tag{4.14}$$

Subtracting Eq. (4.1) from Eq. (4.2), we have:

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$$\bar{1}\cdot\left(\bar{w}_{\alpha 1}-\bar{w}_{\alpha}\right)=\int_{0}^{l}\left(\overline{M}_{1}^{p}\cdot w_{1}^{"}-\bar{r}_{1}^{p}\cdot w_{1}\right)\cdot dz-\int_{0}^{l}\left(\overline{M}^{p}\cdot w"-\bar{r}^{p}\cdot w\right)\cdot dz \tag{4.15}$$

Substituting Eqs. (4.4), (4.6), (4.7), (4.8), (4.9) and (4.10) into Eq. (4.15) we have:

$$\begin{aligned}\bar{1}\cdot\delta\left(w_{\alpha}\right)=&\int_{0}^{l}\left[\left(\overline{M}^{p}+\delta\left(M^{p}\right)\right)\left(w"+\delta\left(w"\right)\right)-\left(\bar{r}^{p}+\delta\left(\bar{r}^{p}\right)\right)\left(w+\delta\left(w\right)\right)\right]\cdot dz-\\&-\int_{0}^{l}\left(\overline{M}^{p}\cdot w"-\bar{r}^{p}\cdot w\right)\cdot dz\end{aligned} \tag{4.16}$$

Performing the required operations, Eq. (4.16) can be expressed as:

$$\begin{aligned}\bar{1}\cdot\left(w_{\alpha}\right)=&\int_{0}^{l}\left(\overline{M}^{p}\cdot w"+\delta\left(M^{p}\right)\cdot w"+\overline{M}^{p}\cdot\delta\left(w"\right)+\delta\left(M^{p}\right)\cdot\delta\left(w"\right)\right)\cdot dz-\\&-\int_{0}^{l}\left(\bar{r}^{p}\cdot w-\delta\left(\bar{r}^{p}\right)\cdot w-\bar{r}^{p}\cdot\delta\left(w\right)-\delta\left(\bar{r}^{p}\right)\cdot\delta\left(w\right)\right)\cdot dz-\int_{0}^{l}\left(\overline{M}^{p}\cdot w"-\bar{r}^{p}\cdot w\right)\cdot dz\end{aligned} \tag{4.17}$$

Neglecting the terms of higher order, Eq. (4.17) gives:

$$\bar{1}\cdot\delta\left(w_{\alpha}\right)=\int_{0}^{l}\left(\delta\left(\overline{M}^{p}\right)\cdot w"+\overline{M}^{p}\cdot\delta\left(w"\right)-\delta\left(\bar{r}^{p}\right)\cdot w-\bar{r}^{p}\cdot\delta\left(w\right)\right)\cdot dz \tag{4.18}$$

After rearrangement Eq. (4.18) can be expressed as:

$$\bar{1}\cdot\delta\left(w_{\alpha}\right)=\int_{0}^{l}\left(\overline{M}^{p}\cdot\delta\left(w"\right)-\bar{r}^{p}\cdot\delta\left(w\right)\right)\cdot dz+\int_{0}^{l}\left(\delta\left(\overline{M}^{p}\right)\cdot w"-\delta\left(\bar{r}^{p}\right)\cdot w\right)\cdot dz \tag{4.19}$$

The Eq. (4.11) and (4.12) for the primary structure can be presented as:

$$w"=-\frac{M}{EI} \tag{4.20}$$

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$$w = \frac{r}{k_h} \tag{4.21}$$

Internal forces M, P in Eqs. (4.11) and (4.12) depend on the state variables w, w'' as well as the design variables EI and k_h. The variations of w'' and w of Eqs. (4.20) and (4.21) have the following form:

$$\delta(w'') = -\frac{\delta(M)}{EI} + \frac{M}{(EI)^2}\cdot\delta(EI) \tag{4.22}$$

$$\delta(w) = \frac{\delta(r)}{k} - \frac{r}{k^2}\cdot\delta(k_h) \tag{4.23}$$

Substituting Eqs. (4.22) and (4.23) into Eq. (4.19) we have:

$$\begin{aligned}\bar{1}\cdot\delta(w_a) = \int_0^l \left\{\overline{M}^p\left[\left(-\frac{\delta(M)}{EI}\right) + \frac{M}{(EI)^2}\cdot\delta(EI)\right] - \bar{r}^p\left(\frac{\delta(r)}{k} - \frac{r}{k^2}\cdot\delta(k_h)\right)\right\}\cdot dz + \\ + \int_0^l \left(\delta\left(\overline{M}^p\right)\cdot w'' - \delta\left(\bar{r}^p\right)\cdot w\right)\cdot dz\end{aligned} \tag{4.24}$$

Performing the required operations, Eq. (4.24) can be presented as:

$$\begin{aligned}\bar{1}\cdot\delta(w_a) = \int_0^l \left(\frac{\overline{M}^p\cdot M}{(EI)^2}\cdot\delta(EI) + \frac{\bar{r}^p\cdot r}{k^2}\cdot\delta(k_h)\right)\cdot dz + \\ + \int_0^l \left(\frac{\overline{M}^p\cdot\delta(M)}{EI} - \frac{\bar{r}^p\cdot\delta(r)}{k_h}\right)\cdot dz - \int_0^l \left(\delta\left(\overline{M}^p\right)\cdot w'' - \delta\left(\bar{r}^p\right)\cdot w\right)\cdot dz\end{aligned} \tag{4.25}$$

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Since the primary structure is subjected to constant load conditions, therefore the variations of internal forces are equal to zero. This means that second integral must vanish. A similar condition is also applied to the adjoint structure. Therefore the third integral is also equal to zero. Thus, Eq. (4.25) reduces to the following form:

$$\bar{1}\cdot\delta(w_\alpha)=\int_0^l\left[\frac{\overline{M}^p\cdot M}{(EI)^2}\cdot\delta(EI)+\frac{\bar{r}^p\cdot r}{k_h^2}\delta(k_h)\right]\cdot dz \tag{4.26}$$

It is clear that Eq. (4.26) represents the sensitivity equation of lateral displacement w_α of the primary structure caused by the variations of the design variables i.e. bending stiffness of the pile *EI* and the modulus of subgrade reaction k_h.

Substitution of constitutive relationships (4.11), (4.12) for the primary structure and (4.13), (4.14) for the adjoint structure into Eq. (4.26) gives:

$$\bar{1}\cdot\delta(w_\alpha)=\int_0^l\left[\overline{w}^{p''}\cdot w''\cdot\delta(EI)+\overline{w}^p\cdot w\cdot\delta(k_h)\right]\cdot dz \tag{4.27}$$

It is interesting to notice, that the determined sensitivity equation of lateral displacement w_α due to the changes of bending stiffness of the pile structure *EI* and the modulus of subgrade reaction k_h contains only generalized displacements of primary and adjoint structures and the variations of the design variables.

Based on the presented considerations, Eq. (4.27) enables one to compute the changes of lateral displacement $\delta(w_\alpha)$ at arbitrary cross-section $z=z_\alpha$ caused by

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the change of EI and k_h. In particular, if EI is constant, then $\delta(EI)$ is equal to zero and Eq. (4.27) becomes:

$$\bar{1} \cdot \delta(w_a) = \int_0^l \left(\overline{w}^p \cdot w \cdot \delta(k_h)\right) \cdot dz \tag{4.28}$$

It is worth noticing, that this formulation enables one to consider bending stiffness EI and the modulus of subgrade reaction k_h in Eq. (4.27) not as the scalar parameter but as the function. The under integral functions w and $\overline{w^p}$ represent the lateral displacement along the pile for the primary structure and adjoint structure respectively. These functions have to be determined for analyzed load conditions either analytically or numerically.

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CHAPTER V

Application of Sensitivity Theory to Identification Problems

5.1 The Difference Between Sensitivity Formulation and Identification Process

Equation (4.28) obtained as the special case of sensitivity of lateral displacement w_α at arbitrary cross section $z = z_\alpha$ due to the change of modulus of subgrade reaction k_h can be employed in identification of true value of material characteristics of the soil medium in which the pile structure is embedded. The identification problem is considered as the inverse to sensitivity formulation.

The typical approach of physical (or material) identification problem is as follows:

The mathematical model which defines the behavior of the system is given. This model requires to its description some physical parameters which can be determined experimentally based on experimental methods. The reliability of experimental method means, that physical parameters determined in laboratory confronted with mathematical model should give the same results in laboratory as well as those obtained from theoretical analysis.

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If the discrepancy between theoretical and experimental results exists, it is postulated that it is associated with incorrectly determined parameters. In the investigated problem of laterally loaded piles embedded in homogeneous soil, this formulation is referred to identification of modulus of subgrade reaction of the soil surrounding the laterally loaded pile structure. The laboratory tested laterally loaded pile structure provides the results in terms of the horizontal displacement component *w(lab)*.

Based on these results, the material characteristics have been determined which are denoted as *k(lab)*. Application of *k(lab)* to theoretical model provided the corresponding results in terms of lateral displacements $w(anal)$ which turned out to be different than *w(lab)*.

The differences in *w(lab)* and *w(anal)* for the same geometry and the same load conditions enabled one to determine the variations of lateral displacement at a specified point, defined as:

$$\delta(w_a) = w(lab) - w(anal) \tag{5.1}$$

It represents the error, which is postulated to be associated with incorrectly determined physical parameter k_h. It is worth noting, that the distribution of $\delta(EI)$ and $\delta(k_h)$ in Eq. (4.27) are considered to be given and the unknown is $\delta(w_a)$, while in identification problem the $\delta(w_a)$ in Eq. (5.1) is given and the unknown is $\delta(k_h)$. Therefore, the physical identification is the inverse problem to

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sensitivity analysis. In other words, during identification process, the sought correction of physical parameter assures the minimization of the error of deformation between experimental and theoretical model. The left hand sides of Eq. (4.28) and (5.1) represent the same quantity.

5.2 Application of Sensitivity Analysis in the Determination of δn_h for Sandy Soil

The true behavior of the pile structure subject to the lateral load is represented by the curve A in the Fig. 2.1. It constituted basis for determination of initial value of n_h based on Terzaghi's method. Then the investigated problem was verified numerically by means of program BESPO which is the Finite Element Analysis program for the Beam on Elastic Foundation. The Finite Element Method requires the discretization of a structural system into n finite elements. In the case of the beam on elastic foundation, the discretization should be performed such that each element j should have constant EI and k_h. The arbitrary finite element j can be subjected to uniform trapezoidal load distributed between nodes I and K. However the concentrated forces and moments can be applied only to the nodes. The program is able to analyze arbitrary changes of k_h however, the distribution of k_h between nodes I and K should have constant value. For sandy soil, the linear variability of k_h associated with $n_h = const$ requires application of stepwise

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incremental distribution of k_h. In numerical analysis performed by means of BESPO program the laterally loaded piles were discretized into 20 finite elements.

The following notations were used in identification of δn_h:

w - Distribution of lateral displacement along the pile length produced by the lateral load.

$\bar{w}$ - Distribution of the lateral displacement along pile axis produced by unit lateral load $\bar{1}$ applied at the top cross-section of the adjoint structure.

The values of w and $\bar{w}$, as obtained from the computer program, are given in Appendix E through Appendix H.

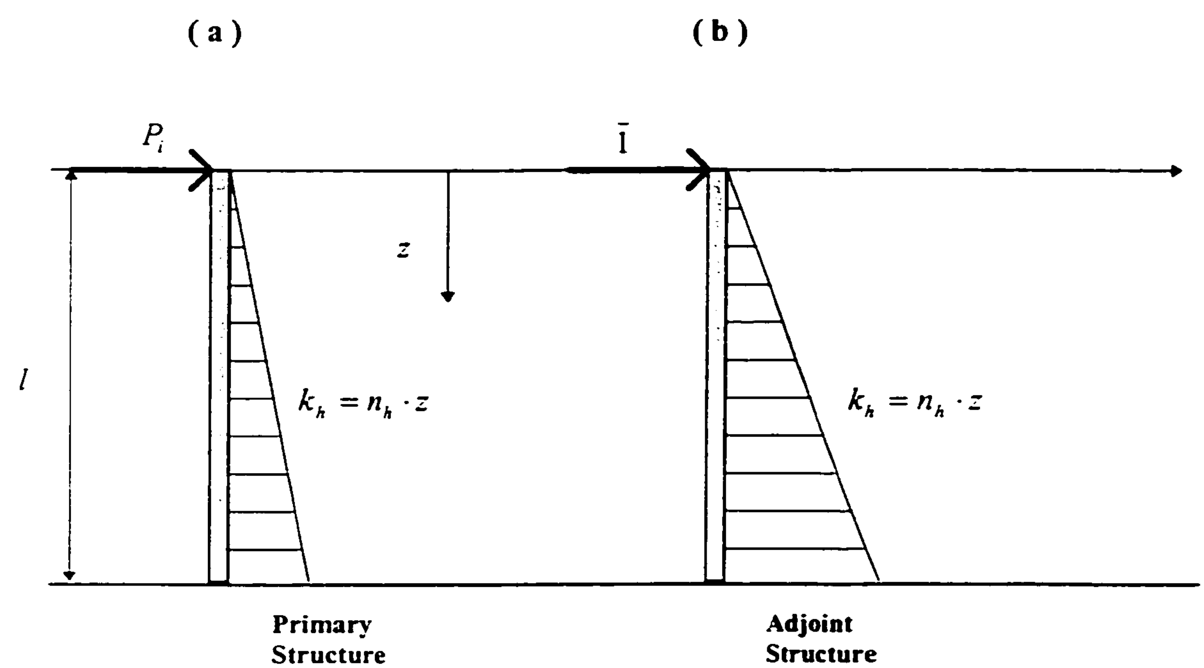

Figure 5.1
Primary and Adjoint Structures for Piles Embedded in Sandy Soil

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Due to the fact that for the same load condition $w_A \neq w_B$, therefore, the error δw is defined as:

$$\delta w = w_B - w_A \tag{5.2}$$

where:

w_A - lateral displacement at the top of the cross-section from laboratory (located on the curve A)

w_B - lateral displacement at the top cross-section obtained from the computer program (located on curve B)

The sensitivity equation given by Eq. (4.28) which will be used in identification of n_h requires some modification. This is connected with variation of δk_h, which for sandy soil is represented as:

$$\delta k_h = \delta n_h \cdot z \tag{5.3}$$

where:

δn_h - is the variation of n_h which minimizes the error of displacement δw_h

z - stands for the arbitrary depth of embedment of the pile.

Substitution of the relationship (5.3) into Eq. (4.28) gives:

$$\delta w = \int_0^l \delta n_h \cdot w \cdot \overline{w} \cdot z \cdot dz \tag{5.4}$$

Since δn_h is constant value, therefore it can be taken in front of the integral.

Thus:

$$\delta w = \delta n_h \int_0^l w \cdot \overline{w} \cdot z \cdot dz \tag{5.5}$$

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Finally δn_h can be calculated as:

$$\delta n_h = \frac{w_B - w_A}{\int_0^l w \cdot \overline{w} \cdot z \cdot dz} \tag{5.6}$$

Based on the results of computational analysis, the evaluation of the integral in Eq. (5.6) was performed numerically using Simpson's method. The investigations were conducted for set of piles subjected to horizontal forces and bending moment applied to the top cross section of the pile. Each of these bending loads was analyzed separately.

The numerical evaluations of the integral given by Eq. (5.6) are presented in Appendices E and F. The results of the identification analysis are presented in Figs. E1, and F1 of the Appendices E, and F respectively.

5.3 Application of Sensitivity Analysis in the Determination of δk_h for Clayey Soil

Due to the fact that for clayey soil $k = const$ with depth, its variation is also constant along the depth of the pile embedment.

The modified Eq. (4.28) for identification of k_h for the clayey soil now becomes:

$$w_B - w_A = \int_0^l \delta k_h \cdot w \cdot \overline{w} \cdot dz \tag{5.7}$$

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therefore, the variation of k_h can be defined as:

$$\delta k_h = \frac{w_B - w_A}{\int_0^l w \cdot \overline{w} \cdot dz} \tag{5.8}$$

The evaluation of the integral in Eq. (5.8) is done numerically by means of Simpson's method for the set of horizontal forces and bending moments applied to the top cross section of the piles embedded in clayey soils. The results of numerical evaluation of Eq. (5.8) are presented in Appendices G and H, together with figures G1 and H1 showing the identifications of k_h.

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CHAPTER VI

Experimental procedure and laboratory set-up

6.1 Purpose

The purpose of this experiment was to obtain deflections of pile structures while subjected to lateral loads. Four different cases were tested:

1. Pile structures having different lengths embedded in sandy soil subjected to horizontal forces.
2. Pile structures having different lengths embedded in sandy soil subjected to bending moments.
3. Pile structures having different lengths embedded in clayey soil subjected to horizontal forces.
4. Pile structures having different lengths embedded in clayey soil subjected to bending moments.

6.2.a Preparation of the Testing Container for Sandy Soil

The testing container (shown in Fig. 6.1) was 0.8 meters wide, 2 meters long and 1.7 meters high. It is made of 15 millimeter thick Plexiglas. In order to test the pile structures in sandy soil, the testing container was filled with sand in 250 millimeter layers. Each layer was compacted following the same procedure (using a wooden impact hammer) in order to have consistently compacted sandy soil.

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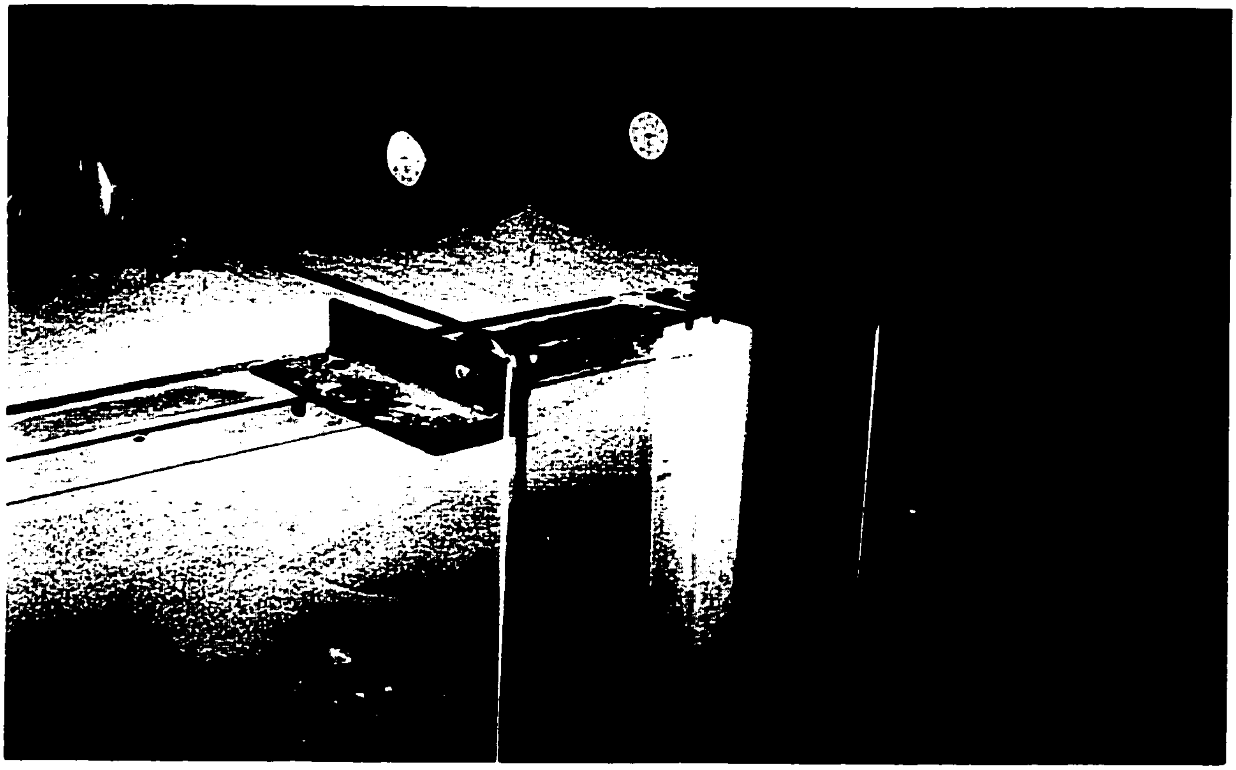

Fig. 6.1 Testing Container

6.2.b Preparation of the Testing Container for Clayey Soil

When preparing the testing container for the clayey soil, the first step was to mix sand and clay with the aid of a small concrete mixer. The ratio by weight was 1:1. After mixing, the soil and clay mixture was shoveled into the testing container and compacted in 250 millimeter layers.

6.3 Method of Driving the Pile Structures into the Soil

In order to save time while testing in the laboratory three pile structures were tested simultaneously. Three piles were used for each length investigated in order to

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ensure that the results obtained were accurate and consistent. By placing the piles 350 mm apart, any interference due to their movement was avoided. The pile structures were driven into the soil with the sledge hammer.

6.4 Description of the Testing Equipment for Application of the Horizontal Load

After driving the pile structures into the soil, the horizontal load was applied using steel cables by means of a system of pulleys (refer to Fig. 6.2). One end of the steel cables was attached to the pile structure 25 mm above the soil surface. Cables were then driven from the pile structures out of the testing container over the friction-less pulleys and the weights were attached to the other end of the cables.

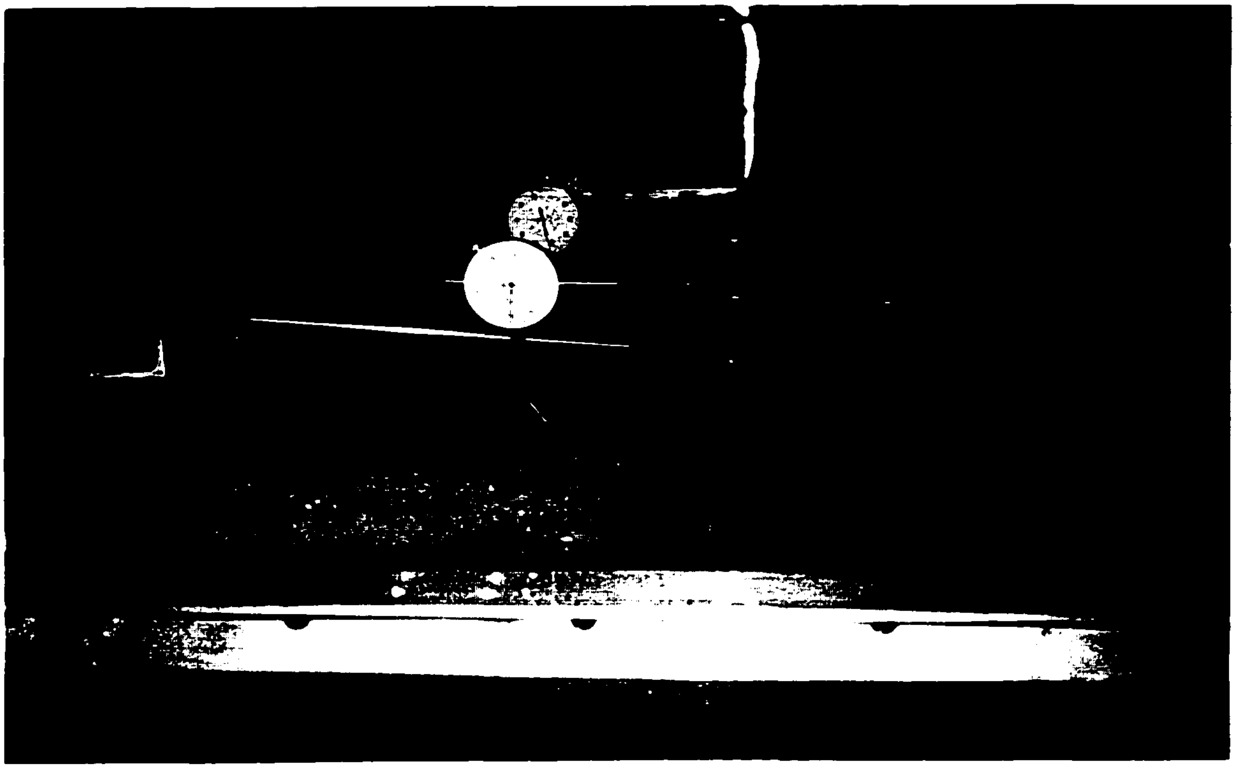

Fig. 6.2 Piles Embedded in Sandy Soil Subjected to Horizontal Load

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6.5 Description of the Testing Equipment for Application of the Bending Moment

In order to analyze the behaviour of piles subjected to bending moments, a frame was designed and built to apply a bending moment to the piles (see Figure 6.3). This frame allowed the moment to be applied as a couple force system at a distance of 254 millimeters. Therefore the bending moment applied was equal to the moment arm (254 millimeters) times force (mass applied times the gravity of acceleration).

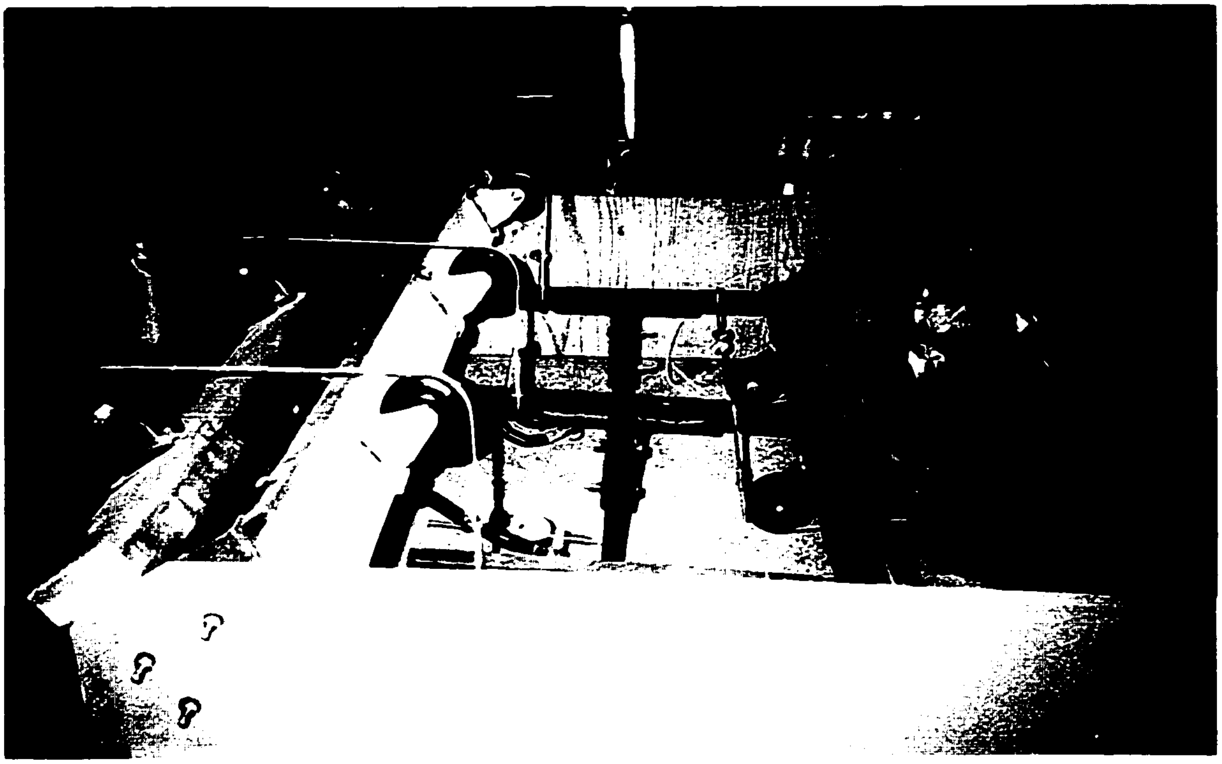

Fig. 6.3 Frame for the Application of Bending Moments

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6.6 Measurement of the Pile Structure Displacements

Pile structure displacements were measured with dial gauges (Figure 6.4). The bases of the dial gauges were attached to a steel beam which was independent of the pile movements. Displacements of the pile structures were recorded as close to the soil level as possible. Load increments were applied each 15 minutes, allowing the pile structure to settle.

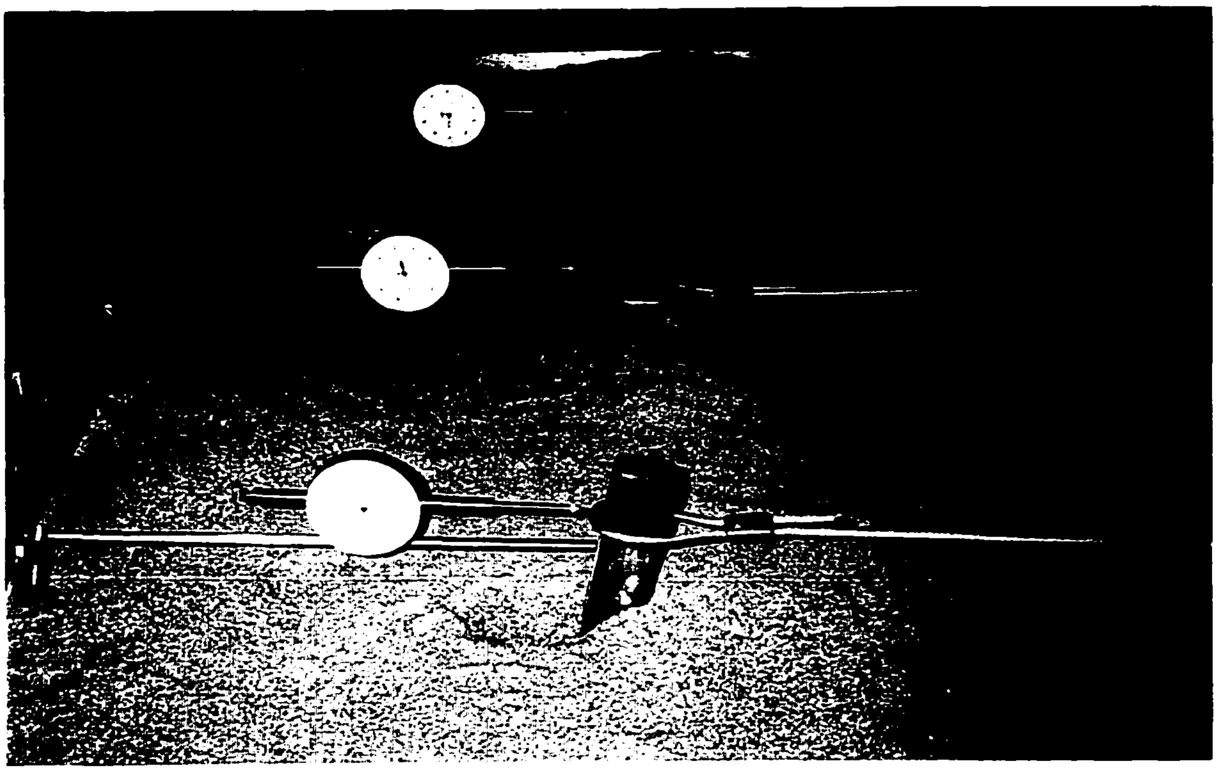

Fig. 6.4 Dial Gauges Used For Measurement of Horizontal Pile Displacements

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CHAPTER VII

Analysis of Experimental Results and Discussion on Identification Investigations

7.1 Discussion on Parameters Associated with Soil Behavior Surrounding Laterally Loaded Piles

The survey of literature on laterally loaded piles generated some questions on irregularities in definitions of the constant of modulus of subgrade reaction n_h and the modulus of subgrade reaction k_h . The first one is connected with linear variability of k_h and is used in simulation of the sandy soil by means of system of springs, while the second parameter k_h with its constant value is associated with modeling of clayey soil by means of system of springs.

This important soil parameter attracted the attention of Terzaghi who wrote a paper to clarify that problem. Unfortunately since that time, many books and papers contain information with misleading data.

The problem is connected with erroneous interpretation of the meaning of the modulus of subgrade reaction k_h which is used in analysis of beams on elastic foundations.

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The starting point is the equilibrium equation which has the form of differential equation for the beam supported by Winkler's foundation written as:

$$EI\frac{d^4w}{dz^4} + kw = p \tag{7.1}$$

where w, $\frac{d^4w}{dz^4}$ are generalized lateral displacement, k [kN/m^2] means the modulus of subgrade reaction acting an the beam of width B, and p denotes the lateral linear load.

This equation considers beam as the linear element. It means, that load $p(z)$ on the right hand side of Eq. (7.1) (in SI system) has units *kN/m*. Consequently, each term on left hand side of Eq. (7.1) should also have the same units. The first term ($EI\frac{d^4w}{dz^4}$) satisfies this requirement. It is worth emphasizing that term *EI* contains real size of the beam as well as the type of material.

The second term on the left hand side of equation (7.1) requires that k_h has unit kN/m^2. However k_h, similarly to the first term of left hand side is already associated with beam having bending stiffness EI and the width equal to B. It is commonly understood, that k_h is the property of the soil and should be independent of the dimensions of the beam element. In order to satisfy that postulate, it is reasonable to introduce another value of $\overline{k_h}$ which represents spring type properties of the soil and enables one to simulate the soil as the elastic foundation of Winkler type.

It is proposed to define the $\overline{k_h}$ quantity as:

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$$\overline{k_h} = \frac{k_h}{B} \qquad (7.2)$$

which is called the real coefficient of modulus of subgrade reaction. It is important to notice, that the unit of $\overline{k_h}$ is kN/m^3 not kN/m^2 which characterizes k_h. Thus, based on the $\overline{k_h}$, the determination of k_h for a given problem can be obtained as

$$k_h = \overline{k_h} B \qquad (7.3)$$

where:

B - is the width of the analyzed beam.

Similar confusion is connected with n_h value which characterizes linear variability of the modulus of subgrade reaction k_h used in analysis of sandy soil.

This problem can be explained again with help of Eq. (7.1), which is valid for constant value of k_h as well as for linear distribution.

In the latter case, k_h can be expressed as:

$$k_h = n_h z \qquad (7.4)$$

The previous discussion explained that k_h from Eqs. (7.1) and (7.4) is linked with width b of the beam. The influence of width b in Eq. (7.4) is obviously connected with n_h, not with variable z. This leads to the conclusion, since n_h has units kN/m^3.

Consequently, this signifies, that the quantity which is independent of the dimensions of the beam should be defined as:

$$\overline{n_h} = \frac{n_h}{B} \qquad (7.5)$$

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The unit of $\overline{n_h}$ is kN/m^4 (not kN/m^3) and $\overline{n_h}$ will be called real constant of modulus of subgrade reaction.

The question which now appears is of the type: what quantities have been determined and analyzed during experimental and numerical investigation if there is confusion in published data connected with this subject. The answer can be explained with help of program BESPO.

The laboratory determined numerical values of k_h and n_h have been used for verification in BESPO program which requires values of k_h and n_h associated with given width (B) of a beam. The obtained numerical results were comparable with laboratory results. The discrepancy between and numerical investigations is associated with approximate values of k_h and n_h determined based on Terzaghi's approach. It is worth mentioning that the presented identification method of k_h and n_h is not only valid for linear range of pile behavior but for entire extent of the analysis.

7.2 Characteristic Features of Experimental Results and Identification Process of Laterally Loaded Piles

The laboratory investigations were performed for short piles, the length of which is given by the relationship:

$$l = \alpha\lambda \tag{7.6}$$

where:

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λ - stands for characteristic length of the pile.

α - is the scalar coefficient

The behavior of bent piles depend on the value of the scalar parameter α. When $\alpha < 5$, the laterally loaded pile behaves as rigid and its deformation is obtained through rotation about point O located at a certain depth.

For $\alpha \geq 5$ the deformation of the pile is flexible, which means that every point of the pile axis has different curvature.

It is interesting to specify some characteristic differences in the performance of rigid and flexible laterally loaded piles. It is commonly agreed that driven bent piles can freely displace in arbitrary direction at the bottom point. The short piles indeed deform in such a way that at the bottom point the lateral displacement $w>0$. For the same load it is bigger as the pile is shorter.

Although the long piles have the possibility of nonzero displacement at the bottom end, in practice this displacement is equal to zero.

Another important observation on the displacement of top point of laterally loaded piles is that the range of linear deformation is shorter as the length of the pile decreases. This is shown schematically in Fig. 7.1

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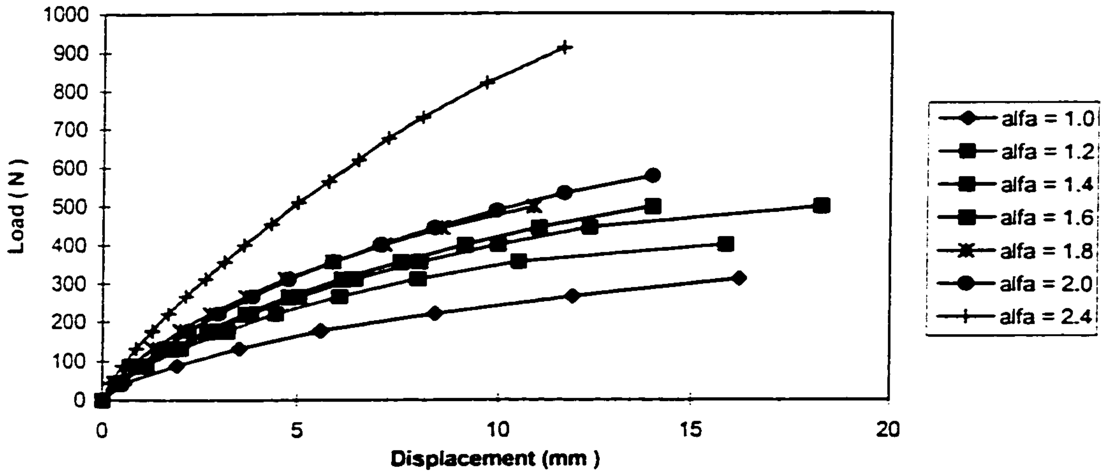

Fig. 7.1 Laboratory Results of Laterally Loaded Piles Embedded in Sandy Soil Subjected to Horizontal Forces

The linear deformation of long piles is represented by the line T. The distance from the straight line T is as farther as the length of the pile is smaller. Moreover, each deformation curve for short piles is clearly distinct. The described behavior of bent piles affects the identification process of k_h and n_h quantities.

The maximum value of load which is applied to the short pile can initiate linear process of deformation of long piles. It is clear that modulus of subgrade reaction associated with points of deformation curve located in strongly nonlinear part is different than that which corresponds to the points placed on linear part of deformation curve. Although Terzaghi's method of determination of k_h and n_h is strictly limited to short piles, that fact is not emphasized in technical literature. Moreover, the distinct behavior of short piles subject to horizontal force did not gain sufficient attention in the process of determination of k_h and n_h.

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7.3 Description of Experimental Results and Identification Process of the Piles Penetrating Sandy Soil

The laboratory results in terms of deformation curves of the top point for set of short piles subjected to variable horizontal forces are presented in Fig. A1 (Appendix A). It is clear, that for $\alpha = 1.0$, 1.2, 1.4, and 2.0 the deformation curves are very distinct. Then for $\alpha = 2.2$ and 2.4 the load-displacement curves almost coincide. The discrete points located on each deformation curve are those for which the laboratory displacements and the horizontal forces were measured. All those points were verified by means of BESPO program and were used for identification of the associated values of n_h.

The results of identification process are summarized in Fig. E1 (Appendix E). The consequence of very strong nonlinear deformation of very short piles results in dramatic changes of n_h for $\alpha = 1.0$, 1.2, and 1.4.

For $\alpha = 2.0$ some tendency towards stabilization of n_h is observed. For $\alpha = 2.2$ and 2.4 were the deformation curves almost coincide, the n_h values have almost constant value. This constant value of existing difference can be explained in terms of the proposed identification method performed in the framework of sensitivity theory. Application of the same load to the short piles having different length results in different values of the lateral displacements along the pile axis which are obtained from numerical analysis. Therefore the errors of displacements for

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α =*2.2* and α =*2.4* are different. The different results of computational analysis affect also the values of integration of the integrals by means of Simpson's method. Finally this leads to the constant difference in identification of n_h for α =*2.2* and α =*2.4*.

The changes of the lateral displacement of the top point of laterally loaded piles subjected to bending moments are shown in Fig. B1 (Appendix B). It is worth comparing Figs. A1 (Appendix A) and B1 (Appendix B), since they show the laboratory behavior of the same pile structures embedded in the same soil. Although the type of load is different, however the lateral displacement of the same points were investigated. Again, some specific features of deformation can be noticed. Similarly to the previous cases of piles subjected to horizontal forces, also now, we can specify some distinguished curves which separate from linear type lines.

The laboratory results in terms of deformation curves of the top point for set of short piles subjected to variable bending moments are presented in Fig. B1 (Appendix B). It is obvious that the tested piles are performing very similarly since they were tested in same soil environment. The reason that longer piles did not reach the nonlinear portion of the load-displacement curve is due to the fact that the available equipment did not allow the capability of applying large bending moments. Comparison of Figs. A1 (Appendix A) and B1 (Appendix B) shows that piles having corresponding lengths behave very similarly. The deformation curves are separate curves for each α which start at the common origin. As α becomes

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smaller, the behavior is described by more nonlinear flat type of curve. Consequently, when α increases the load-displacement curve becomes more linear.

7.4 Description of Experimental Results and Identification Process of the Piles Penetrating Clayey Soil

The results of laboratory experiments performed on piles embedded in clayey soil and subjected to variable horizontal forces are shown in Fig. C1 (Appendix C). The horizontal axis denotes the lateral displacements of the top point of the deformed pile, while the vertical axis represents the variable values of the horizontal forces applied to each pile structure.

The presented experimental results reveal that for each α the behavior of the pile is described by separate nonlinear deformation curve. As α decreases (i.e. pile structure length becomes shorter), the deformation of the pile demonstrates stronger nonlinear character. All deformation curves start almost independently from the origin of coordinate system of load vs. horizontal displacement. This fact indicates, that real range of linear behavior of the pile is very limited. It is interesting to note that for $\alpha = 2.4$ the behavior line of the pile is most linear in comparison to the rest of analyzed pile specimen. The identification process of modulus of subgrade reaction k_n was done for all discrete points located on each deformation curve as shown in Fig. C1 (Appendix C).

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Similarly to the previously discussed piles embedded in sandy soil, also for the piles penetrating clay soil as the deformation curve becomes more nonlinear the decrease of k_h is more rapid. The corresponding results of identification analysis are shown in Fig. G1 (Appendix G). The horizontal axis denotes the applied horizontal forces, while vertical axis represents the modulus of subgrade reaction k_h $[kN/m^2]$. Consistently with experimental results presented in Fig. C1 (Appendix C), the identified values of k_h form set of curvilinear lines. Each line is associated with specific value of α. Their slopes φ with respect to horizontal axis are different and depend on α of the analyzed pile. The slopes φ define rates of changes of k_h as a function of P_i for each pile.

In general, in agreement with experimental results Fig. C1 (Appendix C) as the length of the pile is shorter and behavior of the pile more nonlinear the rate of decrease of k_h during deformation process is faster.

Thus, the identification curve associated with longest investigated pile ($\alpha = 2.4$), which demonstrated most linear behavior, reflects this fact in the slowest rate of decrease of k_h with respect to the applied load.

The results of identification of $k_h[kN/m^3]$ for laterally loaded piles penetrating clay soil are shown in Fig. G1 (Appendix G). The experimental results of the piles embedded in clay soil and subjected to variable bending moments are shown in Fig. D1 (Appendix D). Similarly to Fig. B1 (Appendix B), (for piles embedded in sandy soil and subject to variable bending moment), the deformation curves are separate curves for each α which start at the common origin. As α becomes

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smaller, the behavior is described by more nonlinear flat type of curve. Consequently, when α increases the load-displacement curve becomes more linear. Comparison of the results presented in Figs. B1 (Appendix B) and D1 (Appendix D) reveals that as α increases the corresponding deformation curves are located closer to the curve which defines deformation of the longest pile. The identification of k_h was performed for all discrete points located on the deformation curves shown in Fig. D1 (Appendix D).

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CHAPTER VIII

Conclusions and Recommendations

The objective of this research was fulfilled in that a precise method for the determination of the coefficient of subgrade reaction was found. Comparison of the laboratory results and the numerical calculations indicates that the discrepancy between laboratory results and numerical results occurs since the value of the coefficient of subgrade reaction varies with the applied load.

The basis of the numerical method used was to account for the variation of the force applied while calculating the coefficient of subgrade reaction. Upon analyzing the numerical results, and the corresponding graphs, it is evident that the value of the coefficient of subgrade reaction stabilizes as the applied force increases.

Following is the list of conclusions:

1. The linear behavior of the structural system is described by constant value of material characteristic.
2. The identification of physical parameter for linearly behaved structure in the scope of sensitivity analysis proved to be effective method.

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3. It is important to emphasize that this method can be used in analysis of different type of structures (first evaluation of k_h and n_h for short piles and then extension to long piles).
4. The initial evaluation of k_h and n_h was performed in the scope of Terzaghi's method recommended for short piles.

Following is the list of recommendations:

1. The proposed method of identification of physical characteristics can be extended on the nonlinear behavior.
2. The proposed method can be used in analysis of structural systems subject to different load conditions (forces, moments)
3. It can be used in identification of different types of soils defined by various types of variability of physical parameters e.g. k_h and n_h.
4. The proposed method can be used in proper determination of k_h and n_h for non homogeneous soils if the k_h and n_h can be initially evaluated for each layer.
5. This method can also be used in evaluation of thickness of the layer with known values of k_h and n_h for each layer in non homogeneous soil.
6. In this research only piles considered as short piles ($\alpha < 5$) were tested since the size of the testing container limited the length of the pile which could be tested. However, if a smaller pile cross section were used, it would allow piles which are considered as long piles ($\alpha > 5$) to be tested. Hence, it is recommended for

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future research that smaller pile cross sections be used in order to be able to test long piles in addition to short piles.

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References

1. Anagnostopoulos Christos and Georgiadis Michael, Interaction of axial and lateral pile responses, Journal of Geotechnical Engineering, ASCE, Vol. 119, No. 4, April 1993.
2. Budihu Muniram and Davies G. Trevor, Nonlinear analysis of laterally loaded piles in cohesive soils, Canadian Geotechnical Journal, Vol. 24, No. 2, May 1987.
3. Budkowska B. B. and Szymczak C., Sensitivity analysis of laterally loaded piles by means of adjoint method, Computers and Geotechnics, Vol. 13, (1992)
4. Joshi R. C. and Sparrow D. G., Comparison of pile load test methods, , Canadian Geotechnical Journal, Vol. 26, No. 4, Nov. 1989.
5. Meyerhof G. G. and Ghosh D. P., Ultimate capacity of flexible piles under eccentric and inclined loads, , Canadian Geotechnical Journal, Vol. 26, No. 1, Feb. 1989.
6. Mayerhof G. G., Standard penetration tests and pile behavior under lateral loads in cohesive soils, Canadian Geotechnical Journal, Vol. 32, No. 5, Oct. 1995.
7. Poulos H. G., Effects of pile driving on adjacent piles in clay, , Canadian Geotechnical Journal, Vol. 31, No. 6, Dec. 1994.
8. Prakash S. and Kumar S., Nonlinear lateral pile deflection predictions in sands, Journal of Geotechnical Engineering, ASCE, Vol. 122, No. 2, Feb. 1996.
9. Prasad Y. V. S. N. and Rao S. N., Lateral capacity of helical piles in clays, Journal of Geotechnical Engineering, ASCE, Vol. 122, No. 11, Nov. 1996.

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10. Sastry V. V. R. N. and Meyerhof G. G., Behavior of flexible piles under inclined loads. Canadian Geotechnical Journal, Vol. 27, No. 1, Feb. 1990.

11. Sastry V. V. R. N. and Meyerhof G. G., Behavior of flexible piles in layered sands under eccentric and inclined loads, Canadian Geotechnical Journal, Vol. 31, No. 4, Aug. 1994.

12. Sastry V. V. R. N. and Meyerhof G. G., Behavior of flexible piles in layered clays under eccentric and inclined loads, Canadian Geotechnical Journal, Vol. 32, No. 3, June 1995.

13. Terzaghi K., Evaluation of coefficients of subgrade reaction, Geotechnique, 5, 1995.

14. Vallabhan C. V. G. and Das Y. C.,Modified Vlasov model for beams on elastic foundations, Journal of Geotechnical Engineering, ASCE, Vol. 117, No. 6, June 1991.

15. Yalcin A. S. and Meyerhof G. G., Bearing capacity of flexible piles under eccentric and inclined loads in layered soil, Canadian Geotechnical Journal, Vol. 28, No. 6, Dec. 1991.

16. Yan Li and Byrne P. M., Lateral pile response to monotonic pile head loading, Canadian Geotechnical Journal, Vol. 29, No. 6, Dec. 1992.

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APPENDIX A

Laboratory Results for Piles Embedded in Sandy Soil Subjected to Horizontal Forces

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Table A1

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN SANDY SOIL AND SUBJECTED TO HORIZONTAL FORCES FOR ALFA=1.0

	pile 1	pile 2	pile 3
initial reading (mm)	1.468	27.461	31.000

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
load (N)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	1.468	27.461	31.000	0.000	0.000	0.000	0.000
18	1.781	27.170	30.651	0.313	0.291	0.349	0.318
30	2.142	26.732	30.271	0.674	0.729	0.729	0.711
42	2.596	26.192	29.758	1.128	1.269	1.242	1.213
54	3.161	25.510	29.059	1.693	1.951	1.941	1.862
66	3.849	24.692	28.171	2.381	2.769	2.829	2.660
96	6.728	21.349	24.469	5.260	6.112	6.531	5.968
125	18.948	8.743	11.140	17.480	18.718	19.860	18.686

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Table A2

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN SANDY SOIL AND SUBJECTED TO HORIZONTAL FORCES FOR ALFA=1.2

	pile 1	pile 2	pile 3
initial reading (mm)	0.120	24.238	28.295

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
load (N)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	0.120	24.238	28.295	0.000	0.000	0.000	0.000
18	0.340	24.160	28.169	0.220	0.078	0.126	0.141
30	0.614	24.061	27.983	0.494	0.177	0.312	0.328
42	0.997	23.780	27.723	0.877	0.458	0.572	0.636
54	1.440	23.366	27.410	1.320	0.872	0.885	1.026
66	1.981	22.849	27.039	1.861	1.389	1.256	1.502
96	3.881	21.137	25.763	3.761	3.101	2.532	3.131
125	6.489	18.883	24.095	6.369	5.355	4.200	5.308
155	11.111	15.031	21.013	10.991	9.207	7.282	9.160

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Table A3

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN SANDY SOIL AND SUBJECTED TO HORIZONTAL FORCES FOR ALFA=1.4

	pile 1	pile 2	pile 3
initial reading (mm)	29.920	22.160	31.214

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
load (N)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	29.920	22.160	31.214	0.000	0.000	0.000	0.000
30	30.152	21.921	31.088	0.232	0.239	0.126	0.199
59	30.710	21.300	30.471	0.790	0.860	0.743	0.798
89	31.614	19.552	29.069	1.694	2.608	2.145	2.149
119	32.671	18.351	28.788	2.751	3.809	2.426	2.995
148	34.092	16.918	27.769	4.172	5.242	3.445	4.286
178	36.132	14.867	26.388	6.212	7.293	4.826	6.110
196	37.533	13.441	25.551	7.613	8.719	5.663	7.332
208	39.671	11.073	23.204	9.751	11.087	8.010	9.616

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Table A4

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN SANDY SOIL AND SUBJECTED TO HORIZONTAL FORCES FOR ALFA=2.0

	pile 1	pile 2	pile 3
initial reading (mm)	0.069	23.170	30.175

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
load (N)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	0.069	23.170	30.175	0.000	0.000	0.000	0.000
18	0.180	23.069	30.055	0.111	0.101	0.120	0.111
36	0.483	22.779	29.723	0.414	0.391	0.452	0.419
53	0.792	22.472	29.432	0.723	0.698	0.743	0.721
71	1.082	22.168	29.073	1.013	1.002	1.102	1.039
89	1.373	21.914	28.807	1.304	1.256	1.368	1.309
107	1.658	21.681	28.518	1.589	1.489	1.657	1.578
125	1.958	21.365	28.209	1.889	1.805	1.966	1.887
142	2.243	21.092	27.972	2.174	2.078	2.203	2.152
162	2.608	20.668	27.553	2.539	2.502	2.622	2.554
190	3.163	20.173	27.027	3.094	2.997	3.148	3.080
217	3.774	19.498	26.389	3.705	3.672	3.786	3.721
246	4.539	18.789	25.564	4.470	4.381	4.611	4.487
291	6.013	17.292	24.161	5.944	5.878	6.014	5.945
335	7.831	15.504	22.160	7.762	7.666	8.015	7.814
380	10.307	13.048	19.279	10.238	10.122	10.896	10.419
424	14.223	9.385	15.417	14.154	13.785	14.758	14.232

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Table A5

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN SANDY SOIL AND SUBJECTED TO HORIZONTAL FORCES FOR ALFA=2.2

	pile 1	pile 2	pile 3
initial reading (mm)	0.350	27.249	30.638

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
load (N)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	0.350	27.249	30.638	0.000	0.000	0.000	0.000
30	0.644	27.059	30.439	0.294	0.190	0.199	0.231
59	1.000	26.788	30.102	0.650	0.461	0.536	0.574
89	1.294	26.441	29.871	0.944	0.808	0.767	0.826
119	1.657	26.081	29.571	1.307	1.168	1.067	1.147
148	2.099	25.802	29.309	1.749	1.447	1.329	1.469
178	2.479	25.563	29.048	2.129	1.686	1.590	1.770
208	2.899	25.230	28.761	2.549	2.019	1.877	2.101
237	3.321	24.879	28.448	2.971	2.370	2.190	2.450
267	3.771	24.487	28.120	3.421	2.762	2.518	2.819
297	4.211	24.096	27.809	3.861	3.153	2.829	3.173
327	4.677	23.686	27.470	4.327	3.563	3.168	3.554
356	5.172	23.231	27.087	4.822	4.018	3.551	3.975
386	5.641	22.808	26.732	5.291	4.441	3.906	4.368
419	6.238	22.263	26.268	5.888	4.986	4.370	4.876
451	6.843	21.711	25.781	6.493	5.538	4.857	5.402
488	7.532	21.048	25.222	7.182	6.201	5.416	6.005
525	8.338	20.258	24.568	7.988	6.991	6.070	6.709
562	9.256	19.211	23.764	8.906	8.038	6.874	7.551
598	10.083	18.216	22.981	9.733	9.033	7.657	8.349
635	11.062	17.988	22.062	10.712	9.261	8.576	9.288
672	12.844	15.471	20.939	12.494	11.778	9.699	10.631
709	15.873	11.548	19.076	15.523	15.701	11.562	12.882

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Table A6

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN SANDY SOIL AND SUBJECTED TO HORIZONTAL FORCES FOR ALFA=2.4

	pile 1	pile 2	pile 3
initial reading (mm)	29.667	28.428	32.306

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
load (N)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	29.667	28.428	32.306	0.000	0.000	0.000	0.000
30	29.818	28.257	32.102	0.151	0.171	0.204	0.175
59	30.081	27.989	31.879	0.414	0.439	0.427	0.427
89	30.380	27.612	31.571	0.713	0.816	0.735	0.755
119	30.648	27.253	31.307	0.981	1.175	0.999	1.052
148	30.987	26.867	30.998	1.320	1.561	1.308	1.396
178	31.326	26.485	30.689	1.659	1.943	1.617	1.740
208	31.682	26.090	30.398	2.015	2.338	1.908	2.087
237	32.040	25.711	30.091	2.373	2.717	2.215	2.435
267	32.431	25.301	29.789	2.764	3.127	2.517	2.803
297	32.858	24.848	29.447	3.191	3.580	2.859	3.210
327	33.258	24.409	29.132	3.591	4.019	3.174	3.595
356	33.611	24.013	28.852	3.944	4.415	3.454	3.938
386	34.081	23.522	28.480	4.414	4.906	3.826	4.382
419	34.561	22.988	28.129	4.894	5.440	4.177	4.837
451	35.062	22.411	27.739	5.395	6.017	4.567	5.326
488	35.758	21.641	27.199	6.091	6.787	5.107	5.995
525	36.403	20.844	26.711	6.736	7.584	5.595	6.638
562	36.948	20.065	26.261	7.281	8.363	6.045	7.230
598	37.837	18.959	25.539	8.170	9.469	6.767	8.135
635	38.852	17.900	24.783	9.185	10.528	7.523	9.079
672	40.282	17.070	23.641	10.615	11.358	8.665	10.213
709	41.808	15.788	22.782	12.141	12.640	9.524	11.435
747	43.961	13.568	21.702	14.294	14.860	10.604	13.253

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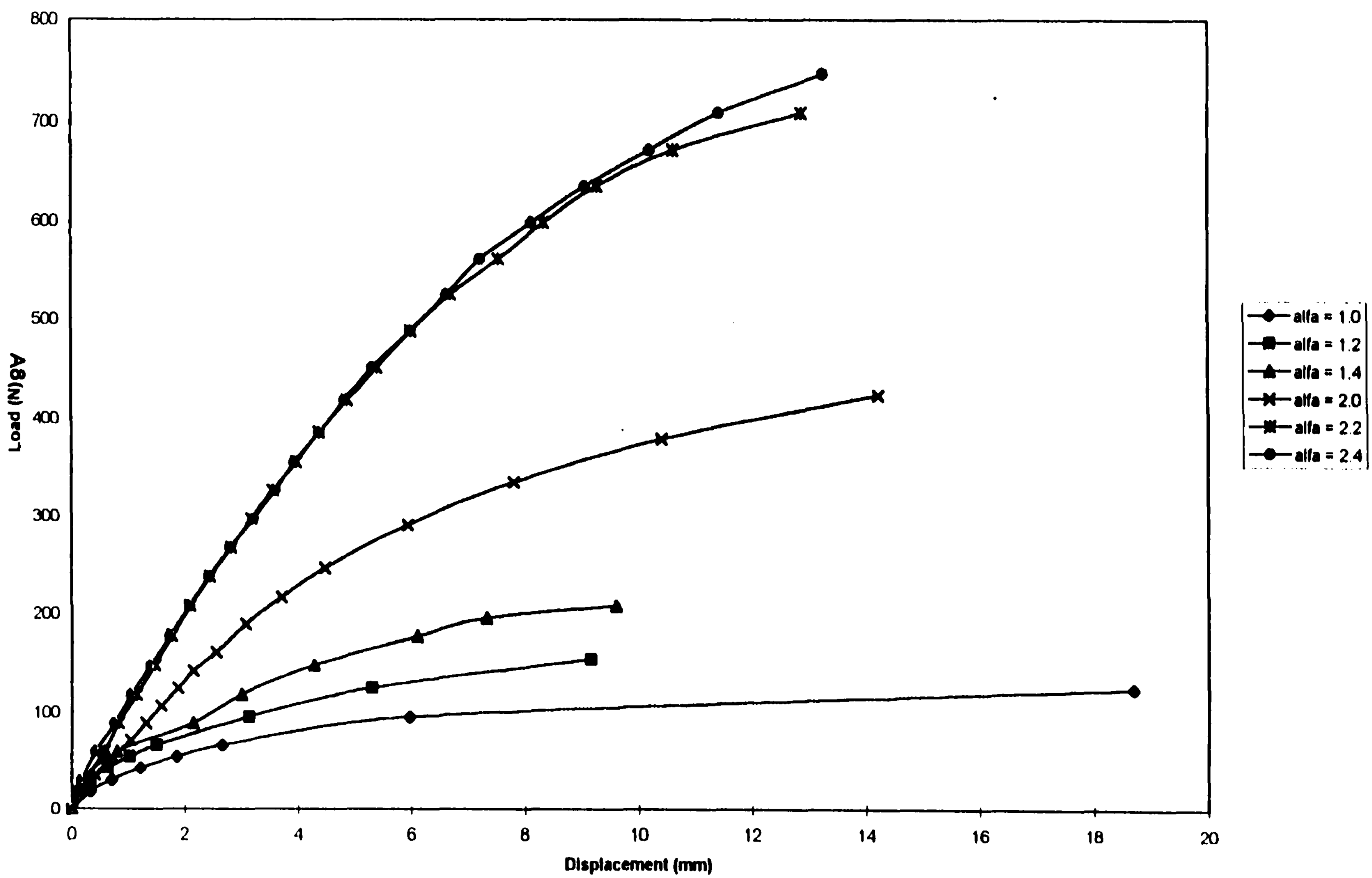

Figure A1 Piles Embedded in Sandy Soil Subjected to Horizontal Load

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APPENDIX B

Laboratory Results for Piles Embedded in Sandy Soil Subjected to Bending Moments

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Table B1

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN SANDY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=1.0

	pile 1	pile 2	pile 3
initial reading (mm)	21.000	20.700	22.200

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	21.000	20.700	22.200	0.000	0.000	0.000	0.000
11	19.327	19.281	21.403	1.673	1.419	0.797	1.296
23	17.763	16.623	19.510	3.237	4.077	2.690	3.335
34	14.637	13.477	17.383	6.363	7.223	4.817	6.134
45	11.360	10.339	14.918	9.640	10.361	7.282	9.094
57	7.862	7.315	11.736	13.138	13.385	10.464	12.329
68	3.871	3.920	8.279	17.129	16.780	13.921	15.943

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Table B2

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN SANDY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=1.2

	pile 1	pile 2	pile 3
initial reading (mm)	21.800	21.300	21.540

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	21.800	21.300	21.540	0.000	0.000	0.000	0.000
11	21.483	20.802	21.129	0.317	0.498	0.411	0.409
23	20.801	19.507	20.244	0.999	1.793	1.296	1.363
34	19.727	18.843	19.183	2.073	2.457	2.357	2.296
45	18.368	16.827	17.987	3.432	4.473	3.553	3.819
57	16.817	14.407	16.574	4.983	6.893	4.966	5.614
68	15.102	11.963	15.158	6.698	9.337	6.382	7.472
79	13.084	9.511	13.542	8.716	11.789	7.998	9.501
91	10.677	7.344	11.964	11.123	13.956	9.576	11.552
105	7.542	4.983	9.136	14.258	16.317	12.404	14.326

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Table B3

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN SANDY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=1.4

	pile 1	pile 2	pile 3
initial reading (mm)	21.250	21.600	21.300

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	21.250	21.600	21.300	0.000	0.000	0.000	0.000
11	20.853	21.202	20.906	0.397	0.398	0.394	0.396
23	20.074	20.656	20.349	1.176	0.944	0.951	1.024
34	19.406	20.033	19.838	1.844	1.567	1.462	1.624
45	18.737	19.419	19.321	2.513	2.181	1.979	2.224
57	17.994	18.738	18.818	3.256	2.862	2.482	2.867
68	17.291	17.976	18.252	3.959	3.624	3.048	3.544
79	16.563	17.177	17.714	4.687	4.423	3.586	4.232
91	15.774	16.203	17.158	5.476	5.397	4.142	5.005
105	14.878	15.017	16.437	6.372	6.583	4.863	5.939
119	13.903	13.784	15.608	7.347	7.816	5.692	6.952
133	12.917	12.244	14.721	8.333	9.356	6.579	8.089
147	11.843	10.728	13.829	9.407	10.872	7.471	9.250
161	10.786	9.219	13.043	10.464	12.381	8.257	10.367
175	9.677	7.717	12.073	11.573	13.883	9.227	11.561
189	8.658	6.230	11.004	12.592	15.370	10.296	12.753
211	6.877	4.141	9.046	14.373	17.459	12.254	14.695

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Table B4

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN SANDY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=2.0

	pile 1	pile 2	pile 3
initial reading (mm)	21.000	19.500	22.000

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	21.000	19.500	22.000	0.000	0.000	0.000	0.000
11	20.711	19.230	21.829	0.289	0.270	0.171	0.243
23	20.369	18.957	21.597	0.631	0.543	0.403	0.526
34	20.083	18.659	21.376	0.917	0.841	0.624	0.794
45	19.819	18.368	21.141	1.181	1.132	0.859	1.057
57	19.530	18.079	20.869	1.470	1.421	1.131	1.341
68	19.252	17.763	20.568	1.748	1.737	1.432	1.639
79	18.981	17.467	20.261	2.019	2.033	1.739	1.930
91	18.726	17.143	19.953	2.274	2.357	2.047	2.226
105	18.367	16.771	19.591	2.633	2.729	2.409	2.590
119	18.013	16.400	19.238	2.987	3.100	2.762	2.950
133	17.672	16.051	18.873	3.328	3.449	3.127	3.301
147	17.342	15.702	18.513	3.658	3.798	3.487	3.648
161	16.987	15.359	18.152	4.013	4.141	3.848	4.001
175	16.644	15.004	17.821	4.356	4.496	4.179	4.344
189	16.672	14.672	17.501	4.328	4.828	4.499	4.552
211	15.372	14.097	16.937	5.628	5.403	5.063	5.365
234	14.843	13.529	16.428	6.157	5.971	5.572	5.900
257	14.324	13.048	15.813	6.676	6.452	6.187	6.438
279	13.877	12.553	15.218	7.123	6.947	6.782	6.951
302	13.336	12.071	14.603	7.664	7.429	7.397	7.497
324	12.822	11.603	13.989	8.178	7.897	8.011	8.029
349	12.334	11.102	13.371	8.666	8.398	8.629	8.564

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Table B5

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN SANDY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=2.2

	pile 1	pile 2	pile 3
initial reading (mm)	21.000	22.000	21.200

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	21.000	22.000	21.200	0.000	0.000	0.000	0.000
11	20.750	21.822	21.011	0.250	0.178	0.189	0.209
23	20.455	21.550	20.750	0.545	0.450	0.450	0.482
34	20.149	21.291	20.412	0.851	0.709	0.788	0.809
45	19.841	21.009	20.090	1.159	0.991	1.110	1.126
57	19.529	20.690	19.747	1.471	1.310	1.453	1.459
68	19.177	20.378	19.416	1.823	1.622	1.784	1.797
79	18.912	20.014	19.098	2.088	1.986	2.102	2.097
91	18.619	19.709	18.787	2.381	2.291	2.413	2.402
105	18.229	19.291	18.363	2.771	2.709	2.837	2.815
119	17.859	18.907	17.901	3.141	3.093	3.299	3.246
133	17.527	18.531	17.541	3.473	3.469	3.659	3.597
147	17.163	18.159	17.213	3.837	3.841	3.987	3.937
161	16.808	17.789	16.874	4.192	4.211	4.326	4.281
175	16.499	17.438	16.547	4.501	4.562	4.653	4.602
189	16.208	17.081	16.223	4.792	4.919	4.977	4.915
211	15.740	17.543	15.708	5.260	4.457	5.492	5.415
234	15.283	15.971	15.235	5.717	6.029	5.965	5.882
257	14.870	15.522	14.761	6.130	6.478	6.439	6.336
279	14.453	15.063	14.346	6.547	6.937	6.854	6.752
302	14.080	14.636	13.903	6.920	7.364	7.297	7.171
324	13.651	14.211	13.507	7.349	7.789	7.693	7.578
349	13.173	13.724	13.043	7.827	8.276	8.157	8.047

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Table B6

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN SANDY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=2.4

	pile 1	pile 2	pile 3
initial reading (mm)	26.900	25.240	27.670

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	26.900	25.240	27.670	0.000	0.000	0.000	0.000
11	26.761	24.900	27.482	0.139	0.340	0.188	0.222
23	26.503	24.595	27.158	0.397	0.645	0.512	0.518
34	26.281	24.293	26.813	0.619	0.947	0.857	0.808
45	26.047	23.954	26.451	0.853	1.286	1.219	1.119
57	25.808	23.659	26.068	1.092	1.581	1.602	1.425
68	25.602	23.346	25.677	1.298	1.894	1.993	1.728
79	25.349	23.029	25.298	1.551	2.211	2.372	2.045
91	25.123	22.700	24.921	1.777	2.540	2.749	2.355
105	24.847	22.346	24.409	2.053	2.894	3.261	2.736
119	24.549	21.933	23.952	2.351	3.307	3.718	3.125
133	24.224	21.609	23.500	2.676	3.631	4.170	3.492
147	24.019	21.243	23.031	2.881	3.997	4.639	3.839
161	23.772	20.869	22.583	3.128	4.371	5.087	4.195
175	23.541	20.528	22.187	3.359	4.712	5.483	4.518
189	23.302	20.188	21.792	3.598	5.052	5.878	4.843
211	22.891	19.653	21.140	4.009	5.587	6.530	5.375
234	22.588	19.144	20.558	4.312	6.096	7.112	5.840
257	22.227	18.622	19.968	4.673	6.618	7.702	6.331
279	21.891	18.188	19.383	5.009	7.052	8.287	6.783
302	21.577	17.753	18.798	5.323	7.487	8.872	7.227
324	21.283	17.280	18.339	5.617	7.960	9.331	7.636
349	20.951	16.782	17.889	5.949	8.458	9.781	8.063

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Table B7

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN SANDY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=3.0

	pile 1	pile 2	pile 3
initial reading (mm)	29.770	0.000	29.400

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	29.770	0.000	29.400	0.000	0.000	0.000	0.000
11	30.027	0.223	29.579	0.257	0.223	0.179	0.220
23	30.350	0.479	29.854	0.580	0.479	0.454	0.504
34	30.658	0.734	30.132	0.888	0.734	0.732	0.785
45	30.971	0.991	30.403	1.201	0.991	1.003	1.065
57	31.292	1.261	30.671	1.522	1.261	1.271	1.351
68	31.604	1.503	30.952	1.834	1.503	1.552	1.630
79	31.941	1.729	31.233	2.171	1.729	1.833	1.911
91	32.271	1.981	31.481	2.501	1.981	2.081	2.188
105	32.660	2.298	31.859	2.890	2.298	2.459	2.549
119	33.062	2.603	32.127	3.292	2.603	2.727	2.874
133	33.441	2.921	32.429	3.671	2.921	3.029	3.207
147	33.803	3.211	32.748	4.033	3.211	3.348	3.531
161	34.182	3.480	33.049	4.412	3.480	3.649	3.847
175	34.563	3.744	33.370	4.793	3.744	3.970	4.169
189	34.921	4.029	33.686	5.151	4.029	4.286	4.489
211	35.517	4.483	34.101	5.747	4.483	4.701	4.977
234	35.925	4.891	34.567	6.155	4.891	5.167	5.404
257	36.352	5.327	35.071	6.582	5.327	5.671	5.860
279	36.785	5.723	35.503	7.015	5.723	6.103	6.280
302	37.236	6.162	35.942	7.466	6.162	6.542	6.723
324	37.673	6.571	36.397	7.903	6.571	6.997	7.157
349	38.126	7.011	36.866	8.356	7.011	7.466	7.611

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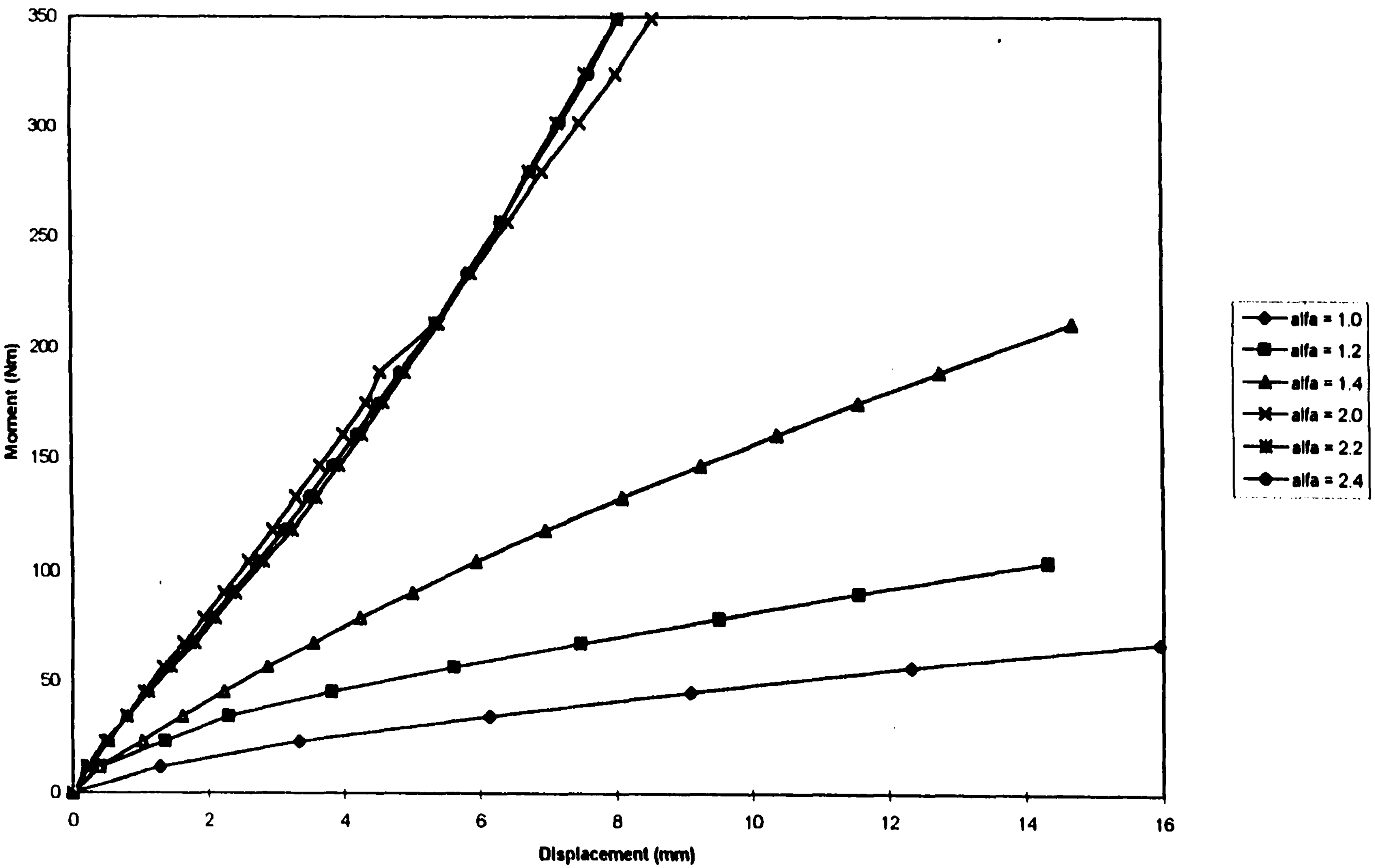

Figure B1 Piles Embedded in Sandy Soil Subjected to Bending Moments

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APPENDIX C

Laboratory Results for Piles Embedded in Clayey Soil Subjected to Horizontal Forces

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Table C1

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO HORIZONTAL FORCES FOR ALFA=1.0

	pile1	pile 2	pile 3
initial reading (mm)	25.940	25.400	25.897

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
load (N)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0.000	25.940	25.400	25.897	0.000	0.000	0.000	0.000
44.540	25.108	24.962	25.448	0.832	0.438	0.449	0.573
89.080	22.915	24.181	24.395	3.025	1.219	1.502	1.915
133.620	20.691	23.178	22.857	5.249	2.222	3.040	3.504
178.160	18.194	21.875	20.523	7.746	3.525	5.374	5.548
222.700	14.770	19.954	17.298	11.170	5.446	8.599	8.405
267.240	10.264	17.628	13.676	15.676	7.772	12.221	11.890
311.780	5.108	13.941	9.538	20.832	11.459	16.359	16.217

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Table C2

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO HORIZONTAL FORCES FOR ALFA=1.2

	pile1	pile 2	pile 3
initial reading (mm)	26.098	26.075	25.950

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
load (N)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	26.098	26.075	25.950	0.000	0.000	0.000	0.000
45	25.661	25.848	25.551	0.437	0.227	0.399	0.354
89	24.852	25.253	24.664	1.246	0.822	1.286	1.118
134	23.895	24.541	23.600	2.203	1.534	2.350	2.029
178	22.770	23.338	22.371	3.328	2.737	3.579	3.215
223	21.485	22.440	20.868	4.613	3.635	5.082	4.443
267	19.959	21.090	19.010	6.139	4.985	6.940	6.021
312	18.158	19.194	16.817	7.940	6.881	9.133	7.985
356	15.520	17.347	13.749	10.578	8.728	12.201	10.502
401	9.874	12.611	8.014	16.224	13.464	17.936	15.875

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Table C3

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO HORIZONTAL FORCES FOR ALFA=1.4

	pile1	pile 2	pile 3
initial reading (mm)	16.507	15.968	16.382

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
load (N)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	16.507	15.968	16.382	0.000	0.000	0.000	0.000
45	16.127	15.560	15.837	0.380	0.408	0.545	0.444
89	15.519	14.948	14.981	0.988	1.020	1.401	1.136
134	14.791	14.253	14.032	1.716	1.715	2.350	1.927
178	13.954	13.477	12.933	2.553	2.491	3.449	2.831
223	12.941	12.640	11.805	3.566	3.328	4.577	3.824
267	11.796	11.537	10.444	4.711	4.431	5.938	5.027
312	10.422	10.298	8.918	6.085	5.670	7.464	6.406
356	8.774	8.841	7.174	7.733	7.127	9.208	8.023
401	6.723	7.104	5.080	9.784	8.864	11.302	9.983
445	4.205	4.984	2.627	12.302	10.984	13.755	12.347
501	-1.948	-0.243	-3.721	18.455	16.211	20.103	18.256

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Table C4

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO HORIZONTAL FORCES FOR ALFA=1.6

	pile1	pile 2	pile 3
initial reading (mm)	15.788	16.170	16.057

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
load (N)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	15.788	16.170	16.057	0.000	0.000	0.000	0.000
45	15.403	15.851	15.664	0.385	0.319	0.393	0.366
89	14.871	15.380	14.805	0.917	0.790	1.252	0.986
134	14.222	14.688	13.740	1.566	1.482	2.317	1.788
178	13.459	13.911	12.577	2.329	2.259	3.480	2.689
223	12.527	13.088	11.395	3.261	3.082	4.662	3.668
267	11.476	12.121	10.084	4.312	4.049	5.973	4.778
312	10.224	10.992	8.540	5.564	5.178	7.517	6.086
356	8.897	9.593	6.874	6.891	6.577	9.183	7.550
401	7.359	8.165	5.057	8.429	8.005	11.000	9.145
445	5.390	6.594	3.002	10.398	9.576	13.055	11.010
501	2.146	3.717	0.261	13.642	12.453	15.796	13.964

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Table C5

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO HORIZONTAL FORCES FOR ALFA=1.8

	pile1	pile 2	pile 3
initial reading (mm)	16.117	16.049	15.621

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
load (N)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	16.117	16.049	15.621	0.000	0.000	0.000	0.000
45	15.833	15.921	15.130	0.284	0.128	0.491	0.301
89	15.403	15.652	14.536	0.714	0.397	1.085	0.732
134	14.906	15.251	13.754	1.211	0.798	1.867	1.292
178	14.291	14.703	12.773	1.826	1.346	2.848	2.007
223	13.589	14.058	11.841	2.528	1.991	3.780	2.766
267	12.744	13.238	10.750	3.373	2.811	4.871	3.685
312	11.762	12.296	9.683	4.355	3.753	5.938	4.682
356	10.604	11.211	8.376	5.513	4.838	7.245	5.865
401	9.388	10.057	6.938	6.729	5.992	8.683	7.135
445	8.083	8.718	5.258	8.034	7.331	10.363	8.576
501	5.933	6.571	2.603	10.184	9.478	13.018	10.893

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Table C6

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO HORIZONTAL FORCES FOR ALFA=2.0

	pile1	pile 2	pile 3
initial reading (mm)	15.948	14.956	15.709

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
load (N)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	15.948	14.956	15.709	0.000	0.000	0.000	0.000
45	15.539	14.587	15.303	0.409	0.369	0.406	0.395
89	15.003	14.024	14.818	0.945	0.932	0.891	0.923
134	14.357	13.398	14.214	1.591	1.558	1.495	1.548
178	13.672	12.770	13.480	2.276	2.186	2.229	2.230
223	12.833	12.117	12.667	3.115	2.839	3.042	2.999
267	11.927	11.406	11.721	4.021	3.550	3.988	3.853
312	10.938	10.610	10.740	5.010	4.346	4.969	4.775
356	9.761	9.745	9.507	6.187	5.211	6.202	5.867
401	8.488	8.767	8.213	7.460	6.189	7.496	7.048
445	7.009	7.714	6.722	8.939	7.242	8.987	8.389
490	5.241	6.493	5.034	10.707	8.463	10.675	9.948
534	3.244	5.347	3.017	12.704	9.609	12.692	11.668
579	0.671	3.206	0.810	15.277	11.750	14.899	13.975

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Table C7

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO HORIZONTAL FORCES FOR ALFA=2.4

	pile1	pile 2	pile 3
initial reading (mm)	26.114	25.923	25.588

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
load (N)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	26.114	25.923	25.588	0.000	0.000	0.000	0.000
45	25.842	25.800	25.381	0.272	0.123	0.207	0.201
89	25.457	25.571	25.052	0.657	0.352	0.536	0.515
134	25.047	25.289	24.680	1.067	0.634	0.908	0.870
178	24.623	24.918	24.266	1.491	1.005	1.322	1.273
223	24.181	24.522	23.843	1.933	1.401	1.745	1.693
267	23.754	24.109	23.358	2.360	1.814	2.230	2.135
312	23.250	23.626	22.822	2.864	2.297	2.766	2.642
356	22.773	23.169	22.295	3.341	2.754	3.293	3.129
401	22.291	22.723	21.740	3.823	3.200	3.848	3.624
456	21.602	22.054	20.990	4.512	3.869	4.598	4.326
511	20.981	21.438	20.238	5.133	4.485	5.350	4.989
567	20.258	20.743	19.421	5.856	5.180	6.167	5.734
622	19.522	20.071	18.630	6.592	5.852	6.958	6.467
677	18.764	19.414	17.773	7.350	6.509	7.815	7.225
732	17.903	18.668	16.819	8.211	7.255	8.769	8.078
821	16.391	17.277	14.983	9.723	8.646	10.605	9.658
910	14.428	15.653	12.620	11.686	10.270	12.968	11.641

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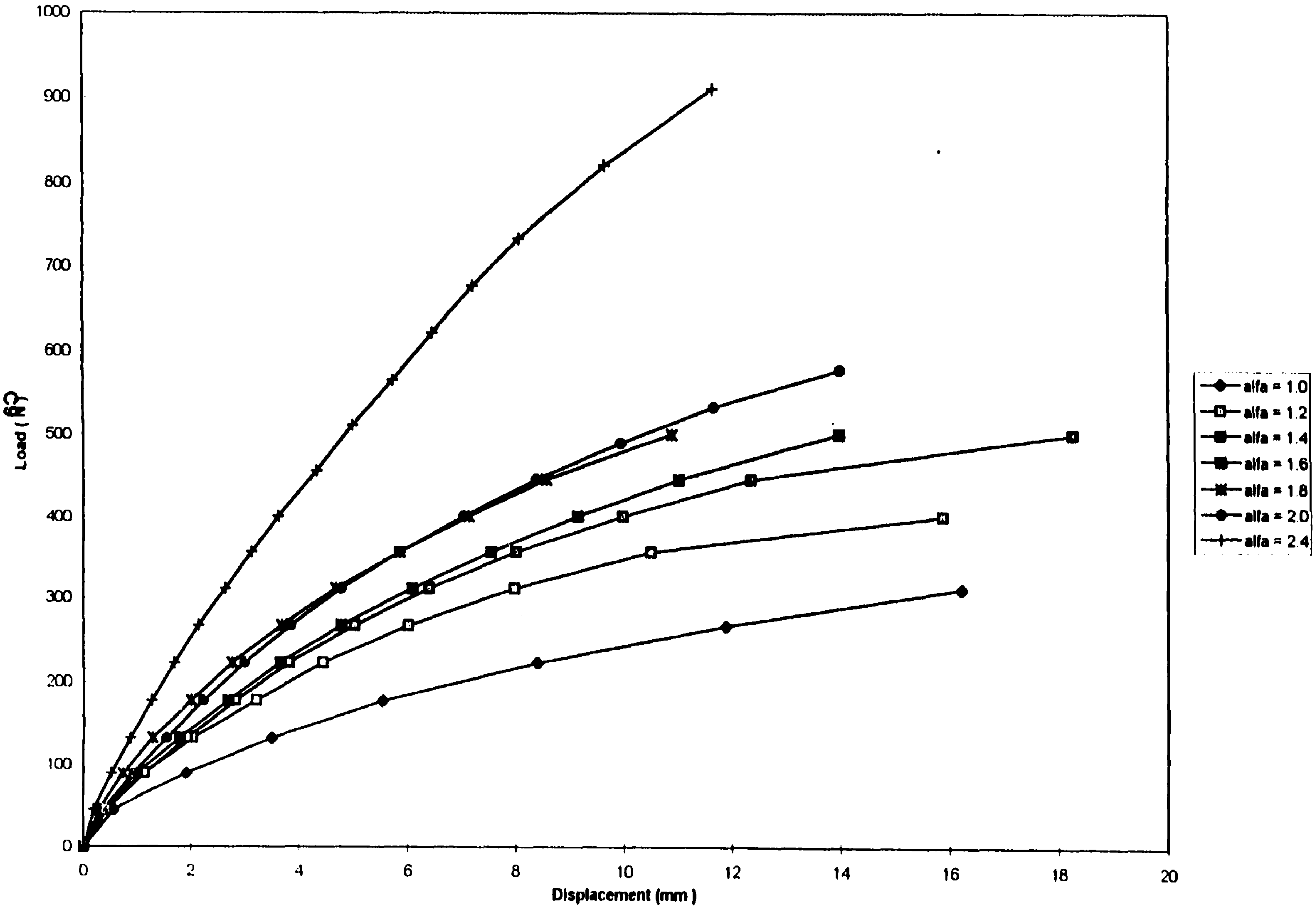

Figure C1 Piles Embedded in Clayey Soil Subjected to Horizontal Load

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APPENDIX D

Laboratory Results for Piles Embedded in Clayey Soil Subjected to Bending Moments

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Table D1

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=1.0

	pile 1	pile 2	pile 3
initial reading (mm)	26.520	25.432	25.842

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	26.520	25.432	25.842	0.000	0.000	0.000	0.000
11	25.306	23.524	24.930	1.214	1.908	0.912	1.345
23	24.403	22.593	24.016	2.117	2.839	1.826	2.261
34	23.511	21.697	23.081	3.009	3.735	2.761	3.168
45	22.574	20.786	22.139	3.946	4.646	3.703	4.098
57	21.583	19.764	21.155	4.937	5.668	4.687	5.097
68	20.571	18.740	20.130	5.949	6.692	5.712	6.118
79	19.494	17.656	19.072	7.026	7.776	6.770	7.191
91	18.398	16.597	17.947	8.122	8.835	7.895	8.284
102	17.264	15.513	16.741	9.256	9.919	9.101	9.425
116	15.903	14.228	15.433	10.617	11.204	10.409	10.743
130	14.391	12.741	13.904	12.129	12.691	11.938	12.253
144	12.767	11.172	12.290	13.753	14.260	13.552	13.855
158	11.033	9.515	10.593	15.487	15.917	15.249	15.551

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Table D2

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=1.2

	pile 1	pile 2	pile 3
initial reading (mm)	24.961	24.811	25.018

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	24.961	24.811	25.018	0.000	0.000	0.000	0.000
11	24.503	24.415	24.631	0.458	0.396	0.387	0.414
23	24.131	24.004	24.235	0.830	0.807	0.783	0.807
34	23.707	23.581	23.820	1.254	1.230	1.198	1.227
45	23.235	23.085	23.324	1.726	1.726	1.694	1.715
57	22.711	22.578	22.810	2.250	2.233	2.208	2.230
68	22.093	21.982	22.223	2.868	2.829	2.795	2.831
79	21.480	21.337	21.600	3.481	3.474	3.418	3.458
91	20.733	20.578	20.818	4.228	4.233	4.200	4.220
102	19.994	19.757	19.989	4.967	5.054	5.029	5.017
116	18.983	18.773	19.021	5.978	6.038	5.997	6.004
130	17.980	17.725	18.043	6.981	7.086	6.975	7.014
144	16.973	16.479	16.850	7.988	8.332	8.168	8.163
158	15.984	15.221	15.698	8.977	9.590	9.320	9.296
172	14.977	13.913	14.551	9.984	10.898	10.467	10.450
186	13.963	12.349	13.125	10.998	12.462	11.893	11.784
209	12.251	10.543	11.497	12.710	14.268	13.521	13.500
231	10.177	8.479	9.629	14.784	16.332	15.389	15.502

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Table D3

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=1.4

	pile 1	pile 2	pile 3
initial reading (mm)	25.880	24.868	25.214

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	25.880	24.868	25.214	0.000	0.000	0.000	0.000
11	25.570	24.563	24.907	0.310	0.305	0.307	0.307
23	25.191	24.249	24.592	0.689	0.619	0.622	0.643
34	24.877	23.929	24.283	1.003	0.939	0.931	0.958
45	24.449	23.543	23.894	1.431	1.325	1.320	1.359
57	24.022	23.162	23.502	1.858	1.706	1.712	1.759
68	23.561	22.756	23.091	2.319	2.112	2.123	2.185
79	23.118	22.340	22.671	2.762	2.528	2.543	2.611
91	22.617	21.819	22.188	3.263	3.049	3.026	3.113
102	22.204	21.316	21.681	3.676	3.552	3.533	3.587
116	21.631	20.723	21.105	4.249	4.145	4.109	4.168
130	21.023	20.108	20.482	4.857	4.760	4.732	4.783
144	20.412	19.487	19.852	5.468	5.381	5.362	5.404
158	19.837	18.864	19.218	6.043	6.004	5.996	6.014
172	19.263	18.230	18.599	6.617	6.638	6.615	6.623
186	18.651	17.594	17.962	7.229	7.274	7.252	7.252
209	17.633	16.560	17.054	8.247	8.308	8.160	8.238
231	16.420	15.374	15.962	9.460	9.494	9.252	9.402

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Table D4

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=1.6

	pile 1	pile 2	pile 3
initial reading (mm)	25.768	25.323	25.107

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	25.768	25.323	25.107	0.000	0.000	0.000	0.000
11	25.461	25.044	24.809	0.307	0.279	0.298	0.295
23	25.107	24.760	24.495	0.661	0.563	0.612	0.612
34	24.746	24.374	24.079	1.022	0.949	1.028	1.000
45	24.390	23.988	23.671	1.378	1.335	1.436	1.383
57	24.039	23.614	23.265	1.729	1.709	1.842	1.760
68	23.646	23.251	22.835	2.122	2.072	2.272	2.155
79	23.272	22.860	22.417	2.496	2.463	2.690	2.550
91	22.915	22.489	21.999	2.853	2.834	3.108	2.932
102	22.512	22.140	21.595	3.256	3.183	3.512	3.317
116	22.103	21.752	21.168	3.665	3.571	3.939	3.725
130	21.653	21.366	20.761	4.115	3.957	4.346	4.139
144	21.212	20.957	20.328	4.556	4.366	4.779	4.567
158	20.808	20.568	19.902	4.960	4.755	5.205	4.973
172	20.440	20.177	19.473	5.328	5.146	5.634	5.369
186	20.043	19.798	19.042	5.725	5.525	6.065	5.772
209	19.408	19.270	18.466	6.360	6.053	6.641	6.351
231	18.853	18.701	17.842	6.915	6.622	7.265	6.934
254	18.268	18.121	17.204	7.500	7.202	7.903	7.535
276	17.432	17.358	16.373	8.336	7.965	8.734	8.345

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Table D5

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=1.8

	pile 1	pile 2	pile 3
initial reading (mm)	25.824	25.367	24.907

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	25.824	25.367	24.907	0.000	0.000	0.000	0.000
11	25.429	25.071	24.595	0.395	0.296	0.312	0.340
23	25.101	24.763	24.309	0.723	0.604	0.598	0.640
34	24.813	24.437	24.030	1.011	0.930	0.877	0.922
45	24.472	24.119	23.714	1.352	1.248	1.193	1.246
57	24.162	23.783	23.389	1.662	1.584	1.518	1.566
68	23.869	23.464	23.070	1.955	1.903	1.837	1.876
79	23.570	23.156	22.756	2.254	2.211	2.151	2.185
91	23.223	22.518	22.472	2.601	2.849	2.435	2.490
102	22.940	22.242	22.181	2.884	3.125	2.726	2.779
116	22.646	21.948	21.900	3.178	3.419	3.007	3.064
130	22.357	21.644	21.601	3.467	3.723	3.306	3.360
144	22.048	21.358	21.285	3.776	4.009	3.622	3.673
158	21.767	21.038	20.977	4.057	4.329	3.930	3.972
172	21.436	20.717	20.663	4.388	4.650	4.244	4.292
186	21.141	20.441	20.356	4.683	4.926	4.551	4.595
209	20.833	20.168	20.035	4.991	5.199	4.872	4.912
231	20.558	19.887	19.715	5.266	5.480	5.192	5.217
254	20.227	19.594	19.391	5.597	5.773	5.516	5.543
276	19.923	19.310	19.065	5.901	6.057	5.842	5.862
299	19.603	19.006	18.747	6.221	6.361	6.160	6.180

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Table D6

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=2.0

	pile 1	pile 2	pile 3
initial reading (mm)	25.870	25.037	24.894

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	25.870	25.037	24.894	0.000	0.000	0.000	0.000
11	25.641	24.840	24.663	0.229	0.197	0.231	0.219
23	25.393	24.651	24.426	0.477	0.386	0.468	0.444
34	25.141	24.454	24.165	0.729	0.583	0.729	0.680
45	24.903	24.257	23.912	0.967	0.780	0.982	0.910
57	24.691	24.054	23.641	1.179	0.983	1.253	1.138
68	24.453	23.848	23.391	1.417	1.189	1.503	1.370
79	24.224	23.641	23.153	1.646	1.396	1.741	1.594
91	24.054	23.414	22.890	1.816	1.623	2.004	1.814
102	23.821	23.183	22.643	2.049	1.854	2.251	2.051
116	23.600	22.957	22.382	2.270	2.080	2.512	2.287
130	23.413	22.739	22.110	2.457	2.298	2.784	2.513
144	23.291	22.519	21.829	2.579	2.518	3.065	2.721
158	23.080	22.281	21.562	2.790	2.756	3.332	2.959
172	22.878	22.032	21.303	2.992	3.005	3.591	3.196
186	22.613	21.791	21.019	3.257	3.246	3.875	3.459
209	22.497	21.513	20.730	3.373	3.524	4.164	3.687
231	22.239	21.219	20.424	3.631	3.818	4.470	3.973
254	22.062	20.911	20.103	3.808	4.126	4.791	4.242
276	21.841	20.593	19.766	4.029	4.444	5.128	4.534
299	21.632	20.270	19.420	4.238	4.767	5.474	4.826

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Table D7

LABORATORY READINGS OF DIAL GAUGES FOR MEASUREMENTS OF HORIZONTAL DISPLACEMENTS FOR THE PILES EMBEDDED IN CLAYEY SOIL AND SUBJECTED TO BENDING MOMENTS FOR ALFA=2.4

	pile 1	pile 2	pile 3
initial reading (mm)	25.690	25.319	24.903

	Relative laboratory dial readings (with respect to initial readings) [mm]			Absolute values of laboratory readings of horizontal displacements [mm]			
M (Nm)	pile 1	pile 2	pile 3	pile 1	pile 2	pile 3	avg. displ.
0	25.690	25.319	24.903	0.000	0.000	0.000	0.000
11	25.448	25.133	24.715	0.242	0.186	0.188	0.205
23	25.227	24.939	24.529	0.463	0.380	0.374	0.406
34	24.996	24.750	24.325	0.694	0.569	0.578	0.614
45	24.761	24.561	24.111	0.929	0.758	0.792	0.826
57	24.538	24.376	23.893	1.152	0.943	1.010	1.035
68	24.313	24.182	23.652	1.377	1.137	1.251	1.255
79	24.091	23.990	23.449	1.599	1.329	1.454	1.461
91	23.878	23.793	23.234	1.812	1.526	1.669	1.669
102	23.661	23.606	23.003	2.029	1.713	1.900	1.881
116	23.485	23.408	22.786	2.205	1.911	2.117	2.078
130	23.222	23.209	22.568	2.468	2.110	2.335	2.304
144	23.089	23.026	22.371	2.601	2.293	2.532	2.475
158	22.887	22.818	22.147	2.803	2.501	2.756	2.687
172	22.628	22.621	21.931	3.062	2.698	2.972	2.911
186	22.413	22.405	21.686	3.277	2.914	3.217	3.136
209	22.277	22.186	21.448	3.413	3.133	3.455	3.334
231	21.920	21.940	21.197	3.770	3.379	3.706	3.618
254	21.665	21.692	20.949	4.025	3.627	3.954	3.869
276	21.307	21.398	20.689	4.383	3.921	4.214	4.173
299	21.031	21.114	20.430	4.659	4.205	4.473	4.446

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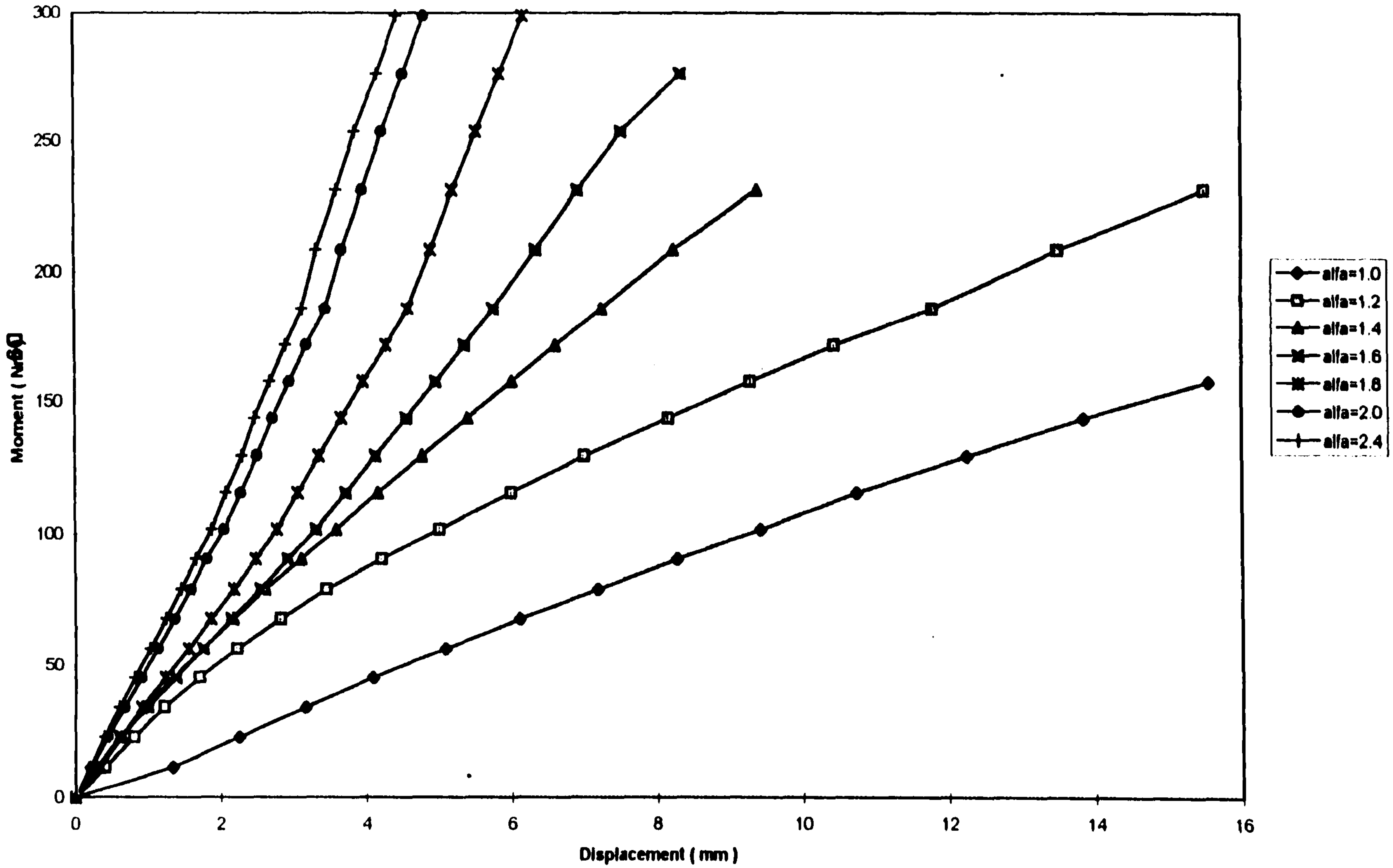

Figure D1 Piles Embedded in Clayey Soil Subjected to Bending Moment

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APPENDIX E

Numerical Analysis for Piles Embedded in Sandy Soil Subjected to Horizontal Forces

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Table E1

NUMERICAL ANALYSIS OF LATERALY LOADED PILES EMBEDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.220m

B= 0.0254 m
delta Z= 0.011 m

	Pi = 0.018 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00139	0.07539	0	0
0.011	0.00129	0.07035	9.98E-07	4820
0.022	0.0012	. 0.06531	1.72E-06	9640
0.033	0.00111	0.06027	2.21E-06	14400
0.044	0.00102	0.05523	2.48E-06	19200
0.055	0.00092	0.05019	2.54E-06	24100
0.066	0.00083	0.04515	2.47E-06	28900
0.077	0.00074	0.04012	2.29E-06	33700
0.088	0.00065	0.03509	2.01E-06	38500
0.099	0.00055	0.03007	1.64E-06	43300
0.11	0.00046	0.02505	1.27E-06	48200
0.121	0.00037	0.02003	8.97E-07	53000
0.132	0.00028	0.01501	5.55E-07	57800
0.143	0.00018	0.00999	2.57E-07	62600
0.154	0.00009	0.00499	6.92E-08	67400
0.165	-0.0000004	-0.00002	1.32E-12	72300
0.176	-0.00009	-0.00503	7.97E-08	77100
0.187	-0.00018	-0.01004	3.38E-07	81900
0.198	-0.00028	-0.01504	8.34E-07	86700
0.209	-0.00037	-0.02005	1.55E-06	91500
0.22	-0.00046	-0.02505	2.54E-06	96400

by Simpson's rule:

INT= 2.8E-07 m^4

w(b)= 0.00139 m
w(a)= 0.00032 m
delta nh= (w(b)-w(a))/INT
delta nh= 3830 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 11130 kN/m^3}}$

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Table E2

NUMERICAL ANALYSIS OF LATERALY LOADED PILES EMBEDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.220m

	Pi = 0.030 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00228	0.07539	0	0
0.011	0.00213	0.07035	1.65E-06	4630
0.022	0.00198	. 0.06531	2.84E-06	9260
0.033	0.00183	0.06027	3.64E-06	13900
0.044	0.00167	0.05523	4.06E-06	18500
0.055	0.00152	0.05019	4.2E-06	23100
0.066	0.00137	0.04515	4.08E-06	27800
0.077	0.00122	0.04012	3.77E-06	32400
0.088	0.00106	0.03509	3.27E-06	37000
0.099	0.00091	0.03007	2.71E-06	41700
0.11	0.00076	0.02505	2.09E-06	46300
0.121	0.00061	0.02003	1.48E-06	50900
0.132	0.00045	0.01501	8.92E-07	55600
0.143	0.0003	0.00999	4.29E-07	60200
0.154	0.00015	0.00499	1.15E-07	64800
0.165	-0.0000007	-0.00002	2.31E-12	69500
0.176	-0.00015	-0.00503	1.33E-07	74100
0.187	-0.0003	-0.01004	5.63E-07	78700
0.198	-0.00046	-0.01504	1.37E-06	83400
0.209	-0.00061	-0.02005	2.56E-06	88000
0.22	-0.00076	-0.02505	4.19E-06	92600

B= 0.0254 m
delta Z= 0.011 m

<u>by Simpson's rule:</u>

INT= 4.6E-07 m^4

w(b)= 0.00228 m
w(a)= 0.00071 m
delta nh= (w(b)-w(a))/INT
delta nh= 3400 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 10700 kN/m\^{}3}}$

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Table E3

NUMERICAL ANALYSIS OF LATERALY LOADED PILES EMBEDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.220m

	Pi = 0.042 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00317	0.07539	0	0
0.011	0.00296	0.07035	2.29E-06	4480
0.022	0.00275	. 0.06531	3.95E-06	8970
0.033	0.00254	0.06027	5.05E-06	13400
0.044	0.00233	0.05523	5.66E-06	17900
0.055	0.00211	0.05019	5.82E-06	22400
0.066	0.0019	0.04515	5.66E-06	26900
0.077	0.00169	0.04012	5.22E-06	31400
0.088	0.00148	0.03509	4.57E-06	35800
0.099	0.00127	0.03007	3.78E-06	40300
0.11	0.00105	0.02505	2.89E-06	44800
0.121	0.00084	0.02003	2.04E-06	49300
0.132	0.00063	0.01501	1.25E-06	53800
0.143	0.00042	0.00999	6E-07	58300
0.154	0.00021	0.00499	1.61E-07	62800
0.165	-0.000001	-0.00002	3.3E-12	67200
0.176	-0.00021	-0.00503	1.86E-07	71700
0.187	-0.00042	-0.01004	7.89E-07	76200
0.198	-0.00063	-0.01504	1.88E-06	80700
0.209	-0.00084	-0.02005	3.52E-06	85200
0.22	-0.00105	-0.02505	5.79E-06	89700

B= 0.0254 m
delta Z= 0.011 m

by Simpson's rule:

INT= 6E-07 m^4

w(b)= 0.0032 m
w(a)= 0.0012 m
delta nh= (w(b)-w(a))/INT
delta nh= 3060 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 10360 kN/m^3}}$

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Table E4
NUMERICAL ANALYSIS OF LATERALY LOADED PILES EMBEDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.220m

	Pi = 0.054 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00407	0.07539	0	0
0.011	0.00379	0.07035	2.93E-06	4320
0.022	0.00353	. 0.06531	5.07E-06	8650
0.033	0.00325	0.06027	6.46E-06	12900
0.044	0.00298	0.05523	7.24E-06	17300
0.055	0.00271	0.05019	7.48E-06	21600
0.066	0.00244	0.04515	7.27E-06	25900
0.077	0.00217	0.04012	6.7E-06	30200
0.088	0.0019	0.03509	5.87E-06	34600
0.099	0.00162	0.03007	4.82E-06	38900
0.11	0.00135	0.02505	3.72E-06	43200
0.121	0.00108	0.02003	2.62E-06	47500
0.132	0.00081	0.01501	1.6E-06	51900
0.143	0.00054	0.00999	7.71E-07	56200
0.154	0.00027	0.00499	2.07E-07	60500
0.165	-0.000001	-0.00002	3.3E-12	64800
0.176	-0.00027	-0.00503	2.39E-07	69200
0.187	-0.00054	-0.01004	1.01E-06	73500
0.198	-0.00081	-0.01504	2.41E-06	77800
0.209	-0.00108	-0.02005	4.53E-06	82200
0.22	-0.00135	-0.02505	7.44E-06	86500

B= 0.0254 m
delta Z= 0.011 m

by Simpson's rule:

INT= 8E-07 m^4

w(b)= 0.0041 m
w(a)= 0.0019 m
delta nh= (w(b)-w(a))/INT
delta nh= 2690 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 9990 kN/m^3}}$

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Table E5
NUMERICAL ANALYSIS OF LATERALY LOADED PILES EMBEDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.220m

	Pi = 0.066 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00497	0.07539	0	0
0.011	0.00464	0.07035	3.59E-06	4150
0.022	0.0043	. 0.06531	6.18E-06	8310
0.033	0.00397	0.06027	7.9E-06	12400
0.044	0.00364	0.05523	8.85E-06	16600
0.055	0.00331	0.05019	9.14E-06	20700
0.066	0.00298	0.04515	8.88E-06	24900
0.077	0.00264	0.04012	8.16E-06	29100
0.088	0.00231	0.03509	7.13E-06	33200
0.099	0.00198	0.03007	5.89E-06	37400
0.11	0.00165	0.02505	4.55E-06	41500
0.121	0.00132	0.02003	3.2E-06	45700
0.132	0.00099	0.01501	1.96E-06	49800
0.143	0.00066	0.00999	9.43E-07	54000
0.154	0.00033	0.00499	2.54E-07	58200
0.165	-0.0000015	-0.00002	4.95E-12	62300
0.176	-0.00033	-0.00503	2.92E-07	66500
0.187	-0.00066	-0.01004	1.24E-06	70600
0.198	-0.00099	-0.01504	2.95E-06	74800
0.209	-0.00132	-0.02005	5.53E-06	78900
0.22	-0.00165	-0.02505	9.09E-06	83100

B= 0.0254 m
delta Z= 0.011 m

by Simpson's rule:

INT= 1E-06 m^4

w(b)= 0.005 m
w(a)= 0.0027 m
delta nh= (w(b)-w(a))/INT
delta nh= 2300 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9600 kN/m^3

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Table E6

NUMERICAL ANALYSIS OF LATERALY LOADED PILES EMBEDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.220m

	Pi = 0.085 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00641	0.07539	0	0
0.011	0.00598	0.07035	4.63E-06	3710
0.022	0.00555	. 0.06531	7.97E-06	7430
0.033	0.00512	0.06027	1.02E-05	11100
0.044	0.00469	0.05523	1.14E-05	14800
0.055	0.00427	0.05019	1.18E-05	18500
0.066	0.00384	0.04515	1.14E-05	22200
0.077	0.00341	0.04012	1.05E-05	26000
0.088	0.00298	0.03509	9.2E-06	29700
0.099	0.00256	0.03007	7.62E-06	33400
0.11	0.00213	0.02505	5.87E-06	37100
0.121	0.0017	0.02003	4.12E-06	40800
0.132	0.00128	0.01501	2.54E-06	44500
0.143	0.00085	0.00999	1.21E-06	48300
0.154	0.000424	0.00499	3.26E-07	52000
0.165	-0.000002	-0.00002	6.6E-12	55700
0.176	-0.000428	-0.00503	3.79E-07	59400
0.187	-0.000853	-0.01004	1.6E-06	63100
0.198	-0.00128	-0.01504	3.81E-06	66800
0.209	-0.0017	-0.02005	7.12E-06	70500
0.22	-0.00213	-0.02505	1.17E-05	74300

B= 0.0254 m
delta Z= 0.011 m

by Simpson's rule:

INT= 1.3E-06 m^4

w(b)= 0.00641 m
w(a)= 0.00475 m
delta nh= (w(b)-w(a))/INT
delta nh= 1280 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8580 kN/m^3

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Table E7

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Pi = 0.018 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00097	0.05256	0	0
0.0132	0.0009	0.04903	5.82E-07	6000
0.0264	0.00084	. 0.04549	1.01E-06	12000
0.0396	0.00077	0.04196	1.28E-06	18000
0.0528	0.00071	0.03844	1.44E-06	24000
0.066	0.00064	0.03491	1.47E-06	30000
0.0792	0.00058	0.03139	1.44E-06	36000
0.0924	0.00051	0.02788	1.31E-06	42000
0.1056	0.00045	0.02437	1.16E-06	48000
0.1188	0.00038	0.02087	9.42E-07	54000
0.132	0.00032	0.01737	7.34E-07	60000
0.1452	0.00026	0.01388	5.24E-07	66000
0.1584	0.00019	0.0104	3.13E-07	72000
0.1716	0.00013	0.00692	1.54E-07	78000
0.1848	0.000063	0.00344	4E-08	84000
0.198	-0.0000006	-0.000034	4.04E-12	90000
0.2112	-0.00006	-0.00351	4.45E-08	96000
0.2244	-0.00013	-0.00697	2.03E-07	102000
0.2376	-0.00019	-0.01044	4.71E-07	108000
0.2508	-0.00026	-0.01391	9.07E-07	114000
0.264	-0.00032	-0.01738	1.47E-06	120000

B= 0.0254 m
delta Z= 0.0132 m

<u>by Simpson's rule:</u>

INT= 1.95E-07 m^4

w(b)= 0.00097 m
w(a)= 0.000141 m
delta nh= (w(b)-w(a))/INT
delta nh= 4250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\text{nh= 11550 kN/m^3}}$

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Table E8

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Pi = 0.030 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00159	0.05256	0	0
0.0132	0.00149	0.04903	9.64E-07	5840
0.0264	0.00138	0.04549	1.66E-06	11600
0.0396	0.00127	0.04196	2.11E-06	17500
0.0528	0.00116	0.03844	2.35E-06	23300
0.066	0.00106	0.03491	2.44E-06	29200
0.0792	0.00095	0.03139	2.36E-06	35000
0.0924	0.00084	0.02788	2.16E-06	40800
0.1056	0.00074	0.02437	1.9E-06	46700
0.1188	0.00063	0.02087	1.56E-06	52500
0.132	0.00053	0.01737	1.22E-06	58400
0.1452	0.00042	0.01388	8.46E-07	64200
0.1584	0.00032	0.0104	5.27E-07	70000
0.1716	0.00021	0.00692	2.49E-07	75900
0.1848	0.0001	0.00344	6.36E-08	81700
0.198	-0.000001	-0.000034	6.73E-12	87600
0.2112	-0.00011	-0.00351	8.15E-08	93400
0.2244	-0.00021	-0.00697	3.28E-07	99300
0.2376	-0.00032	-0.01044	7.94E-07	105000
0.2508	-0.00042	-0.01391	1.47E-06	110000
0.264	-0.00053	-0.01738	2.43E-06	116000

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 3.21E-07 m^4

w(b)= 0.00159 m
w(a)= 0.000328 m
delta nh= (w(b)-w(a))/INT
delta nh= 3940 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 11240 kN/m^3

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Table E9

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Pi = 0.042 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00221	0.05256	0	0
0.0132	0.00206	0.04903	1.33E-06	5620
0.0264	0.00192	0.04549	2.31E-06	11200
0.0396	0.00177	0.04196	2.94E-06	16800
0.0528	0.00162	0.03844	3.29E-06	22500
0.066	0.00147	0.03491	3.39E-06	28100
0.0792	0.00132	0.03139	3.28E-06	33700
0.0924	0.00117	0.02788	3.01E-06	39300
0.1056	0.00103	0.02437	2.65E-06	45000
0.1188	0.00088	0.02087	2.18E-06	50600
0.132	0.00073	0.01737	1.67E-06	56200
0.1452	0.00058	0.01388	1.17E-06	61900
0.1584	0.00044	0.0104	7.25E-07	67500
0.1716	0.00029	0.00692	3.44E-07	73100
0.1848	0.00014	0.00344	8.9E-08	78700
0.198	-0.0000014	-0.000034	9.42E-12	84400
0.2112	-0.00015	-0.00351	1.11E-07	90000
0.2244	-0.00029	-0.00697	4.54E-07	95600
0.2376	-0.00044	-0.01044	1.09E-06	101000
0.2508	-0.00059	-0.01391	2.06E-06	106000
0.264	-0.00073	-0.01738	3.35E-06	112000

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 4.46E-07 m^4

w(b)= 0.00221 m
w(a)= 0.000636 m
delta nh= (w(b)-w(a))/INT
delta nh= 3530 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 10830 kN/m^3}}$

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Table E10
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Pi = 0.054 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00284	0.05256	0	0
0.0132	0.00265	0.04903	1.72E-06	5440
0.0264	0.00246	0.04549	2.95E-06	10800
0.0396	0.00227	0.04196	3.77E-06	16300
0.0528	0.00208	0.03844	4.22E-06	21700
0.066	0.00189	0.03491	4.35E-06	27200
0.0792	0.00169	0.03139	4.2E-06	32600
0.0924	0.00151	0.02788	3.89E-06	38000
0.1056	0.00132	0.02437	3.4E-06	43500
0.1188	0.00113	0.02087	2.8E-06	48900
0.132	0.00094	0.01737	2.16E-06	54400
0.1452	0.00075	0.01388	1.51E-06	59800
0.1584	0.00056	0.0104	9.23E-07	65200
0.1716	0.00037	0.00692	4.39E-07	70700
0.1848	0.000186	0.00344	1.18E-07	76100
0.198	-0.000002	-0.000034	1.35E-11	81600
0.2112	-0.00019	-0.00351	1.41E-07	87000
0.2244	-0.00038	-0.00697	5.94E-07	92400
0.2376	-0.00056	-0.01044	1.39E-06	97900
0.2508	-0.00075	-0.01391	2.62E-06	103000
0.264	-0.00094	-0.01738	4.31E-06	108000

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 5.72E-07 m^4

w(b)= 0.00284 m
w(a)= 0.001026 m
delta nh= (w(b)-w(a))/INT
delta nh= 3170 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 10470 kN/m^3

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Table E11

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Pi = 0.066 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00346	0.05256	0	0
0.0132	0.00323	0.04903	2.09E-06	5250
0.0264	0.00299	0.04549	3.59E-06	10500
0.0396	0.00277	0.04196	4.6E-06	15700
0.0528	0.00253	0.03844	5.13E-06	21000
0.066	0.0023	0.03491	5.3E-06	26200
0.0792	0.00207	0.03139	5.15E-06	31500
0.0924	0.00184	0.02788	4.74E-06	36700
0.1056	0.00161	0.02437	4.14E-06	42000
0.1188	0.00138	0.02087	3.42E-06	47200
0.132	0.00114	0.01737	2.61E-06	52500
0.1452	0.00091	0.01388	1.83E-06	57700
0.1584	0.00069	0.0104	1.14E-06	63000
0.1716	0.00046	0.00692	5.46E-07	68300
0.1848	0.00023	0.00344	1.46E-07	73500
0.198	-0.000002	-0.000034	1.35E-11	78800
0.2112	-0.00023	-0.00351	1.71E-07	84000
0.2244	-0.00046	-0.00697	7.19E-07	89300
0.2376	-0.00069	-0.01044	1.71E-06	94500
0.2508	-0.00092	-0.01391	3.21E-06	99800
0.264	-0.00114	-0.01738	5.23E-06	105000

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 6.98E-07 m^4

w(b)= 0.00346 m
w(a)= 0.001502 m
delta nh= (w(b)-w(a))/INT
delta nh= 2810 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 10110 kN/m^3

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Table E12

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Pi = 0.096 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00502	0.05256	0	0
0.0132	0.00469	0.04903	3.04E-06	4760
0.0264	0.00435	0.04549	5.22E-06	9530
0.0396	0.00401	0.04196	6.66E-06	14200
0.0528	0.00367	0.03844	7.45E-06	19000
0.066	0.00334	0.03491	7.7E-06	23800
0.0792	0.003	0.03139	7.46E-06	28500
0.0924	0.00267	0.02788	6.88E-06	33300
0.1056	0.00233	0.02437	6E-06	38100
0.1188	0.00199	0.02087	4.93E-06	42800
0.132	0.00166	0.01737	3.81E-06	47600
0.1452	0.00133	0.01388	2.68E-06	52400
0.1584	0.00099	0.0104	1.63E-06	57100
0.1716	0.00066	0.00692	7.84E-07	61900
0.1848	0.00033	0.00344	2.1E-07	66700
0.198	-0.000003	-0.000034	2.02E-11	71400
0.2112	-0.00034	-0.00351	2.52E-07	76200
0.2244	-0.00067	-0.00697	1.05E-06	81000
0.2376	-0.00099	-0.01044	2.46E-06	85700
0.2508	-0.00133	-0.01391	4.64E-06	90500
0.264	-0.00166	-0.01738	7.62E-06	95300

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 1.01E-06 m^4

w(b)= 0.00502 m
w(a)= 0.003131 m
delta nh= (w(b)-w(a))/INT
delta nh= 1870 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9170 kN/m^3

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Table E13

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Pi = 0.125 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00657	0.05256	0	0
0.0132	0.00613	0.04903	3.97E-06	4280
0.0264	0.00569	0.04549	6.83E-06	8570
0.0396	0.00525	0.04196	8.72E-06	12800
0.0528	0.0048	0.03844	9.74E-06	17100
0.066	0.00436	0.03491	1E-05	21400
0.0792	0.00392	0.03139	9.75E-06	25700
0.0924	0.00349	0.02788	8.99E-06	30000
0.1056	0.00305	0.02437	7.85E-06	34200
0.1188	0.00261	0.02087	6.47E-06	38500
0.132	0.00217	0.01737	4.98E-06	42800
0.1452	0.00174	0.01388	3.51E-06	47100
0.1584	0.0013	0.0104	2.14E-06	51400
0.1716	0.00086	0.00692	1.02E-06	55700
0.1848	0.00043	0.00344	2.73E-07	60000
0.198	-0.000004	-0.000034	2.69E-11	64300
0.2112	-0.00044	-0.00351	3.26E-07	68500
0.2244	-0.00087	-0.00697	1.36E-06	72800
0.2376	-0.00131	-0.01044	3.25E-06	77100
0.2508	-0.00174	-0.01391	6.07E-06	81400
0.264	-0.00217	-0.01738	9.96E-06	85700

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 1.32E-06 m^4

w(b)= 0.00657 m
w(a)= 0.005308 m
delta nh= (w(b)-w(a))/INT
delta nh= 953 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 8250 kN/m^3}}$

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Table E14

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Pi = 0.030 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00115	0.03884	0	0
0.0154	0.00108	0.0362	6.02E-07	6920
0.0308	0.00099	0.03357	1.02E-06	13800
0.0462	0.00092	0.03094	1.32E-06	20700
0.0616	0.00084	0.02831	1.46E-06	27600
0.077	0.00076	0.0257	1.5E-06	34600
0.0924	0.00069	0.02308	1.47E-06	41500
0.1078	0.00061	0.02048	1.35E-06	48400
0.1232	0.00053	0.01788	1.17E-06	55300
0.1386	0.00045	0.0153	9.54E-07	62300
0.154	0.00038	0.01272	7.44E-07	69200
0.1694	0.0003	0.01015	5.16E-07	76100
0.1848	0.00023	0.00759	3.23E-07	83000
0.2002	0.00015	0.00504	1.51E-07	90000
0.2156	0.00007	0.0025	3.77E-08	96900
0.231	-0.0000014	-0.000046	1.49E-11	103000
0.2464	-0.000077	-0.00258	4.89E-08	110000
0.2618	-0.00015	-0.00512	2.01E-07	117000
0.2772	-0.00023	-0.00765	4.88E-07	124000
0.2926	-0.0003	-0.01018	8.94E-07	131000
0.308	-0.00038	-0.01271	1.49E-06	138000

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 2.31E-07 m^4

w(b)= 0.00115 m
w(a)= 0.000199 m
delta nh= (w(b)-w(a))/INT
delta nh= 4120 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 11420 kN/m^3

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Table E15

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Pi = 0.059 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00231	0.03884	0	0
0.0154	0.00215	0.0362	1.2E-06	6410
0.0308	0.00199	0.03357	2.06E-06	12800
0.0462	0.00184	0.03094	2.63E-06	19200
0.0616	0.00168	0.02831	2.93E-06	25600
0.077	0.00153	0.0257	3.03E-06	32000
0.0924	0.00137	0.02308	2.92E-06	38400
0.1078	0.00122	0.02048	2.69E-06	44900
0.1232	0.00106	0.01788	2.33E-06	51300
0.1386	0.00091	0.0153	1.93E-06	57700
0.154	0.00076	0.01272	1.49E-06	64100
0.1694	0.0006	0.01015	1.03E-06	70500
0.1848	0.00045	0.00759	6.31E-07	76900
0.2002	0.00029	0.00504	2.93E-07	83300
0.2156	0.00015	0.0025	8.09E-08	89800
0.231	-0.0000027	-0.000046	2.87E-11	96200
0.2464	-0.00015	-0.00258	9.54E-08	102000
0.2618	-0.0003	-0.00512	4.02E-07	109000
0.2772	-0.00045	-0.00765	9.54E-07	115000
0.2926	-0.0006	-0.01018	1.79E-06	121000
0.308	-0.00076	-0.01271	2.98E-06	128000

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 4.62E-07 m^4

w(b)= 0.00231 m
w(a)= 0.000798 m
delta nh= (w(b)-w(a))/INT
delta nh= 3280 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 10580 kN/m^3}}$

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Table E16

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Pi = 0.089 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00346	0.03884	0	0
0.0154	0.00322	0.0362	1.8E-06	5570
0.0308	0.00299	0.03357	3.09E-06	11100
0.0462	0.00275	0.03094	3.93E-06	16700
0.0616	0.00252	0.02831	4.39E-06	22200
0.077	0.00229	0.0257	4.53E-06	27800
0.0924	0.00205	0.02308	4.37E-06	33400
0.1078	0.00182	0.02048	4.02E-06	39000
0.1232	0.00159	0.01788	3.5E-06	44500
0.1386	0.00136	0.0153	2.88E-06	50100
0.154	0.00113	0.01272	2.21E-06	55700
0.1694	0.0009	0.01015	1.55E-06	61200
0.1848	0.00068	0.00759	9.54E-07	66800
0.2002	0.00045	0.00504	4.54E-07	72400
0.2156	0.00022	0.0025	1.19E-07	78000
0.231	-0.000004	-0.000046	4.25E-11	83500
0.2464	-0.00023	-0.00258	1.46E-07	89100
0.2618	-0.00046	-0.00512	6.17E-07	94700
0.2772	-0.00068	-0.00765	1.44E-06	100000
0.2926	-0.00091	-0.01018	2.71E-06	105000
0.308	-0.00113	-0.01271	4.42E-06	111000

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 6.92E-07 m^4

w(b)= 0.00346 m
w(a)= 0.002149 m
delta nh= (w(b)-w(a))/INT
delta nh= 1890 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9190 kN/m^3

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Table E17

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Pi = 0.119 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00461	0.03884	0	0
0.0154	0.00429	0.0362	2.39E-06	5480
0.0308	0.00398	0.03357	4.12E-06	10900
0.0462	0.00367	0.03094	5.25E-06	16400
0.0616	0.00336	0.02831	5.86E-06	21900
0.077	0.00305	0.0257	6.04E-06	27400
0.0924	0.00274	0.02308	5.84E-06	32900
0.1078	0.00243	0.02048	5.36E-06	38400
0.1232	0.00212	0.01788	4.67E-06	43800
0.1386	0.00182	0.0153	3.86E-06	49300
0.154	0.00151	0.01272	2.96E-06	54800
0.1694	0.00121	0.01015	2.08E-06	60300
0.1848	0.0009	0.00759	1.26E-06	65800
0.2002	0.00059	0.00504	5.95E-07	71300
0.2156	0.000296	0.0025	1.6E-07	76800
0.231	-0.0000054	-0.000046	5.74E-11	82300
0.2464	-0.00031	-0.00258	1.97E-07	87700
0.2618	-0.00061	-0.00512	8.18E-07	93200
0.2772	-0.00091	-0.00765	1.93E-06	98700
0.2926	-0.0012	-0.01018	3.57E-06	104000
0.308	-0.00151	-0.01271	5.91E-06	109000

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 9.23E-07 m^4

w(b)= 0.00461 m
w(a)= 0.002995 m
delta nh= (w(b)-w(a))/INT
delta nh= 1750 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9050 kN/m^3

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Table E18

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Pi = 0.148 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00576	0.03884	0	0
0.0154	0.00537	0.0362	2.99E-06	5200
0.0308	0.00498	.0.03357	5.15E-06	10400
0.0462	0.00459	0.03094	6.56E-06	15600
0.0616	0.0042	0.02831	7.32E-06	20800
0.077	0.00381	0.0257	7.54E-06	26000
0.0924	0.00343	0.02308	7.31E-06	31200
0.1078	0.00304	0.02048	6.71E-06	36400
0.1232	0.00265	0.01788	5.84E-06	41600
0.1386	0.00227	0.0153	4.81E-06	46800
0.154	0.00189	0.01272	3.7E-06	52000
0.1694	0.00151	0.01015	2.6E-06	57200
0.1848	0.00113	0.00759	1.58E-06	62400
0.2002	0.00075	0.00504	7.57E-07	67600
0.2156	0.00037	0.0025	1.99E-07	72800
0.231	-0.0000068	-0.000046	7.23E-11	78000
0.2464	-0.00038	-0.00258	2.42E-07	83200
0.2618	-0.00076	-0.00512	1.02E-06	88400
0.2772	-0.00114	-0.00765	2.42E-06	93600
0.2926	-0.00151	-0.01018	4.5E-06	98800
0.308	-0.00189	-0.01271	7.4E-06	104000

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 1.15E-06 m^4

w(b)= 0.00576 m
w(a)= 0.004286 m
delta nh= (w(b)-w(a))/INT
delta nh= 1280 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8580 kN/m^3

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Table E19

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

B= 0.0254 m
delta Z= 0.0154 m

	Pi = 0.173 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00672	0.03884	0	0
0.0154	0.00626	0.0362	3.49E-06	4830
0.0308	0.00581	0.03357	6.01E-06	9660
0.0462	0.00535	0.03094	7.65E-06	14400
0.0616	0.0049	0.02831	8.55E-06	19300
0.077	0.00445	0.0257	8.81E-06	24100
0.0924	0.00399	0.02308	8.51E-06	28900
0.1078	0.00354	0.02048	7.82E-06	33800
0.1232	0.00309	0.01788	6.81E-06	38600
0.1386	0.00265	0.0153	5.62E-06	43400
0.154	0.0022	0.01272	4.31E-06	48300
0.1694	0.00176	0.01015	3.03E-06	53100
0.1848	0.00131	0.00759	1.84E-06	57900
0.2002	0.00087	0.00504	8.78E-07	62800
0.2156	0.00043	0.0025	2.32E-07	67600
0.231	-0.000008	-0.000046	8.5E-11	72400
0.2464	-0.00045	-0.00258	2.86E-07	77300
0.2618	-0.00089	-0.00512	1.19E-06	82100
0.2772	-0.00132	-0.00765	2.8E-06	86900
0.2926	-0.00176	-0.01018	5.24E-06	91800
0.308	-0.0022	-0.01271	8.61E-06	96600

by Simpson's rule:

INT= 1.35E-06 m^4

w(b)= 0.00672 m
w(a)= 0.005825 m
delta nh= (w(b)-w(a))/INT
delta nh= 665.00 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7970 kN/m^3

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Table E20

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.018 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00056	0.03164	0	0
0.022	0.00053	0.02951	3.44E-07	8380
0.044	0.00049	0.02737	5.9E-07	16700
0.066	0.00045	0.02523	7.49E-07	25100
0.088	0.00041	0.0231	8.33E-07	33500
0.11	0.00037	0.02097	8.53E-07	41900
0.132	0.00034	0.01885	8.46E-07	50300
0.154	0.00029	0.01673	7.47E-07	58700
0.176	0.00026	0.01462	6.69E-07	67100
0.198	0.00022	0.01251	5.45E-07	75400
0.22	0.00019	0.01041	4.35E-07	83800
0.242	0.00015	0.00831	3.02E-07	92200
0.264	0.00011	0.00622	1.81E-07	100000
0.286	0.00007	0.00413	8.27E-08	109000
0.308	0.00004	0.00205	2.53E-08	117000
0.33	-0.0000005	-0.0000302	4.98E-12	125000
0.352	-0.000038	-0.00211	2.82E-08	134000
0.374	-0.000074	-0.00418	1.16E-07	142000
0.396	-0.00011	-0.00626	2.73E-07	150000
0.418	-0.00015	-0.00833	5.22E-07	159000
0.44	-0.00019	-0.0104	8.69E-07	167000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 2E-07 m^4

w(b)= 0.0006 m
w(a)= 0.0001 m
delta nh= (w(b)-w(a))/INT
delta nh= 2380 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9680 kN/m^3

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Table E21

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.036 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00113	0.03164	0	0
0.022	0.00105	0.02951	6.82E-07	7960
0.044	0.00097	. 0.02737	1.17E-06	15900
0.066	0.00089	0.02523	1.48E-06	23800
0.088	0.00082	0.0231	1.67E-06	31800
0.11	0.00075	0.02097	1.73E-06	39700
0.132	0.00067	0.01885	1.67E-06	47700
0.154	0.00059	0.01673	1.52E-06	55700
0.176	0.00052	0.01462	1.34E-06	63600
0.198	0.00045	0.01251	1.11E-06	71600
0.22	0.00037	0.01041	8.47E-07	79500
0.242	0.00029	0.00831	5.83E-07	87500
0.264	0.00022	0.00622	3.61E-07	95500
0.286	0.00015	0.00413	1.77E-07	103000
0.308	0.00007	0.00205	4.42E-08	111000
0.33	-0.000001	-0.0000302	9.97E-12	119000
0.352	-0.00008	-0.00211	5.94E-08	127000
0.374	-0.00015	-0.00418	2.34E-07	135000
0.396	-0.00022	-0.00626	5.45E-07	143000
0.418	-0.00029	-0.00833	1.01E-06	151000
0.44	-0.00037	-0.0104	1.69E-06	159000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 4E-07 m^4

w(b)= 0.0011 m
w(a)= 0.0004 m
delta nh= (w(b)-w(a))/INT
delta nh= 1890 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 9190 kN/m^3}}$

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Table E22

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.053 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00169	0.03164	0	0
0.022	0.00158	0.02951	1.03E-06	7810
0.044	0.00146	0.02737	1.76E-06	15600
0.066	0.00135	0.02523	2.25E-06	23400
0.088	0.00123	0.0231	2.5E-06	31200
0.11	0.00112	0.02097	2.58E-06	39000
0.132	0.001	0.01885	2.49E-06	46800
0.154	0.00089	0.01673	2.29E-06	54600
0.176	0.00078	0.01462	2.01E-06	62500
0.198	0.00068	0.01251	1.68E-06	70300
0.22	0.00055	0.01041	1.26E-06	78100
0.242	0.00044	0.00831	8.85E-07	85900
0.264	0.00033	0.00622	5.42E-07	93700
0.286	0.00022	0.00413	2.6E-07	101000
0.308	0.00011	0.00205	6.95E-08	109000
0.33	-0.000002	-0.0000302	1.99E-11	117000
0.352	-0.00011	-0.00211	8.17E-08	125000
0.374	-0.00022	-0.00418	3.44E-07	132000
0.396	-0.00033	-0.00626	8.18E-07	140000
0.418	-0.00044	-0.00833	1.53E-06	148000
0.44	-0.00055	-0.0104	2.52E-06	156000

B= 0.0254 m
delta Z= 0.022 m

<u>by Simpson's rule:</u>

INT= 6E-07 m^4

w(b)= 0.0017 m
w(a)= 0.0007 m
delta nh= (w(b)-w(a))/INT
delta nh= 1720 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh=	**9020**	**kN/m^3**

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Table E23

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.071 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	**kh (kN/m^2)**
0	0.00225	0.03164	0	0
0.022	0.0021	0.02951	1.36E-06	7710
0.044	0.00195	0.02737	2.35E-06	15400
0.066	0.00179	0.02523	2.98E-06	23100
0.088	0.00164	0.0231	3.33E-06	30800
0.11	0.00149	0.02097	3.44E-06	38500
0.132	0.00134	0.01885	3.33E-06	46300
0.154	0.00119	0.01673	3.07E-06	54000
0.176	0.00104	0.01462	2.68E-06	61700
0.198	0.00089	0.01251	2.2E-06	69400
0.22	0.00074	0.01041	1.69E-06	77100
0.242	0.00059	0.00831	1.19E-06	84800
0.264	0.00044	0.00622	7.23E-07	92600
0.286	0.00029	0.00413	3.43E-07	100000
0.308	0.00015	0.00205	9.47E-08	108000
0.33	-0.000002	-0.0000302	1.99E-11	115000
0.352	-0.00015	-0.00211	1.11E-07	123000
0.374	-0.00029	-0.00418	4.53E-07	131000
0.396	-0.00045	-0.00626	1.12E-06	138000
0.418	-0.00059	-0.00833	2.05E-06	146000
0.44	-0.00074	-0.0104	3.39E-06	154000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 8E-07 m^4

w(b)= 0.0023 m
w(a)= 0.001 m
delta nh= (w(b)-w(a))/INT
delta nh= 1610 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8910 kN/m^3

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Table E24

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.089 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00282	0.03164	0	0
0.022	0.00263	0.02951	1.71E-06	7700
0.044	0.00244	0.02737	2.94E-06	15400
0.066	0.00225	0.02523	3.75E-06	23100
0.088	0.00206	0.0231	4.19E-06	30800
0.11	0.00187	0.02097	4.31E-06	38500
0.132	0.00168	0.01885	4.18E-06	46200
0.154	0.00149	0.01673	3.84E-06	53900
0.176	0.0013	0.01462	3.35E-06	61600
0.198	0.00111	0.01251	2.75E-06	69300
0.22	0.00093	0.01041	2.13E-06	77000
0.242	0.00074	0.00831	1.49E-06	84700
0.264	0.00055	0.00622	9.03E-07	92500
0.286	0.00037	0.00413	4.37E-07	100000
0.308	0.00018	0.00205	1.14E-07	107000
0.33	-0.000003	-0.0000302	2.99E-11	115000
0.352	-0.00019	-0.00211	1.41E-07	123000
0.374	-0.00037	-0.00418	5.78E-07	131000
0.396	-0.00056	-0.00626	1.39E-06	138000
0.418	-0.00074	-0.00833	2.58E-06	146000
0.44	-0.00093	-0.0104	4.26E-06	154000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 9E-07 m^4

w(b)= 0.0028 m
w(a)= 0.0013 m
delta nh= (w(b)-w(a))/INT
delta nh= 1600 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 8900 kN/m^3}}$

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Table E25
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.107 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00338	0.03164	0	0
0.022	0.00315	0.02951	2.05E-06	7700
0.044	0.00293	0.02737	3.53E-06	15400
0.066	0.00269	0.02523	4.48E-06	23100
0.088	0.00247	0.0231	5.02E-06	30800
0.11	0.00224	0.02097	5.17E-06	38500
0.132	0.00201	0.01885	5E-06	46200
0.154	0.00179	0.01673	4.61E-06	53900
0.176	0.00156	0.01462	4.01E-06	61600
0.198	0.00134	0.01251	3.32E-06	69300
0.22	0.00111	0.01041	2.54E-06	77000
0.242	0.00089	0.00831	1.79E-06	84700
0.264	0.00066	0.00622	1.08E-06	92400
0.286	0.00044	0.00413	5.2E-07	100100
0.308	0.00022	0.00205	1.39E-07	107800
0.33	-0.000003	-0.0000302	2.99E-11	115500
0.352	-0.00023	-0.00211	1.71E-07	123200
0.374	-0.00044	-0.00418	6.88E-07	130900
0.396	-0.00067	-0.00626	1.66E-06	138600
0.418	-0.00089	-0.00833	3.1E-06	146300
0.44	-0.00111	-0.0104	5.08E-06	154000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 1E-06 m^4

w(b)= 0.0034 m
w(a)= 0.0016 m
delta nh= (w(b)-w(a))/INT
delta nh= 1590 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8890 kN/m^3

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Table E26

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.125 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00395	0.03164	0	0
0.022	0.00368	0.02951	2.39E-06	7690
0.044	0.00341	0.02737	4.11E-06	15300
0.066	0.00315	0.02523	5.25E-06	23000
0.088	0.00288	0.0231	5.85E-06	30700
0.11	0.00262	0.02097	6.04E-06	38400
0.132	0.00235	0.01885	5.85E-06	46100
0.154	0.00209	0.01673	5.38E-06	53800
0.176	0.00182	0.01462	4.68E-06	61500
0.198	0.00156	0.01251	3.86E-06	69200
0.22	0.00129	0.01041	2.95E-06	76900
0.242	0.00104	0.00831	2.09E-06	84600
0.264	0.00077	0.00622	1.26E-06	92200
0.286	0.00052	0.00413	6.14E-07	99900
0.308	0.00026	0.00205	1.64E-07	107000
0.33	-0.000004	-0.0000302	3.99E-11	115000
0.352	-0.00026	-0.00211	1.93E-07	123000
0.374	-0.00052	-0.00418	8.13E-07	130000
0.396	-0.00078	-0.00626	1.93E-06	138000
0.418	-0.00103	-0.00833	3.59E-06	146000
0.44	-0.00129	-0.0104	5.9E-06	153000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 1E-06 m^4

w(b)= 0.004 m
w(a)= 0.0019 m
delta nh= (w(b)-w(a))/INT
delta nh= 1580 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8880 kN/m^3

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Table E27

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.142 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00451	0.03164	0	0
0.022	0.0042	0.02951	2.73E-06	7680
0.044	0.00389	0.02737	4.68E-06	15300
0.066	0.00359	0.02523	5.98E-06	23000
0.088	0.00329	0.0231	6.69E-06	30700
0.11	0.00298	0.02097	6.87E-06	38400
0.132	0.00268	0.01885	6.67E-06	46000
0.154	0.00238	0.01673	6.13E-06	53700
0.176	0.00208	0.01462	5.35E-06	61400
0.198	0.00178	0.01251	4.41E-06	69100
0.22	0.00148	0.01041	3.39E-06	76800
0.242	0.00118	0.00831	2.37E-06	84500
0.264	0.00089	0.00622	1.46E-06	92100
0.286	0.00059	0.00413	6.97E-07	99800
0.308	0.00029	0.00205	1.83E-07	107000
0.33	-0.000004	-0.0000302	3.99E-11	115000
0.352	-0.0003	-0.00211	2.23E-07	122000
0.374	-0.00059	-0.00418	9.22E-07	130000
0.396	-0.00089	-0.00626	2.21E-06	138000
0.418	-0.00118	-0.00833	4.11E-06	145000
0.44	-0.00148	-0.0104	6.77E-06	153000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 2E-06 m^4

w(b)= 0.0045 m
w(a)= 0.0022 m
delta nh= (w(b)-w(a))/INT
delta nh= 1570 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8870 kN/m^3

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Table E28
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.162 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	**kh (kN/m^2)**
0	0.00513	0.03164	0	0
0.022	0.00478	0.02951	3.1E-06	7620
0.044	0.00444	0.02737	5.35E-06	15200
0.066	0.00409	0.02523	6.81E-06	22800
0.088	0.00374	0.0231	7.6E-06	30400
0.11	0.00339	0.02097	7.82E-06	38100
0.132	0.00305	0.01885	7.59E-06	45700
0.154	0.00271	0.01673	6.98E-06	53300
0.176	0.00237	0.01462	6.1E-06	60900
0.198	0.00203	0.01251	5.03E-06	68500
0.22	0.00169	0.01041	3.87E-06	76200
0.242	0.00135	0.00831	2.71E-06	83800
0.264	0.00101	0.00622	1.66E-06	91400
0.286	0.00067	0.00413	7.91E-07	99000
0.308	0.00033	0.00205	2.08E-07	106000
0.33	-0.000005	-0.0000302	4.98E-11	114000
0.352	-0.00034	-0.00211	2.53E-07	121000
0.374	-0.00068	-0.00418	1.06E-06	129000
0.396	-0.00101	-0.00626	2.5E-06	137000
0.418	-0.00135	-0.00833	4.7E-06	144000
0.44	-0.00169	-0.0104	7.73E-06	152000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 2E-06 m^4

w(b)= 0.0051 m
w(a)= 0.0026 m
delta nh= (w(b)-w(a))/INT
delta nh= 1500 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8800 kN/m^3

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Table E29

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.190 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.006	0.03164	0	0
0.022	0.00559	0.02951	3.63E-06	7580
0.044	0.00519	0.02737	6.25E-06	15100
0.066	0.00478	0.02523	7.96E-06	22700
0.088	0.00438	0.0231	8.9E-06	30300
0.11	0.00397	0.02097	9.16E-06	37900
0.132	0.00357	0.01885	8.88E-06	45500
0.154	0.00317	0.01673	8.17E-06	53100
0.176	0.00277	0.01462	7.13E-06	60600
0.198	0.00237	0.01251	5.87E-06	68200
0.22	0.00197	0.01041	4.51E-06	75800
0.242	0.00158	0.00831	3.18E-06	83400
0.264	0.00118	0.00622	1.94E-06	91000
0.286	0.00078	0.00413	9.21E-07	98600
0.308	0.00039	0.00205	2.46E-07	106000
0.33	-0.000006	-0.0000302	5.98E-11	113000
0.352	-0.00039	-0.00211	2.9E-07	121000
0.374	-0.00079	-0.00418	1.24E-06	128000
0.396	-0.00118	-0.00626	2.93E-06	136000
0.418	-0.00157	-0.00833	5.47E-06	144000
0.44	-0.00197	-0.0104	9.01E-06	151000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 2E-06 m^4

w(b)= 0.006 m
w(a)= 0.0031 m
delta nh= (w(b)-w(a))/INT
delta nh= 1460 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8760 kN/m^3

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Table E30
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.217 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00687	0.03164	0	0
0.022	0.00641	0.02951	4.16E-06	7500
0.044	0.00594	0.02737	7.15E-06	15000
0.066	0.00548	0.02523	9.13E-06	22500
0.088	0.00502	0.0231	1.02E-05	30000
0.11	0.00455	0.02097	1.05E-05	37500
0.132	0.00409	0.01885	1.02E-05	45000
0.154	0.00363	0.01673	9.35E-06	52500
0.176	0.00317	0.01462	8.16E-06	60000
0.198	0.00272	0.01251	6.74E-06	67500
0.22	0.00226	0.01041	5.18E-06	75000
0.242	0.00181	0.00831	3.64E-06	82500
0.264	0.00135	0.00622	2.22E-06	90100
0.286	0.00089	0.00413	1.05E-06	97600
0.308	0.00045	0.00205	2.84E-07	105000
0.33	-0.000007	-0.0000302	6.98E-11	112000
0.352	-0.00046	-0.00211	3.42E-07	120000
0.374	-0.00091	-0.00418	1.42E-06	127000
0.396	-0.00136	-0.00626	3.37E-06	135000
0.418	-0.00181	-0.00833	6.3E-06	142000
0.44	-0.00226	-0.0104	1.03E-05	150000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 2E-06 m^4

w(b)= 0.0069 m
w(a)= 0.0037 m
delta nh= (w(b)-w(a))/INT
delta nh= 1370 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8670 kN/m^3

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Table E31

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.246 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00779	0.03164	0	0
0.022	0.00726	0.02951	4.71E-06	7420
0.044	0.00673	0.02737	8.1E-06	14800
0.066	0.00621	0.02523	1.03E-05	22200
0.088	0.00568	0.0231	1.15E-05	29600
0.11	0.00516	0.02097	1.19E-05	37100
0.132	0.00464	0.01885	1.15E-05	44500
0.154	0.00412	0.01673	1.06E-05	51900
0.176	0.00359	0.01462	9.24E-06	59300
0.198	0.00308	0.01251	7.63E-06	66800
0.22	0.00256	0.01041	5.86E-06	74200
0.242	0.00205	0.00831	4.12E-06	81600
0.264	0.00153	0.00622	2.51E-06	89000
0.286	0.00102	0.00413	1.2E-06	96400
0.308	0.0005	0.00205	3.16E-07	103000
0.33	-0.000007	-0.0000302	6.98E-11	111000
0.352	-0.00052	-0.00211	3.86E-07	118000
0.374	-0.00103	-0.00418	1.61E-06	126000
0.396	-0.00154	-0.00626	3.82E-06	133000
0.418	-0.00205	-0.00833	7.14E-06	141000
0.44	-0.00256	-0.0104	1.17E-05	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 3E-06 m^4

w(b)= 0.0078 m
w(a)= 0.0045 m
delta nh= (w(b)-w(a))/INT
delta nh= 1270 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8570 kN/m^3

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Table E32

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.291 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00919	0.03164	0	0
0.022	0.00858	0.02951	5.57E-06	7230
0.044	0.00795	0.02737	9.57E-06	14400
0.066	0.00733	0.02523	1.22E-05	21600
0.088	0.00671	0.0231	1.36E-05	28900
0.11	0.00609	0.02097	1.4E-05	36100
0.132	0.00547	0.01885	1.36E-05	43300
0.154	0.00486	0.01673	1.25E-05	50600
0.176	0.00425	0.01462	1.09E-05	57800
0.198	0.00363	0.01251	8.99E-06	65000
0.22	0.00302	0.01041	6.92E-06	72300
0.242	0.00242	0.00831	4.87E-06	79500
0.264	0.00181	0.00622	2.97E-06	86700
0.286	0.0012	0.00413	1.42E-06	94000
0.308	0.00059	0.00205	3.73E-07	101000
0.33	-0.000009	-0.0000302	8.97E-11	108000
0.352	-0.00061	-0.00211	4.53E-07	115000
0.374	-0.00122	-0.00418	1.91E-06	122000
0.396	-0.00182	-0.00626	4.51E-06	130000
0.418	-0.00242	-0.00833	8.43E-06	137000
0.44	-0.00302	-0.0104	1.38E-05	144000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 3E-06 m^4

w(b)= 0.0092 m
w(a)= 0.0059 m
delta nh= (w(b)-w(a))/INT
delta nh= 1050 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8350 kN/m^3

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Table E33
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Pi = 0.316 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01	0.03164	0	0
0.022	0.00932	0.02951	6.05E-06	7190
0.044	0.00865	0.02737	1.04E-05	14300
0.066	0.000797	0.02523	1.33E-06	21500
0.088	0.0073	0.0231	1.48E-05	28700
0.11	0.00663	0.02097	1.53E-05	35900
0.132	0.00596	0.01885	1.48E-05	43100
0.154	0.00529	0.01673	1.36E-05	50300
0.176	0.00462	0.01462	1.19E-05	57500
0.198	0.00395	0.01251	9.78E-06	64700
0.22	0.00329	0.01041	7.53E-06	71900
0.242	0.00263	0.00831	5.29E-06	79100
0.264	0.00196	0.00622	3.22E-06	86300
0.286	0.00131	0.00413	1.55E-06	93500
0.308	0.00065	0.00205	4.1E-07	100000
0.33	-0.0000096	-0.0000302	9.57E-11	107000
0.352	-0.00067	-0.00211	4.98E-07	115000
0.374	-0.00132	-0.00418	2.06E-06	122000
0.396	-0.00198	-0.00626	4.91E-06	129000
0.418	-0.00263	-0.00833	9.16E-06	136000
0.44	-0.00329	-0.0104	1.51E-05	143000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 3E-06 m^4

w(b)= 0.01 m
w(a)= 0.00697 m
delta nh= (w(b)-w(a))/INT
delta nh= 1010 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8310 kN/m^3

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Table E34
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.030 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00085	0.02879	0	0
0.0242	0.00079	0.02684	5.13E-07	8840
0.0484	0.00074	0.0249	8.92E-07	17600
0.0726	0.00068	0.02295	1.13E-06	26500
0.0968	0.00062	0.02101	1.26E-06	35300
0.121	0.00057	0.01907	1.32E-06	44200
0.1452	0.00051	0.01714	1.27E-06	53000
0.1694	0.00045	0.01521	1.16E-06	61800
0.1936	0.00039	0.01328	1E-06	70700
0.2178	0.00034	0.01137	8.42E-07	79500
0.242	0.00028	0.00945	6.4E-07	88400
0.2662	0.00022	0.00755	4.42E-07	97200
0.2904	0.00017	0.00565	2.79E-07	106000
0.3146	0.00011	0.00375	1.3E-07	114000
0.3388	0.00005	0.00186	3.15E-08	123000
0.363	-0.0000009	-0.0000296	9.67E-12	132000
0.3872	-0.00005	-0.00192	3.72E-08	141000
0.4114	-0.00011	-0.0038	1.72E-07	150000
0.4356	-0.00017	-0.00568	4.21E-07	159000
0.4598	-0.00022	-0.00757	7.66E-07	167000
0.484	-0.00028	-0.00945	1.28E-06	176000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 3.1E-07 m^4

w(b)= 0.00085 m
w(a)= 0.00023 m
delta nh= (w(b)-w(a))/INT
delta nh= 1980 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9280 kN/m^3

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Table E35
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO z w w(ad)ORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTz w w(ad)=0.484m

	Pi = 0.059 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00171	0.02879	0	0
0.0242	0.00159	0.02684	1.03E-06	8680
0.0484	0.00148	0.0249	1.78E-06	17300
0.0726	0.00136	0.02295	2.27E-06	26000
0.0968	0.00125	0.02101	2.54E-06	34700
0.121	0.00113	0.01907	2.61E-06	43300
0.1452	0.00102	0.01714	2.54E-06	52000
0.1694	0.0009	0.01521	2.32E-06	60700
0.1936	0.00079	0.01328	2.03E-06	69400
0.2178	0.00068	0.01137	1.68E-06	78100
0.242	0.00056	0.00945	1.28E-06	86700
0.2662	0.00045	0.00755	9.04E-07	95400
0.2904	0.00034	0.00565	5.58E-07	104000
0.3146	0.00022	0.00375	2.6E-07	112000
0.3388	0.00011	0.00186	6.93E-08	121000
0.363	-0.0000018	-0.0000296	1.93E-11	130000
0.3872	-0.00011	-0.00192	8.18E-08	138000
0.4114	-0.00023	-0.0038	3.6E-07	147000
0.4356	-0.00034	-0.00568	8.41E-07	156000
0.4598	-0.00045	-0.00757	1.57E-06	164000
0.484	-0.00056	-0.00945	2.56E-06	173000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 6.3E-07 m^4

w(b)= 0.00171 m
w(a)= 0.00057 m
delta nh= (w(b)-w(a))/INT
delta nh= 1810 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9110 kN/m^3

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Table E36

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.089 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00256	0.02879	0	0
0.0242	0.00239	0.02684	1.55E-06	8700
0.0484	0.00222	0.0249	2.68E-06	17400
0.0726	0.00204	0.02295	3.4E-06	26100
0.0968	0.00187	0.02101	3.8E-06	34800
0.121	0.00169	0.01907	3.9E-06	43500
0.1452	0.00153	0.01714	3.81E-06	52200
0.1694	0.00135	0.01521	3.48E-06	60900
0.1936	0.00118	0.01328	3.03E-06	69600
0.2178	0.00101	0.01137	2.5E-06	78300
0.242	0.00084	0.00945	1.92E-06	87000
0.2662	0.00067	0.00755	1.35E-06	95700
0.2904	0.0005	0.00565	8.2E-07	104000
0.3146	0.00033	0.00375	3.89E-07	113000
0.3388	0.00016	0.00186	1.01E-07	121000
0.363	-0.000003	-0.0000296	3.22E-11	130000
0.3872	-0.00017	-0.00192	1.26E-07	139000
0.4114	-0.00034	-0.0038	5.32E-07	148000
0.4356	-0.00051	-0.00568	1.26E-06	156000
0.4598	-0.00067	-0.00757	2.33E-06	165000
0.484	-0.00084	-0.00945	3.84E-06	174000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 9.4E-07 m^4

w(b)= 0.00256 m
w(a)= 0.00083 m
delta nh= (w(b)-w(a))/INT
delta nh= 1840 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9140 kN/m^3

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Table E37

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

B= 0.0254 m
delta Z= 0.0242 m

	Pi = 0.119 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00342	0.02879	0	0
0.0242	0.00318	0.02684	2.07E-06	8680
0.0484	0.00295	0.0249	3.56E-06	17300
0.0726	0.00272	0.02295	4.53E-06	26000
0.0968	0.00249	0.02101	5.06E-06	34700
0.121	0.00226	0.01907	5.21E-06	43300
0.1452	0.00203	0.01714	5.05E-06	52000
0.1694	0.00181	0.01521	4.66E-06	60700
0.1936	0.00158	0.01328	4.06E-06	69400
0.2178	0.00134	0.01137	3.32E-06	78100
0.242	0.00112	0.00945	2.56E-06	86700
0.2662	0.00089	0.00755	1.79E-06	95400
0.2904	0.00067	0.00565	1.1E-06	104000
0.3146	0.00045	0.00375	5.31E-07	112000
0.3388	0.00022	0.00186	1.39E-07	121000
0.363	-0.000004	-0.0000296	4.3E-11	130000
0.3872	-0.00023	-0.00192	1.71E-07	138000
0.4114	-0.00045	-0.0038	7.03E-07	147000
0.4356	-0.00067	-0.00568	1.66E-06	156000
0.4598	-0.00089	-0.00757	3.1E-06	164000
0.484	-0.00112	-0.00945	5.12E-06	173000

by Simpson's rule:

INT= 1.3E-06 m^4

w(b)= 0.00342 m
w(a)= 0.00115 m
delta nh= (w(b)-w(a))/INT
delta nh= 1810 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\text{nh= 9110 kN/m^3}}$

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Table E38

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.148 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00427	0.02879	0	0
0.0242	0.00398	0.02684	2.59E-06	8650
0.0484	0.00369	0.0249	4.45E-06	17300
0.0726	0.00341	0.02295	5.68E-06	25900
0.0968	0.00312	0.02101	6.35E-06	34600
0.121	0.00282	0.01907	6.51E-06	43200
0.1452	0.00254	0.01714	6.32E-06	51900
0.1694	0.00226	0.01521	5.82E-06	60500
0.1936	0.00197	0.01328	5.06E-06	69200
0.2178	0.00168	0.01137	4.16E-06	77800
0.242	0.0014	0.00945	3.2E-06	86500
0.2662	0.00112	0.00755	2.25E-06	95100
0.2904	0.00084	0.00565	1.38E-06	103000
0.3146	0.00056	0.00375	6.61E-07	112000
0.3388	0.00028	0.00186	1.76E-07	121000
0.363	-0.000004	-0.0000296	4.3E-11	129000
0.3872	-0.00028	-0.00192	2.08E-07	138000
0.4114	-0.00056	-0.0038	8.75E-07	147000
0.4356	-0.00084	-0.00568	2.08E-06	155000
0.4598	-0.00112	-0.00757	3.9E-06	164000
0.484	-0.0014	-0.00945	6.4E-06	173000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 1.6E-06 m^4

w(b)= 0.00427 m
w(a)= 0.00147 m
delta nh= (w(b)-w(a))/INT
delta nh= 1780 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9080 kN/m^3

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Table E39

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.178 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00513	0.02879	0	0
0.0242	0.00478	0.02684	3.1E-06	8650
0.0484	0.00443	0.0249	5.34E-06	17300
0.0726	0.00408	0.02295	6.8E-06	25900
0.0968	0.00374	0.02101	7.61E-06	34600
0.121	0.00339	0.01907	7.82E-06	43200
0.1452	0.00305	0.01714	7.59E-06	51900
0.1694	0.00271	0.01521	6.98E-06	60500
0.1936	0.00236	0.01328	6.07E-06	69200
0.2178	0.00202	0.01137	5E-06	77800
0.242	0.00168	0.00945	3.84E-06	86500
0.2662	0.00134	0.00755	2.69E-06	95100
0.2904	0.00101	0.00565	1.66E-06	103000
0.3146	0.00067	0.00375	7.9E-07	112000
0.3388	0.00033	0.00186	2.08E-07	121000
0.363	-0.000005	-0.0000296	5.37E-11	129000
0.3872	-0.00034	-0.00192	2.53E-07	138000
0.4114	-0.00068	-0.0038	1.06E-06	147000
0.4356	-0.00101	-0.00568	2.5E-06	155000
0.4598	-0.00134	-0.00757	4.66E-06	164000
0.484	-0.00168	-0.00945	7.68E-06	173000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 1.9E-06 m^4

w(b)= 0.00513 m
w(a)= 0.00177 m
delta nh= (w(b)-w(a))/INT
delta nh= 1780 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9080 kN/m^3

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Table E40

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.208 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00598	0.02879	0	0
0.0242	0.00558	0.02684	3.62E-06	8630
0.0484	0.00517	0.0249	6.23E-06	17200
0.0726	0.00477	0.02295	7.95E-06	25800
0.0968	0.00436	0.02101	8.87E-06	34500
0.121	0.00396	0.01907	9.14E-06	43100
0.1452	0.00356	0.01714	8.86E-06	51700
0.1694	0.00316	0.01521	8.14E-06	60400
0.1936	0.00276	0.01328	7.1E-06	69000
0.2178	0.00236	0.01137	5.84E-06	77600
0.242	0.00196	0.00945	4.48E-06	86300
0.2662	0.00156	0.00755	3.14E-06	94900
0.2904	0.00117	0.00565	1.92E-06	103000
0.3146	0.00078	0.00375	9.2E-07	112000
0.3388	0.000386	0.00186	2.43E-07	120000
0.363	-0.000006	-0.0000296	6.45E-11	129000
0.3872	-0.00039	-0.00192	2.9E-07	138000
0.4114	-0.00078	-0.0038	1.22E-06	146000
0.4356	-0.00118	-0.00568	2.92E-06	155000
0.4598	-0.00157	-0.00757	5.46E-06	164000
0.484	-0.00196	-0.00945	8.96E-06	172000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 2.2E-06 m^4

w(b)= 0.00598 m
w(a)= 0.0021 m
delta nh= (w(b)-w(a))/INT
delta nh= 1760 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9060 kN/m^3

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Table E41

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.238 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00683	0.02879	0	0
0.0242	0.00637	0.02684	4.14E-06	8610
0.0484	0.00591	0.0249	7.12E-06	17200
0.0726	0.00545	0.02295	9.08E-06	25800
0.0968	0.00498	0.02101	1.01E-05	34400
0.121	0.00453	0.01907	1.05E-05	43000
0.1452	0.00406	0.01714	1.01E-05	51600
0.1694	0.00361	0.01521	9.3E-06	60200
0.1936	0.00315	0.01328	8.1E-06	68900
0.2178	0.00269	0.01137	6.66E-06	77500
0.242	0.00224	0.00945	5.12E-06	86100
0.2662	0.00179	0.00755	3.6E-06	94700
0.2904	0.00134	0.00565	2.2E-06	103000
0.3146	0.00089	0.00375	1.05E-06	111000
0.3388	0.00044	0.00186	2.77E-07	120000
0.363	-0.000007	-0.0000296	7.52E-11	129000
0.3872	-0.00045	-0.00192	3.35E-07	137000
0.4114	-0.0009	-0.0038	1.41E-06	146000
0.4356	-0.00135	-0.00568	3.34E-06	155000
0.4598	-0.00179	-0.00757	6.23E-06	163000
0.484	-0.00224	-0.00945	1.02E-05	172000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 2.5E-06 m^4

w(b)= 0.00683 m
w(a)= 0.00245 m
delta nh= (w(b)-w(a))/INT
delta nh= 1740 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9040 kN/m^3

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Table E42

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.267 kN	P = 1.000 kN		
z (m)	w (m)	w1 (m)	z w w(ad)	kh (kN/m^2)
0	0.00769	0.02879	0	0
0.0242	0.00716	0.02684	4.65E-06	8590
0.0484	0.00664	0.0249	8E-06	17100
0.0726	0.00613	0.02295	1.02E-05	25700
0.0968	0.00561	0.02101	1.14E-05	34300
0.121	0.00509	0.01907	1.17E-05	42900
0.1452	0.00457	0.01714	1.14E-05	51500
0.1694	0.00406	0.01521	1.05E-05	60100
0.1936	0.00354	0.01328	9.1E-06	68700
0.2178	0.00304	0.01137	7.53E-06	77300
0.242	0.00252	0.00945	5.76E-06	85900
0.2662	0.00202	0.00755	4.06E-06	94500
0.2904	0.00151	0.00565	2.48E-06	103000
0.3146	0.001	0.00375	1.18E-06	111000
0.3388	0.00049	0.00186	3.09E-07	120000
0.363	-0.000008	-0.0000296	8.6E-11	128000
0.3872	-0.00051	-0.00192	3.79E-07	137000
0.4114	-0.00101	-0.0038	1.58E-06	146000
0.4356	-0.00152	-0.00568	3.76E-06	154000
0.4598	-0.00202	-0.00757	7.03E-06	163000
0.484	-0.00252	-0.00945	1.15E-05	171000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 2.8E-06 m^4

w(b)= 0.00769 m
w(a)= 0.00282 m
delta nh= (w(b)-w(a))/INT
delta nh= 1720 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9020 kN/m^3

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Table E43

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.297 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00854	0.02879	0	0
0.0242	0.00796	0.02684	5.17E-06	8580
0.0484	0.00738	0.0249	8.89E-06	17100
0.0726	0.00681	0.02295	1.13E-05	25700
0.0968	0.00623	0.02101	1.27E-05	34300
0.121	0.00565	0.01907	1.3E-05	42900
0.1452	0.00508	0.01714	1.26E-05	51500
0.1694	0.00451	0.01521	1.16E-05	60000
0.1936	0.00394	0.01328	1.01E-05	68600
0.2178	0.00337	0.01137	8.35E-06	77200
0.242	0.00281	0.00945	6.43E-06	85800
0.2662	0.00224	0.00755	4.5E-06	94400
0.2904	0.00167	0.00565	2.74E-06	103000
0.3146	0.00111	0.00375	1.31E-06	111000
0.3388	0.00055	0.00186	3.47E-07	120000
0.363	-0.000009	-0.0000296	9.67E-11	128000
0.3872	-0.00057	-0.00192	4.24E-07	137000
0.4114	-0.00113	-0.0038	1.77E-06	145000
0.4356	-0.00169	-0.00568	4.18E-06	154000
0.4598	-0.00225	-0.00757	7.83E-06	163000
0.484	-0.0028	-0.00945	1.28E-05	171000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 3.1E-06 m^4

w(b)= 0.00854 m
w(a)= 0.00317 m
delta nh= (w(b)-w(a))/INT
delta nh= 1710 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9010 kN/m^3

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Table E44

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

B= 0.0254 m
delta Z= 0.0242 m

	Pi = 0.327 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.0094	0.02879	0	0
0.0242	0.00876	0.02684	5.69E-06	8560
0.0484	0.00812	. 0.0249	9.79E-06	17100
0.0726	0.00749	0.02295	1.25E-05	25600
0.0968	0.00685	0.02101	1.39E-05	34200
0.121	0.00623	0.01907	1.44E-05	42800
0.1452	0.00559	0.01714	1.39E-05	51300
0.1694	0.00496	0.01521	1.28E-05	59900
0.1936	0.00433	0.01328	1.11E-05	68500
0.2178	0.00371	0.01137	9.19E-06	77000
0.242	0.00308	0.00945	7.04E-06	85600
0.2662	0.00246	0.00755	4.94E-06	94200
0.2904	0.00184	0.00565	3.02E-06	102000
0.3146	0.00122	0.00375	1.44E-06	111000
0.3388	0.00061	0.00186	3.84E-07	119000
0.363	-0.00001	-0.0000296	1.07E-10	128000
0.3872	-0.00063	-0.00192	4.68E-07	137000
0.4114	-0.00124	-0.0038	1.94E-06	145000
0.4356	-0.00185	-0.00568	4.58E-06	154000
0.4598	-0.00247	-0.00757	8.6E-06	162000
0.484	-0.00309	-0.00945	1.41E-05	171000

by Simpson's rule:

INT= 3.5E-06 m^4

w(b)= 0.0094 m
w(a)= 0.00355 m
delta nh= (w(b)-w(a))/INT
delta nh= 1690 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8990 kN/m^3

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Table E45

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

B= 0.0254 m
delta Z= 0.0242 m

	Pi = 0.356 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01025	0.02879	0	0
0.0242	0.00956	0.02684	6.21E-06	8530
0.0484	0.00887	0.0249	1.07E-05	17000
0.0726	0.00817	0.02295	1.36E-05	25600
0.0968	0.00748	0.02101	1.52E-05	34100
0.121	0.00679	0.01907	1.57E-05	42600
0.1452	0.0061	0.01714	1.52E-05	51200
0.1694	0.00542	0.01521	1.4E-05	59700
0.1936	0.00473	0.01328	1.22E-05	68200
0.2178	0.00405	0.01137	1E-05	76800
0.242	0.00337	0.00945	7.71E-06	85300
0.2662	0.00269	0.00755	5.41E-06	93900
0.2904	0.00201	0.00565	3.3E-06	102000
0.3146	0.00134	0.00375	1.58E-06	110000
0.3388	0.00066	0.00186	4.16E-07	119000
0.363	-0.000011	-0.0000296	1.18E-10	128000
0.3872	-0.00068	-0.00192	5.06E-07	136000
0.4114	-0.00135	-0.0038	2.11E-06	145000
0.4356	-0.00202	-0.00568	5E-06	153000
0.4598	-0.00269	-0.00757	9.36E-06	162000
0.484	-0.00336	-0.00945	1.54E-05	170000

by Simpson's rule:

INT= 3.8E-06 m^4

w(b)= 0.01025 m
w(a)= 0.00398 m
delta nh= (w(b)-w(a))/INT
delta nh= 1660 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8960 kN/m^3

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Table E46

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.386 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01111	0.02879	0	0
0.0242	0.01036	0.02684	6.73E-06	8520
0.0484	0.00961	0.0249	1.16E-05	17000
0.0726	0.00886	0.02295	1.48E-05	25500
0.0968	0.00811	0.02101	1.65E-05	34100
0.121	0.00736	0.01907	1.7E-05	42600
0.1452	0.00661	0.01714	1.65E-05	51100
0.1694	0.00586	0.01521	1.51E-05	59600
0.1936	0.00513	0.01328	1.32E-05	68200
0.2178	0.00438	0.01137	1.08E-05	76700
0.242	0.00365	0.00945	8.35E-06	85200
0.2662	0.00291	0.00755	5.85E-06	93700
0.2904	0.00218	0.00565	3.58E-06	102000
0.3146	0.00145	0.00375	1.71E-06	110000
0.3388	0.00072	0.00186	4.54E-07	119000
0.363	-0.000011	-0.0000296	1.18E-10	127000
0.3872	-0.00074	-0.00192	5.5E-07	136000
0.4114	-0.00147	-0.0038	2.3E-06	144000
0.4356	-0.00219	-0.00568	5.42E-06	153000
0.4598	-0.00292	-0.00757	1.02E-05	162000
0.484	-0.00364	-0.00945	1.66E-05	170000

B= 0.0254 m
delta Z= 0.0242 m

<u>by Simpson's rule:</u>

INT= 4.1E-06 m^4

w(b)= 0.01111 m
w(a)= 0.00437 m
delta nh= (w(b)-w(a))/INT
delta nh= 1650 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8950 kN/m^3

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Table E47

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.419 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01204	0.02879	0	0
0.0242	0.01123	0.02684	7.29E-06	8490
0.0484	0.01042	0.0249	1.26E-05	16900
0.0726	0.0096	0.02295	1.6E-05	25400
0.0968	0.00879	0.02101	1.79E-05	33900
0.121	0.00798	0.01907	1.84E-05	42400
0.1452	0.00717	0.01714	1.78E-05	50900
0.1694	0.00636	0.01521	1.64E-05	59400
0.1936	0.00555	0.01328	1.43E-05	67900
0.2178	0.00475	0.01137	1.18E-05	76400
0.242	0.00395	0.00945	9.03E-06	84900
0.2662	0.00316	0.00755	6.35E-06	93400
0.2904	0.00236	0.00565	3.87E-06	101000
0.3146	0.00157	0.00375	1.85E-06	110000
0.3388	0.00078	0.00186	4.92E-07	118000
0.363	-0.000012	-0.0000296	1.29E-10	127000
0.3872	-0.0008	-0.00192	5.95E-07	135000
0.4114	-0.00159	-0.0038	2.49E-06	144000
0.4356	-0.00238	-0.00568	5.89E-06	152000
0.4598	-0.00317	-0.00757	1.1E-05	161000
0.484	-0.00395	-0.00945	1.81E-05	169000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 4.4E-06 m^4

w(b)= 0.01204 m
w(a)= 0.00488 m
delta nh= (w(b)-w(a))/INT
delta nh= 1620 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8920 kN/m^3

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Table E48

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.451 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01299	0.02879	0	0
0.0242	0.01211	0.02684	7.87E-06	8470
0.0484	0.01123	0.0249	1.35E-05	16900
0.0726	0.01035	0.02295	1.72E-05	25400
0.0968	0.00947	0.02101	1.93E-05	33800
0.121	0.0086	0.01907	1.98E-05	42300
0.1452	0.00773	0.01714	1.92E-05	50800
0.1694	0.00686	0.01521	1.77E-05	59200
0.1936	0.00599	0.01328	1.54E-05	67700
0.2178	0.00513	0.01137	1.27E-05	76200
0.242	0.00426	0.00945	9.74E-06	84700
0.2662	0.00341	0.00755	6.85E-06	93100
0.2904	0.00254	0.00565	4.17E-06	101000
0.3146	0.00169	0.00375	1.99E-06	110000
0.3388	0.00084	0.00186	5.29E-07	118000
0.363	-0.000013	-0.0000296	1.4E-10	127000
0.3872	-0.00086	-0.00192	6.39E-07	135000
0.4114	-0.00171	-0.0038	2.67E-06	143000
0.4356	-0.00256	-0.00568	6.33E-06	152000
0.4598	-0.00341	-0.00757	1.19E-05	160000
0.484	-0.00426	-0.00945	1.95E-05	169000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 4.8E-06 m^4

w(b)= 0.01299 m
w(a)= 0.0054 m
delta nh= (w(b)-w(a))/INT
delta nh= 1590 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8890 kN/m^3

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Table E49

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.488 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01404	0.02879	0	0
0.0242	0.01309	0.02684	8.5E-06	8440
0.0484	0.01214	0.0249	1.46E-05	16800
0.0726	0.01119	0.02295	1.86E-05	25300
0.0968	0.01024	0.02101	2.08E-05	33700
0.121	0.0093	0.01907	2.15E-05	42200
0.1452	0.00836	0.01714	2.08E-05	50600
0.1694	0.00742	0.01521	1.91E-05	59000
0.1936	0.00648	0.01328	1.67E-05	67500
0.2178	0.00555	0.01137	1.37E-05	75900
0.242	0.00461	0.00945	1.05E-05	84400
0.2662	0.00368	0.00755	7.4E-06	92800
0.2904	0.00275	0.00565	4.51E-06	101000
0.3146	0.00183	0.00375	2.16E-06	109000
0.3388	0.00091	0.00186	5.73E-07	118000
0.363	-0.000014	-0.0000296	1.5E-10	126000
0.3872	-0.00093	-0.00192	6.91E-07	135000
0.4114	-0.00185	-0.0038	2.89E-06	143000
0.4356	-0.00277	-0.00568	6.85E-06	151000
0.4598	-0.00369	-0.00757	1.28E-05	160000
0.484	-0.00461	-0.00945	2.11E-05	168000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 5.2E-06 m^4

w(b)= 0.01404 m
w(a)= 0.00601 m
delta nh= (w(b)-w(a))/INT
delta nh= 1560 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8860 kN/m^3

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Table E50

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

B= 0.0254 m
delta Z= 0.0242 m

	Pi = 0.525 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01511	0.02879	0	0
0.0242	0.01408	0.02684	9.15E-06	8390
0.0484	0.01306	0.0249	1.57E-05	16700
0.0726	0.01204	0.02295	2.01E-05	25100
0.0968	0.01102	0.02101	2.24E-05	33500
0.121	0.01001	0.01907	2.31E-05	41900
0.1452	0.00899	0.01714	2.24E-05	50300
0.1694	0.00798	0.01521	2.06E-05	58700
0.1936	0.00697	0.01328	1.79E-05	67100
0.2178	0.00596	0.01137	1.48E-05	75500
0.242	0.00496	0.00945	1.13E-05	83900
0.2662	0.00396	0.00755	7.96E-06	92300
0.2904	0.00296	0.00565	4.86E-06	100000
0.3146	0.00197	0.00375	2.32E-06	109000
0.3388	0.00098	0.00186	6.18E-07	117000
0.363	-0.000016	-0.0000296	1.72E-10	125000
0.3872	-0.00101	-0.00192	7.51E-07	134000
0.4114	-0.00199	-0.0038	3.11E-06	142000
0.4356	-0.00298	-0.00568	7.37E-06	151000
0.4598	-0.00397	-0.00757	1.38E-05	159000
0.484	-0.00495	-0.00945	2.26E-05	167000

by Simpson's rule:

INT= 5.6E-06 m^4

w(b)= 0.01511 m
w(a)= 0.00671 m
delta nh= (w(b)-w(a))/INT
delta nh= 1510 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8810 kN/m^3

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Table E51

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.562 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01616	0.02879	0	0
0.0242	0.01507	0.02684	9.79E-06	8330
0.0484	0.01398	0.0249	1.68E-05	16600
0.0726	0.01288	0.02295	2.15E-05	25000
0.0968	0.01179	0.02101	2.4E-05	33300
0.121	0.0107	0.01907	2.47E-05	41600
0.1452	0.00962	0.01714	2.39E-05	50000
0.1694	0.00854	0.01521	2.2E-05	58300
0.1936	0.00746	0.01328	1.92E-05	66600
0.2178	0.00638	0.01137	1.58E-05	75000
0.242	0.00531	0.00945	1.21E-05	83300
0.2662	0.00423	0.00755	8.5E-06	91700
0.2904	0.00317	0.00565	5.2E-06	100000
0.3146	0.00211	0.00375	2.49E-06	108000
0.3388	0.00104	0.00186	6.55E-07	116000
0.363	-0.000017	-0.0000296	1.83E-10	125000
0.3872	-0.00108	-0.00192	8.03E-07	133000
0.4114	-0.00213	-0.0038	3.33E-06	141000
0.4356	-0.00319	-0.00568	7.89E-06	150000
0.4598	-0.00425	-0.00757	1.48E-05	158000
0.484	-0.00531	-0.00945	2.43E-05	166000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 5.9E-06 m^4

w(b)= 0.01616 m
w(a)= 0.00755 m
delta nh= (w(b)-w(a))/INT
delta nh= 1450 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8750 kN/m^3

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Table E52

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY
Table E

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Pi = 0.583 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01678	0.02879	0	0
0.0242	0.01564	0.02684	1.02E-05	8300
0.0484	0.01451	0.0249	1.75E-05	16600
0.0726	0.01338	0.02295	2.23E-05	24900
0.0968	0.01224	0.02101	2.49E-05	33200
0.121	0.01111	0.01907	2.56E-05	41500
0.1452	0.00998	0.01714	2.48E-05	49800
0.1694	0.00886	0.01521	2.28E-05	58100
0.1936	0.00774	0.01328	1.99E-05	66400
0.2178	0.00663	0.01137	1.64E-05	74700
0.242	0.00551	0.00945	1.26E-05	83000
0.2662	0.0044	0.00755	8.84E-06	91300
0.2904	0.00329	0.00565	5.4E-06	99600
0.3146	0.00218	0.00375	2.57E-06	108000
0.3388	0.00108	0.00186	6.81E-07	116000
0.363	-0.000017	-0.0000296	1.83E-10	124000
0.3872	-0.00111	-0.00192	8.25E-07	132000
0.4114	-0.00222	-0.0038	3.47E-06	141000
0.4356	-0.00331	-0.00568	8.19E-06	149000
0.4598	-0.00441	-0.00757	1.53E-05	157000
0.484	-0.00551	-0.00945	2.52E-05	166000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 6.2E-06 m^4

w(b)= 0.01678 m
w(a)= 0.00799 m
delta nh= (w(b)-w(a))/INT
delta nh= 1420 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8720 kN/m^3

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Table E53
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Pi = 0.030 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00078	0.02642	0	0
0.0264	0.00073	0.02463	4.75E-07	9580
0.0528	0.00068	0.02284	8.2E-07	19100
0.0792	0.00063	0.02105	1.05E-06	28700
0.1056	0.00057	0.01927	1.16E-06	38300
0.132	0.00052	0.01749	1.2E-06	47900
0.1584	0.00047	0.01571	1.17E-06	57500
0.1848	0.00041	0.01394	1.06E-06	67000
0.2112	0.00036	0.01218	9.26E-07	76600
0.2376	0.00031	0.01042	7.67E-07	86200
0.264	0.00026	0.00866	5.94E-07	95800
0.2904	0.00021	0.00692	4.22E-07	105000
0.3168	0.00015	0.00517	2.46E-07	115000
0.3432	0.0001	0.00344	1.18E-07	124000
0.3696	0.00005	0.0017	3.14E-08	134000
0.396	-0.0000009	-0.0000292	1.04E-11	143000
0.4224	-0.00005	-0.00176	3.72E-08	153000
0.4488	-0.0001	-0.00348	1.56E-07	162000
0.4752	-0.00015	-0.00521	3.71E-07	172000
0.5016	-0.00021	-0.00693	7.3E-07	182000
0.528	-0.00026	-0.00866	1.19E-06	191000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 3.2E-07 m^4

w(b)= 0.00078 m
w(a)= 0.00018 m
delta nh= (w(b)-w(a))/INT
delta nh= 1920 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9220 kN/m^3

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Table E54

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Pi = 0.059 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00156	0.02642	0	0
0.0264	0.00146	0.02463	9.49E-07	9430
0.0528	0.00135	0.02284	1.63E-06	18800
0.0792	0.00125	0.02105	2.08E-06	28300
0.1056	0.00114	0.01927	2.32E-06	37700
0.132	0.00104	0.01749	2.4E-06	47100
0.1584	0.00093	0.01571	2.31E-06	56600
0.1848	0.00093	0.01394	2.4E-06	66000
0.2112	0.00072	0.01218	1.85E-06	75500
0.2376	0.00062	0.01042	1.53E-06	84900
0.264	0.00051	0.00866	1.17E-06	94300
0.2904	0.00041	0.00692	8.24E-07	103000
0.3168	0.00031	0.00517	5.08E-07	113000
0.3432	0.0002	0.00344	2.36E-07	122000
0.3696	0.0001	0.0017	6.28E-08	132000
0.396	-0.0000017	-0.0000292	1.97E-11	141000
0.4224	-0.0001	-0.00176	7.43E-08	151000
0.4488	-0.00021	-0.00348	3.28E-07	160000
0.4752	-0.00031	-0.00521	7.67E-07	169000
0.5016	-0.00041	-0.00693	1.43E-06	179000
0.528	-0.00051	-0.00866	2.33E-06	188000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 6.4E-07 m^4

w(b)= 0.00156 m
w(a)= 0.00043 m
delta nh= (w(b)-w(a))/INT
delta nh= 1780 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9080 kN/m^3

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Table E55
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.0254 m
delta Z= 0.0264 m

	Pi = 0.089 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00235	0.02642	0	0
0.0264	0.00219	0.02463	1.42E-06	9340
0.0528	0.00203	0.02284	2.45E-06	18600
0.0792	0.00187	0.02105	3.12E-06	28000
0.1056	0.00171	0.01927	3.48E-06	37300
0.132	0.00156	0.01749	3.6E-06	46700
0.1584	0.00139	0.01571	3.46E-06	56000
0.1848	0.00124	0.01394	3.19E-06	65400
0.2112	0.00108	0.01218	2.78E-06	74700
0.2376	0.00093	0.01042	2.3E-06	84000
0.264	0.00077	0.00866	1.76E-06	93400
0.2904	0.00062	0.00692	1.25E-06	102000
0.3168	0.00046	0.00517	7.53E-07	112000
0.3432	0.00031	0.00344	3.66E-07	121000
0.3696	0.00015	0.0017	9.42E-08	130000
0.396	-0.0000026	-0.0000292	3.01E-11	140000
0.4224	-0.00016	-0.00176	1.19E-07	149000
0.4488	-0.00031	-0.00348	4.84E-07	158000
0.4752	-0.00046	-0.00521	1.14E-06	168000
0.5016	-0.00062	-0.00693	2.16E-06	177000
0.528	-0.00077	-0.00866	3.52E-06	186000

by Simpson's rule:

INT= 9.4E-07 m^4

w(b)= 0.00235 m
w(a)= 0.00076 m
delta nh= (w(b)-w(a))/INT
delta nh= 1690 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8990 kN/m^3

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Table E56

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

Alfa=2.4
LINEAR PART
PILE LENGTH=0.528m

	Pi = 0.119 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00314	0.02642	0	0
0.0264	0.00292	0.02463	1.9E-06	9390
0.0528	0.00271	0.02284	3.27E-06	18700
0.0792	0.00249	0.02105	4.15E-06	28100
0.1056	0.00228	0.01927	4.64E-06	37500
0.132	0.00207	0.01749	4.78E-06	46900
0.1584	0.00186	0.01571	4.63E-06	56300
0.1848	0.00165	0.01394	4.25E-06	65700
0.2112	0.00144	0.01218	3.7E-06	75100
0.2376	0.00123	0.01042	3.05E-06	84500
0.264	0.00102	0.00866	2.33E-06	93900
0.2904	0.00082	0.00692	1.65E-06	103000
0.3168	0.00061	0.00517	9.99E-07	112000
0.3432	0.00041	0.00344	4.84E-07	122000
0.3696	0.0002	0.0017	1.26E-07	131000
0.396	-0.0000035	-0.0000292	4.05E-11	140000
0.4224	-0.00021	-0.00176	1.56E-07	150000
0.4488	-0.00041	-0.00348	6.4E-07	159000
0.4752	0.00062	-0.00521	-1.5E-06	169000
0.5016	-0.00082	-0.00693	2.85E-06	178000
0.528	-0.00103	-0.00866	4.71E-06	187000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 1.2E-06 m^4

w(b)= 0.00314 m
w(a)= 0.00105 m
delta nh= (w(b)-w(a))/INT
delta nh= 1740 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 9040 kN/m^3

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Table E57

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Pi = 0.148 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00392	0.02642	0	0
0.0264	0.00365	0.02463	2.37E-06	9260
0.0528	0.00339	0.02284	4.09E-06	18500
0.0792	0.00312	0.02105	5.2E-06	27700
0.1056	0.00286	0.01927	5.82E-06	37000
0.132	0.00259	0.01749	5.98E-06	46300
0.1584	0.00233	0.01571	5.8E-06	55500
0.1848	0.00207	0.01394	5.33E-06	64800
0.2112	0.00181	0.01218	4.66E-06	74000
0.2376	0.00154	0.01042	3.81E-06	83300
0.264	0.00128	0.00866	2.93E-06	92600
0.2904	0.00103	0.00692	2.07E-06	101000
0.3168	0.00077	0.00517	1.26E-06	111000
0.3432	0.00051	0.00344	6.02E-07	120000
0.3696	0.00025	0.0017	1.57E-07	129000
0.396	-0.0000043	-0.0000292	4.97E-11	138000
0.4224	-0.00026	-0.00176	1.93E-07	148000
0.4488	-0.00052	-0.00348	8.12E-07	157000
0.4752	-0.00077	-0.00521	1.91E-06	166000
0.5016	-0.00102	-0.00693	3.55E-06	175000
0.528	-0.00128	-0.00866	5.85E-06	185000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 1.6E-06 m^4

w(b)= 0.00392 m
w(a)= 0.0014 m
delta nh= (w(b)-w(a))/INT
delta nh= 1610 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 8910 kN/m^3}}$

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Table E58

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Pi = 0.178 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.0047	0.02642	0	0
0.0264	0.00438	0.02463	2.85E-06	9210
0.0528	0.00407	0.02284	4.91E-06	18400
0.0792	0.00374	0.02105	6.24E-06	27600
0.1056	0.00343	0.01927	6.98E-06	36800
0.132	0.00311	0.01749	7.18E-06	46000
0.1584	0.00279	0.01571	6.94E-06	55300
0.1848	0.00248	0.01394	6.39E-06	64500
0.2112	0.00216	0.01218	5.56E-06	73700
0.2376	0.00185	0.01042	4.58E-06	82900
0.264	0.00154	0.00866	3.52E-06	92100
0.2904	0.00123	0.00692	2.47E-06	101000
0.3168	0.00092	0.00517	1.51E-06	110000
0.3432	0.00061	0.00344	7.2E-07	119000
0.3696	0.0003	0.0017	1.88E-07	129000
0.396	-0.0000052	-0.0000292	6.01E-11	138000
0.4224	-0.00031	-0.00176	2.3E-07	147000
0.4488	-0.00062	-0.00348	9.68E-07	156000
0.4752	-0.00093	-0.00521	2.3E-06	165000
0.5016	-0.00123	-0.00693	4.28E-06	175000
0.528	-0.00154	-0.00866	7.04E-06	184000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 1.9E-06 m^4

w(b)= 0.0047 m
w(a)= 0.00174 m
delta nh= (w(b)-w(a))/INT
delta nh= 1570 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8870 kN/m^3

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Table E59

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Pi = 0.208 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00548	0.02642	0	0
0.0264	0.00512	0.02463	3.33E-06	9180
0.0528	0.00474	0.02284	5.72E-06	18300
0.0792	0.00437	0.02105	7.29E-06	27500
0.1056	0.004	0.01927	8.14E-06	36700
0.132	0.00363	0.01749	8.38E-06	45900
0.1584	0.00326	0.01571	8.11E-06	55100
0.1848	0.00289	0.01394	7.44E-06	64300
0.2112	0.00253	0.01218	6.51E-06	73500
0.2376	0.00216	0.01042	5.35E-06	82600
0.264	0.0018	0.00866	4.12E-06	91800
0.2904	0.00143	0.00692	2.87E-06	101000
0.3168	0.00107	0.00517	1.75E-06	110000
0.3432	0.00071	0.00344	8.38E-07	119000
0.3696	0.00035	0.0017	2.2E-07	128000
0.396	-0.0000061	-0.0000292	7.05E-11	137000
0.4224	-0.00036	-0.00176	2.68E-07	147000
0.4488	-0.00072	-0.00348	1.12E-06	156000
0.4752	-0.00108	-0.00521	2.67E-06	165000
0.5016	-0.00144	-0.00693	5.01E-06	174000
0.528	-0.00179	-0.00866	8.18E-06	183000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 2.2E-06 m^4

w(b)= 0.00548 m
w(a)= 0.00209 m
delta nh= (w(b)-w(a))/INT
delta nh= 1540 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8840 kN/m^3

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Table E60

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.0254 m
delta Z= 0.0264 m

	Pi = 0.238 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00627	0.02642	0	0
0.0264	0.00584	0.02463	3.8E-06	9170
0.0528	0.00543	0.02284	6.55E-06	18300
0.0792	0.00499	0.02105	8.32E-06	27500
0.1056	0.00457	0.01927	9.3E-06	36700
0.132	0.00415	0.01749	9.58E-06	45800
0.1584	0.00373	0.01571	9.28E-06	55000
0.1848	0.00331	0.01394	8.53E-06	64200
0.2112	0.00289	0.01218	7.43E-06	73400
0.2376	0.00247	0.01042	6.12E-06	82500
0.264	0.00205	0.00866	4.69E-06	91700
0.2904	0.00164	0.00692	3.3E-06	100000
0.3168	0.00123	0.00517	2.01E-06	110000
0.3432	0.00082	0.00344	9.68E-07	119000
0.3696	0.0004	0.0017	2.51E-07	128000
0.396	-0.000007	-0.0000292	8.09E-11	137000
0.4224	-0.00042	-0.00176	3.12E-07	146000
0.4488	-0.00083	-0.00348	1.3E-06	156000
0.4752	-0.00124	-0.00521	3.07E-06	165000
0.5016	-0.00164	-0.00693	5.7E-06	174000
0.528	-0.00206	-0.00866	9.42E-06	183000

by Simpson's rule:

INT= 2.5E-06 m^4

w(b)= 0.00627 m
w(a)= 0.00244 m
delta nh= (w(b)-w(a))/INT
delta nh= 1530 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8830 kN/m^3

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Table E61

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.0254 m
delta Z= 0.0264 m

	Pi = 0.267 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00705	0.02642	0	0
0.0264	0.00657	0.02463	4.27E-06	9140
0.0528	0.00609	0.02284	7.34E-06	18200
0.0792	0.00562	0.02105	9.37E-06	27400
0.1056	0.00514	0.01927	1.05E-05	36500
0.132	0.00467	0.01749	1.08E-05	45700
0.1584	0.00419	0.01571	1.04E-05	54800
0.1848	0.00372	0.01394	9.58E-06	64000
0.2112	0.00325	0.01218	8.36E-06	73100
0.2376	0.00278	0.01042	6.88E-06	82300
0.264	0.00231	0.00866	5.28E-06	91400
0.2904	0.00184	0.00692	3.7E-06	100000
0.3168	0.00138	0.00517	2.26E-06	109000
0.3432	0.00092	0.00344	1.09E-06	118000
0.3696	0.00045	0.0017	2.83E-07	128000
0.396	-0.000008	-0.0000292	9.25E-11	137000
0.4224	-0.00047	-0.00176	3.49E-07	146000
0.4488	-0.00093	-0.00348	1.45E-06	155000
0.4752	-0.00139	-0.00521	3.44E-06	164000
0.5016	-0.00185	-0.00693	6.43E-06	173000
0.528	-0.00231	-0.00866	1.06E-05	182000

by Simpson's rule:

INT= 2.8E-06 m^4

w(b)= 0.00705 m
w(a)= 0.0028 m
delta nh= (w(b)-w(a))/INT
delta nh= 1500 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8800 kN/m^3

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Table E62

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Pi = 0.297 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00784	0.02642	0	0
0.0264	0.0073	0.02463	4.75E-06	9110
0.0528	0.00678	0.02284	8.18E-06	18200
0.0792	0.00624	0.02105	1.04E-05	27300
0.1056	0.00571	0.01927	1.16E-05	36400
0.132	0.00519	0.01749	1.2E-05	45500
0.1584	0.00466	0.01571	1.16E-05	54600
0.1848	0.00414	0.01394	1.07E-05	63800
0.2112	0.00361	0.01218	9.29E-06	72900
0.2376	0.00309	0.01042	7.65E-06	82000
0.264	0.00257	0.00866	5.88E-06	91100
0.2904	0.00205	0.00692	4.12E-06	100000
0.3168	0.00153	0.00517	2.51E-06	109000
0.3432	0.00102	0.00344	1.2E-06	118000
0.3696	0.0005	0.0017	3.14E-07	127000
0.396	-0.000009	-0.0000292	1.04E-10	136000
0.4224	-0.00052	-0.00176	3.87E-07	145000
0.4488	-0.00103	-0.00348	1.61E-06	154000
0.4752	-0.00154	-0.00521	3.81E-06	164000
0.5016	-0.00206	-0.00693	7.16E-06	173000
0.528	-0.00257	-0.00866	1.18E-05	182000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 3.1E-06 m^4

w(b)= 0.00784 m
w(a)= 0.00321 m
delta nh= (w(b)-w(a))/INT
delta nh= 1470 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8770 kN/m^3

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Table E63
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.0254 m
delta Z= 0.0264 m

	Pi = 0.327 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00862	0.02642	0	0
0.0264	0.00804	0.02463	5.23E-06	9090
0.0528	0.00745	0.02284	8.98E-06	18100
0.0792	0.00687	0.02105	1.15E-05	27200
0.1056	0.00629	0.01927	1.28E-05	36300
0.132	0.00571	0.01749	1.32E-05	45400
0.1584	0.00513	0.01571	1.28E-05	54500
0.1848	0.00455	0.01394	1.17E-05	63600
0.2112	0.00397	0.01218	1.02E-05	72700
0.2376	0.0034	0.01042	8.42E-06	81800
0.264	0.00283	0.00866	6.47E-06	90900
0.2904	0.00226	0.00692	4.54E-06	100000
0.3168	0.00169	0.00517	2.77E-06	109000
0.3432	0.00112	0.00344	1.32E-06	118000
0.3696	0.00056	0.0017	3.52E-07	127000
0.396	-0.000009	-0.0000292	1.04E-10	136000
0.4224	-0.00057	-0.00176	4.24E-07	145000
0.4488	-0.00114	-0.00348	1.78E-06	154000
0.4752	-0.0017	-0.00521	4.21E-06	163000
0.5016	-0.00226	-0.00693	7.86E-06	172000
0.528	-0.00283	-0.00866	1.29E-05	181000

by Simpson's rule:

INT= 3.5E-06 m^4

w(b)= 0.00862 m
w(a)= 0.0036 m
delta nh= (w(b)-w(a))/INT
delta nh= 1450 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8750 kN/m^3

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Table E64

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Pi = 0.356 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.00941	0.02642	0	0
0.0264	0.00877	0.02463	5.7E-06	9090
0.0528	0.00813	0.02284	9.8E-06	18100
0.0792	0.00749	0.02105	1.25E-05	27200
0.1056	0.00686	0.01927	1.4E-05	36300
0.132	0.00623	0.01749	1.44E-05	45400
0.1584	0.00559	0.01571	1.39E-05	54500
0.1848	0.00496	0.01394	1.28E-05	63600
0.2112	0.00433	0.01218	1.11E-05	72700
0.2376	0.00371	0.01042	9.19E-06	81800
0.264	0.00309	0.00866	7.06E-06	90900
0.2904	0.00246	0.00692	4.94E-06	100000
0.3168	0.00184	0.00517	3.01E-06	109000
0.3432	0.00122	0.00344	1.44E-06	118000
0.3696	0.00061	0.0017	3.83E-07	127000
0.396	-0.00001	-0.0000292	1.16E-10	136000
0.4224	-0.00063	-0.00176	4.68E-07	145000
0.4488	-0.00124	-0.00348	1.94E-06	154000
0.4752	-0.00185	-0.00521	4.58E-06	163000
0.5016	-0.00246	-0.00693	8.55E-06	172000
0.528	-0.00308	-0.00866	1.41E-05	181000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 3.8E-06 m^4

w(b)= 0.00941 m
w(a)= 0.00394 m
delta nh= (w(b)-w(a))/INT
delta nh= 1450 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8750 kN/m^3

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Table E65

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.0254 m
delta Z= 0.0264 m

	Pi = 0.386 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01019	0.02642	0	0
0.0264	0.0095	0.02463	6.18E-06	9060
0.0528	0.00881	0.02284	1.06E-05	18100
0.0792	0.00812	0.02105	1.35E-05	27100
0.1056	0.00743	0.01927	1.51E-05	36200
0.132	0.00674	0.01749	1.56E-05	45300
0.1584	0.00606	0.01571	1.51E-05	54300
0.1848	0.00537	0.01394	1.38E-05	63400
0.2112	0.00469	0.01218	1.21E-05	72500
0.2376	0.00401	0.01042	9.93E-06	81500
0.264	0.00334	0.00866	7.64E-06	90600
0.2904	0.00266	0.00692	5.35E-06	99600
0.3168	0.00199	0.00517	3.26E-06	108000
0.3432	0.00132	0.00344	1.56E-06	117000
0.3696	0.00065	0.0017	4.08E-07	126000
0.396	-0.000011	-0.0000292	1.27E-10	135000
0.4224	-0.00068	-0.00176	5.06E-07	145000
0.4488	-0.00134	-0.00348	2.09E-06	154000
0.4752	-0.00201	-0.00521	4.98E-06	163000
0.5016	-0.00268	-0.00693	9.32E-06	172000
0.528	-0.00334	-0.00866	1.53E-05	181000

by Simpson's rule:

INT= 4.1E-06 m^4

w(b)= 0.01019 m
w(a)= 0.00438 m
delta nh= (w(b)-w(a))/INT
delta nh= 1420 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8720 kN/m^3

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Table E66

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Pi = 0.419 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01105	0.02642	0	0
0.0264	0.01031	0.02463	6.7E-06	9040
0.0528	0.00955	0.02284	1.15E-05	18000
0.0792	0.00881	0.02105	1.47E-05	27100
0.1056	0.00806	0.01927	1.64E-05	36100
0.132	0.00732	0.01749	1.69E-05	45200
0.1584	0.00657	0.01571	1.63E-05	54200
0.1848	0.00583	0.01394	1.5E-05	63200
0.2112	0.00509	0.01218	1.31E-05	72300
0.2376	0.00435	0.01042	1.08E-05	81300
0.264	0.00362	0.00866	8.28E-06	90400
0.2904	0.00289	0.00692	5.81E-06	99400
0.3168	0.00216	0.00517	3.54E-06	108000
0.3432	0.00144	0.00344	1.7E-06	117000
0.3696	0.00071	0.0017	4.46E-07	126000
0.396	-0.000012	-0.0000292	1.39E-10	135000
0.4224	-0.00074	-0.00176	5.5E-07	144000
0.4488	-0.00145	-0.00348	2.26E-06	153000
0.4752	-0.00218	-0.00521	5.4E-06	162000
0.5016	-0.0029	-0.00693	1.01E-05	171000
0.528	-0.00362	-0.00866	1.66E-05	180000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 4.4E-06 m^4

w(b)= 0.01105 m
w(a)= 0.00484 m
delta nh= (w(b)-w(a))/INT
delta nh= 1400 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8700 kN/m^3

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Table E67

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Pi = 0.451 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01191	0.02642	0	0
0.0264	0.01111	0.02463	7.22E-06	9020
0.0528	0.0103	0.02284	1.24E-05	18000
0.0792	0.00949	0.02105	1.58E-05	27000
0.1056	0.00869	0.01927	1.77E-05	36000
0.132	0.00789	0.01749	1.82E-05	45100
0.1584	0.00709	0.01571	1.76E-05	54100
0.1848	0.00629	0.01394	1.62E-05	63100
0.2112	0.00549	0.01218	1.41E-05	72100
0.2376	0.0047	0.01042	1.16E-05	81100
0.264	0.00391	0.00866	8.94E-06	90200
0.2904	0.00312	0.00692	6.27E-06	99200
0.3168	0.00233	0.00517	3.82E-06	108000
0.3432	0.00155	0.00344	1.83E-06	117000
0.3696	0.00077	0.0017	4.84E-07	126000
0.396	-0.000013	-0.0000292	1.5E-10	135000
0.4224	-0.00079	-0.00176	5.87E-07	144000
0.4488	-0.00157	-0.00348	2.45E-06	153000
0.4752	-0.00235	-0.00521	5.82E-06	162000
0.5016	-0.00313	-0.00693	1.09E-05	171000
0.528	-0.00391	-0.00866	1.79E-05	180000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 4.8E-06 m^4

w(b)= 0.01191 m
w(a)= 0.00533 m
delta nh= (w(b)-w(a))/INT
delta nh= 1380 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8680 kN/m^3

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Table E68

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Pi = 0.488 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01288	0.02642	0	0
0.0264	0.01201	0.02463	7.81E-06	8970
0.0528	0.01114	0.02284	1.34E-05	17900
0.0792	0.01027	0.02105	1.71E-05	26900
0.1056	0.00939	0.01927	1.91E-05	35800
0.132	0.00853	0.01749	1.97E-05	44800
0.1584	0.00766	0.01571	1.91E-05	53800
0.1848	0.0068	0.01394	1.75E-05	62700
0.2112	0.00594	0.01218	1.53E-05	71700
0.2376	0.00508	0.01042	1.26E-05	80700
0.264	0.00423	0.00866	9.67E-06	89600
0.2904	0.00337	0.00692	6.77E-06	98600
0.3168	0.00252	0.00517	4.13E-06	107000
0.3432	0.00167	0.00344	1.97E-06	116000
0.3696	0.00083	0.0017	5.22E-07	125000
0.396	-0.000014	-0.0000292	1.62E-10	134000
0.4224	-0.00086	-0.00176	6.39E-07	143000
0.4488	-0.00169	-0.00348	2.64E-06	152000
0.4752	-0.00254	-0.00521	6.29E-06	161000
0.5016	-0.00338	-0.00693	1.17E-05	170000
0.528	-0.00422	-0.00866	1.93E-05	179000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 5.2E-06 m^4

w(b)= 0.01288 m
w(a)= 0.006 m
delta nh= (w(b)-w(a))/INT
delta nh= 1330 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh=	**8630**	**kN/m^3**

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Table E69

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Pi = 0.525 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01386	0.02642	0	0
0.0264	0.01292	0.02463	8.4E-06	8930
0.0528	0.01198	0.02284	1.44E-05	17800
0.0792	0.01104	0.02105	1.84E-05	26800
0.1056	0.01011	0.01927	2.06E-05	35700
0.132	0.00918	0.01749	2.12E-05	44600
0.1584	0.00824	0.01571	2.05E-05	53600
0.1848	0.00731	0.01394	1.88E-05	62500
0.2112	0.00639	0.01218	1.64E-05	71500
0.2376	0.00547	0.01042	1.35E-05	80400
0.264	0.00455	0.00866	1.04E-05	89300
0.2904	0.00363	0.00692	7.29E-06	98300
0.3168	0.00271	0.00517	4.44E-06	107000
0.3432	0.0018	0.00344	2.13E-06	116000
0.3696	0.000893	0.0017	5.61E-07	125000
0.396	-0.000015	-0.0000292	1.73E-10	134000
0.4224	-0.00092	-0.00176	6.84E-07	143000
0.4488	-0.00183	-0.00348	2.86E-06	151000
0.4752	-0.00273	-0.00521	6.76E-06	160000
0.5016	-0.00364	-0.00693	1.27E-05	169000
0.528	-0.00454	-0.00866	2.08E-05	178000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 5.6E-06 m^4

w(b)= 0.01386 m
w(a)= 0.00664 m
delta nh= (w(b)-w(a))/INT
delta nh= 1300 kN/m^3

mh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8600 kN/m^3

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Table E70

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Pi = 0.562 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01483	0.02642	0	0
0.0264	0.01383	0.02463	8.99E-06	8930
0.0528	0.01283	0.02284	1.55E-05	17800
0.0792	0.01182	0.02105	1.97E-05	26800
0.1056	0.01082	0.01927	2.2E-05	35700
0.132	0.00982	0.01749	2.27E-05	44600
0.1584	0.00882	0.01571	2.19E-05	53600
0.1848	0.00783	0.01394	2.02E-05	62500
0.2112	0.00683	0.01218	1.76E-05	71500
0.2376	0.00585	0.01042	1.45E-05	80400
0.264	0.00486	0.00866	1.11E-05	89300
0.2904	0.00388	0.00692	7.8E-06	98300
0.3168	0.00291	0.00517	4.77E-06	107000
0.3432	0.00193	0.00344	2.28E-06	116000
0.3696	0.00096	0.0017	6.03E-07	125000
0.396	-0.000016	-0.0000292	1.85E-10	134000
0.4224	-0.00098	-0.00176	7.29E-07	143000
0.4488	-0.00195	-0.00348	3.05E-06	151000
0.4752	-0.00292	-0.00521	7.23E-06	160000
0.5016	-0.00289	-0.00693	1E-05	169000
0.528	-0.00486	-0.00866	2.22E-05	178000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 5.8E-06 m^4

w(b)= 0.01483 m
w(a)= 0.00723 m
delta nh= (w(b)-w(a))/INT
delta nh= 1300 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8600 kN/m^3

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Table E71

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.0254 m
delta Z= 0.0264 m

	Pi = 0.592 kN	P = 1.000 kN		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	0.01564	0.02642	0	0
0.0264	0.01458	0.02463	9.48E-06	8830
0.0528	0.01352	0.02284	1.63E-05	17600
0.0792	0.01246	0.02105	2.08E-05	26500
0.1056	0.01141	0.01927	2.32E-05	35300
0.132	0.01035	0.01749	2.39E-05	44100
0.1584	0.0093	0.01571	2.31E-05	53000
0.1848	0.00825	0.01394	2.13E-05	61800
0.2112	0.00721	0.01218	1.85E-05	70600
0.2376	0.00617	0.01042	1.53E-05	79500
0.264	0.00513	0.00866	1.17E-05	88300
0.2904	0.00409	0.00692	8.22E-06	97100
0.3168	0.00306	0.00517	5.01E-06	106000
0.3432	0.00203	0.00344	2.4E-06	114000
0.3696	0.00101	0.0017	6.35E-07	123000
0.396	-0.0000173	-0.0000292	2E-10	132000
0.4224	-0.00104	-0.00176	7.73E-07	141000
0.4488	-0.00206	-0.00348	3.22E-06	150000
0.4752	-0.00308	-0.00521	7.63E-06	159000
0.5016	-0.0041	-0.00693	1.43E-05	167000
0.528	-0.00513	-0.00866	2.35E-05	176000

by Simpson's rule:

INT= 6.3E-06 m^4

w(b)= 0.01564 m
w(a)= 0.00811 m
delta nh= (w(b)-w(a))/INT
delta nh= 1200 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8500 kN/m^3

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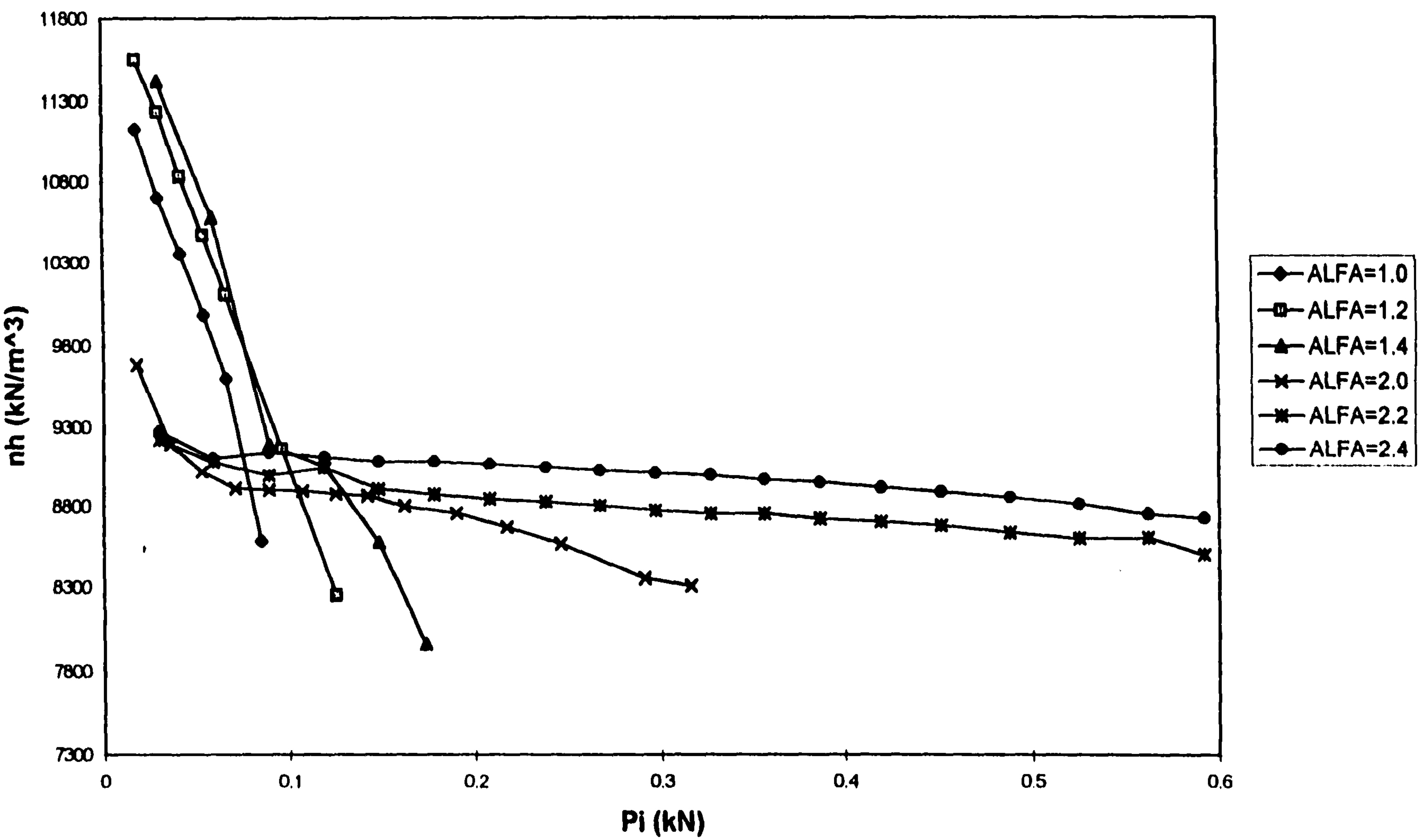

Figure E1. Horizontal Force vs hh for Piles Embedded in Sandy Soil Subjected To Horizontal Forces

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APPENDIX F

Numerical Analysis for Piles Embedded in Sandy Soil Subjected to Bending Moments

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Table F1

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.220m

B= 0.0254 m
delta Z= 0.011 m

	Mi=0.011kNm	M=1.000 kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00518	-0.45852	0	0
0.011	-0.00479	-0.42376	2.23E-05	3390
0.022	-0.00439	. -0.38905	3.76E-05	6790
0.033	-0.004	-0.35441	4.68E-05	10100
0.044	-0.00361	-0.31982	5.08E-05	13500
0.055	-0.00322	-0.28529	5.05E-05	16900
0.066	-0.00283	-0.25081	4.68E-05	20300
0.077	-0.00245	-0.21639	4.08E-05	23700
0.088	-0.00206	-0.18201	3.3E-05	27100
0.099	-0.00167	-0.14769	2.44E-05	30500
0.11	-0.00128	-0.11341	1.6E-05	33900
0.121	-0.00089	-0.07917	8.53E-06	37300
0.132	-0.00051	-0.04496	3.03E-06	40700
0.143	-0.00012	-0.01079	1.85E-07	44100
0.154	0.00026	0.02336	9.35E-07	47500
0.165	0.00065	0.05749	6.17E-06	50900
0.176	0.00104	0.0916	1.68E-05	54300
0.187	0.00142	0.12571	3.34E-05	57700
0.198	0.00181	0.1598	5.73E-05	61100
0.209	0.00219	0.1939	8.87E-05	64500
0.22	0.00257	0.22799	0.000129	67900

by Simpson's rule:

INT= 7.12E-06 m^4

w(b)= 0.00518 m
w(a)= 0.001296 m
delta nh= (w(b)-w(a))/INT
delta nh= 546 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 7850 kN/m^3}}$

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Table F2

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.220m

	Mi=0.023kNm	M=1.000 kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01036	-0.45852	0	0
0.011	-0.00958	-0.42376	4.47E-05	3370
0.022	-0.00879	-0.38905	7.52E-05	6747
0.033	-0.00801	-0.35441	9.37E-05	10100
0.044	-0.00723	-0.31982	0.000102	13500
0.055	-0.00645	-0.28529	0.000101	16800
0.066	-0.00567	-0.25081	9.39E-05	20200
0.077	-0.00489	-0.21639	8.15E-05	23600
0.088	-0.00411	-0.18201	6.58E-05	27000
0.099	-0.00334	-0.14769	4.88E-05	30300
0.11	-0.00256	-0.11341	3.19E-05	33700
0.121	-0.00179	-0.07917	1.71E-05	37100
0.132	-0.00102	-0.04496	6.05E-06	40500
0.143	-0.00024	-0.01079	3.7E-07	43800
0.154	0.00053	0.02336	1.91E-06	47200
0.165	0.00129	0.05749	1.22E-05	50600
0.176	0.00207	0.0916	3.34E-05	54000
0.187	0.00284	0.12571	6.68E-05	57300
0.198	0.00361	0.1598	0.000114	60700
0.209	0.00438	0.1939	0.000177	64100
0.22	0.00515	0.22799	0.000258	67500

B= 0.0254 m
delta Z= 0.011 m

by Simpson's rule:

INT= 1.42E-05 m^4

w(b)= 0.01036 m
w(a)= 0.003335 m
delta nh= (w(b)-w(a))/INT
delta nh= 494 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh=	**7790**	**kN/m^3**

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Table F3

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.220m

B= 0.0254 m
delta Z= 0.011 m

	Mi=0.034kNm	M=1.000 kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01554	-0.45852	0	0
0.011	-0.01437	-0.42376	6.7E-05	3350
0.022	-0.01319	-0.38905	0.000113	6700
0.033	-0.01201	-0.35441	0.00014	10000
0.044	-0.01084	-0.31982	0.000153	13400
0.055	-0.00967	-0.28529	0.000152	16700
0.066	-0.0085	-0.25081	0.000141	20100
0.077	-0.00734	-0.21639	0.000122	23400
0.088	-0.00617	-0.18201	9.88E-05	26800
0.099	-0.00501	-0.14769	7.33E-05	30100
0.11	-0.00384	-0.11341	4.79E-05	33500
0.121	-0.00268	-0.07917	2.57E-05	36800
0.132	-0.00152	-0.04496	9.02E-06	40200
0.143	-0.00037	-0.01079	5.71E-07	43500
0.154	0.00079	0.02336	2.84E-06	46900
0.165	0.00195	0.05749	1.85E-05	50200
0.176	0.00311	0.0916	5.01E-05	53600
0.187	0.00426	0.12571	0.0001	56900
0.198	0.00542	0.1598	0.000171	60300
0.209	0.00657	0.1939	0.000266	63600
0.22	0.00773	0.22799	0.000388	67000

by Simpson's rule:

INT= 2.14E-05 m^4

w(b)= 0.01554 m
w(a)= 0.006134 m
delta nh= (w(b)-w(a))/INT
delta nh= 440 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7740 kN/m^3

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Table F4

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.220m

B= 0.0254 m
delta Z= 0.011 m

	Mi=0.045kNm	M=1.000 kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02077	-0.45852	0	0
0.011	-0.01919	-0.42376	8.95E-05	3330
0.022	-0.01762	. -0.38905	0.000151	6670
0.033	-0.01605	-0.35441	0.000188	10000
0.044	-0.01449	-0.31982	0.000204	13300
0.055	-0.01292	-0.28529	0.000203	16600
0.066	-0.01136	-0.25081	0.000188	20000
0.077	-0.0098	-0.21639	0.000163	23300
0.088	-0.00825	-0.18201	0.000132	26700
0.099	-0.00669	-0.14769	9.78E-05	30000
0.11	-0.00514	-0.11341	6.41E-05	33300
0.121	-0.00359	-0.07917	3.44E-05	36700
0.132	-0.00204	-0.04496	1.21E-05	40000
0.143	-0.00049	-0.01079	7.56E-07	43400
0.154	0.00105	0.02336	3.78E-06	46700
0.165	0.0026	0.05749	2.47E-05	50000
0.176	0.00415	0.0916	6.69E-05	53400
0.187	0.00569	0.12571	0.000134	56700
0.198	0.00724	0.1598	0.000229	60000
0.209	0.00878	0.1939	0.000356	63400
0.22	0.01033	0.22799	0.000518	66700

by Simpson's rule:

INT= 2.85E-05 m^4

w(b)= 0.02077 m
w(a)= 0.009094 m
delta nh= (w(b)-w(a))/INT
delta nh= 409 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7710 kN/m^3

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Table F5

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTkh (kN/m^2)=0.220m

B= 0.0254 m
delta Z= 0.011 m

	Mi=0.057kNm	M=1.000 kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02595	-0.45852	0	0
0.011	-0.02398	-0.42376	0.000112	3320
0.022	-0.02202	. -0.38905	0.000188	6650
0.033	-0.02006	-0.35441	0.000235	9980
0.044	-0.0181	-0.31982	0.000255	13300
0.055	-0.01615	-0.28529	0.000253	16600
0.066	-0.01419	-0.25081	0.000235	19900
0.077	-0.01225	-0.21639	0.000204	23200
0.088	-0.0103	-0.18201	0.000165	26600
0.099	-0.00836	-0.14769	0.000122	29900
0.11	-0.00642	-0.11341	8.01E-05	33200
0.121	-0.00448	-0.07917	4.29E-05	36500
0.132	-0.00254	-0.04496	1.51E-05	39900
0.143	-0.00061	-0.01079	9.41E-07	43200
0.154	0.00132	0.02336	4.75E-06	46500
0.165	0.00325	0.05749	3.08E-05	49900
0.176	0.00518	0.0916	8.35E-05	53200
0.187	0.00711	0.12571	0.000167	56500
0.198	0.00904	0.1598	0.000286	59800
0.209	0.01097	0.1939	0.000445	63200
0.22	0.0129	0.22799	0.000647	66500

by Simpson's rule:

INT= 3.56E-05 m^4

w(b)= 0.02595 m
w(a)= 0.012329 m
delta nh= (w(b)-w(a))/INT
delta nh= 382 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7680 kN/m^3

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Table F6
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.220m

	Mi=0.068kNm	M=1.000 kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.03113	-0.45852	0	0
0.011	-0.02877	-0.42376	0.000134	3310
0.022	-0.02642	-0.38905	0.000226	6635
0.033	-0.02406	-0.35441	0.000281	9940
0.044	-0.02172	-0.31982	0.000306	13200
0.055	-0.01937	-0.28529	0.000304	16500
0.066	-0.01703	-0.25081	0.000282	19800
0.077	-0.01469	-0.21639	0.000245	23200
0.088	-0.01236	-0.18201	0.000198	26500
0.099	-0.01003	-0.14769	0.000147	29800
0.11	-0.0077	-0.11341	9.61E-05	33100
0.121	-0.00538	-0.07917	5.15E-05	36400
0.132	-0.00305	-0.04496	1.81E-05	39700
0.143	-0.00073	-0.01079	1.13E-06	43000
0.154	0.00159	0.02336	5.72E-06	46400
0.165	0.0039	0.05749	3.7E-05	49700
0.176	0.00622	0.0916	0.0001	53000
0.187	0.00853	0.12571	0.000201	56300
0.198	0.01085	0.1598	0.000343	59600
0.209	0.01317	0.1939	0.000534	62900
0.22	0.01548	0.22799	0.000776	66300

B= 0.0254 m
delta Z= 0.011 m

by Simpson's rule:

INT= 4.28E-05 m^4

w(b)= 0.03113 m
w(a)= 0.015943 m
delta nh= (w(b)-w(a))/INT
delta nh= 355 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7660 kN/m^3

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Table F7

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Mi=0.011kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00303	-0.2677	0	0
0.0132	-0.00279	-0.2471	9.1E-06	4189
0.0264	-0.00256	. -0.22659	1.53E-05	8377
0.0396	-0.00233	-0.20616	1.9E-05	12500
0.0528	-0.00209	-0.18582	2.05E-05	16700
0.066	-0.00187	-0.16555	2.04E-05	20900
0.0792	-0.00164	-0.14537	1.89E-05	25100
0.0924	-0.00142	-0.12526	1.64E-05	29300
0.1056	-0.00119	-0.10522	1.32E-05	33500
0.1188	-0.00096	-0.08526	9.72E-06	37700
0.132	-0.00074	-0.06535	6.38E-06	41800
0.1452	-0.00051	-0.04551	3.37E-06	46000
0.1584	-0.00029	-0.02572	1.18E-06	50200
0.1716	-0.00007	-0.005965	7.17E-08	54400
0.1848	0.00016	0.01375	4.07E-07	58600
0.198	0.00038	0.03343	2.52E-06	62800
0.2112	0.0006	0.0531	6.73E-06	67000
0.2244	0.00082	0.07274	1.34E-05	71200
0.2376	0.00104	0.09238	2.28E-05	75400
0.2508	0.00127	0.11201	3.57E-05	79600
0.264	0.00149	0.13165	5.18E-05	83700

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 3.44E-06 m^3

w(b)= 0.00303 m
w(a)= 0.000409 m
delta nh= (w(b)-w(a))/INT
delta nh= 762 kN/m^2

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8060 kN/m^3

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Table F8

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Mi=0.023kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00605	-0.2677	0	0
0.0132	-0.00558	-0.2471	1.82E-05	4140
0.0264	-0.00512	. -0.22659	3.06E-05	8290
0.0396	-0.00466	-0.20616	3.8E-05	12400
0.0528	-0.00419	-0.18582	4.11E-05	16500
0.066	-0.00374	-0.16555	4.09E-05	20700
0.0792	-0.00329	-0.14537	3.79E-05	24800
0.0924	-0.00283	-0.12526	3.28E-05	29000
0.1056	-0.00238	-0.10522	2.64E-05	33100
0.1188	-0.00193	-0.08526	1.95E-05	37300
0.132	-0.00148	-0.06535	1.28E-05	41400
0.1452	-0.00103	-0.04551	6.81E-06	45600
0.1584	-0.00058	-0.02572	2.36E-06	49700
0.1716	-0.00013	-0.005965	1.33E-07	53900
0.1848	0 000311	0.01375	7.9E-07	58000
0.198	0.00076	0.03343	5.03E-06	62200
0.2112	0.00119	0.0531	1.33E-05	66300
0.2244	0.00164	0.07274	2.68E-05	70500
0.2376	0.00209	0.09238	4.59E-05	74600
0.2508	0.00253	0.11201	7.11E-05	78800
0.264	0.00298	0.13165	0.000104	82900

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 6.88E-06 m^3

w(b)= 0.00605 m
w(a)= 0.001363 m
delta nh= (w(b)-w(a))/INT
delta nh= 682 kN/m^2

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7980 kN/m^3

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Table F9

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Mi=0.034kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00908	-0.2677	0	0
0.0132	-0.00838	-0.2471	2.73E-05	4130
0.0264	-0.00768	. -0.22659	4.59E-05	8270
0.0396	-0.00699	-0.20616	5.71E-05	12400
0.0528	-0.00629	-0.18582	6.17E-05	16500
0.066	-0.00561	-0.16555	6.13E-05	20600
0.0792	-0.00493	-0.14537	5.68E-05	24800
0.0924	-0.00425	-0.12526	4.92E-05	28900
0.1056	-0.00357	-0.10522	3.97E-05	33000
0.1188	-0.00289	-0.08526	2.93E-05	37200
0.132	-0.00222	-0.06535	1.92E-05	41300
0.1452	-0.00154	-0.04551	1.02E-05	45400
0.1584	-0.00087	-0.02572	3.54E-06	49600
0.1716	-0.0002	-0.005965	2.05E-07	53700
0.1848	0.00047	0.01375	1.19E-06	57800
0.198	0.00113	0.03343	7.48E-06	62000
0.2112	0.00179	0.0531	2.01E-05	66100
0.2244	0.00247	0.07274	4.03E-05	70300
0.2376	0.00313	0.09238	6.87E-05	74400
0.2508	0.00379	0.11201	0.000106	78500
0.264	0.00446	0.13165	0.000155	82700

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 1.03E-05 m^3

w(b)= 0.00908 m
w(a)= 0.002296 m
delta nh= (w(b)-w(a))/INT
delta nh= 658 kN/m^2

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7960 kN/m^3

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Table F10
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Mi=0.045kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01213	-0.2677	0	0
0.0132	-0.01119	-0.2471	3.65E-05	4100
0.0264	-0.01026	. -0.22659	6.14E-05	8210
0.0396	-0.00934	-0.20616	7.63E-05	12300
0.0528	-0.00842	-0.18582	8.26E-05	16400
0.066	-0.00749	-0.16555	8.18E-05	20500
0.0792	-0.00659	-0.14537	7.59E-05	24600
0.0924	-0.00567	-0.12526	6.56E-05	28700
0.1056	-0.00477	-0.10522	5.3E-05	32800
0.1188	-0.00386	-0.08526	3.91E-05	36900
0.132	-0.00296	-0.06535	2.55E-05	41000
0.1452	-0.00206	-0.04551	1.36E-05	45100
0.1584	-0.00116	-0.02572	4.73E-06	49200
0.1716	-0.00027	-0.005965	2.76E-07	53300
0.1848	0.00062	0.01375	1.58E-06	57500
0.198	0.00151	0.03343	9.99E-06	61600
0.2112	0.00241	0.0531	2.7E-05	65700
0.2244	0.00329	0.07274	5.37E-05	69800
0.2376	0.00418	0.09238	9.17E-05	73900
0.2508	0.00507	0.11201	0.000142	78000
0.264	0.00596	0.13165	0.000207	82100

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 1.38E-05 m^3

w(b)= 0.01213 m
w(a)= 0.003819 m
delta nh= (w(b)-w(a))/INT
delta nh= 603 kN/m^2

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7900 kN/m^3

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Table F11

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Mi=0.057kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01515	-0.2677	0	0
0.0132	-0.01398	-0.2471	4.56E-05	4080
0.0264	-0.01283	-0.22659	7.67E-05	8160
0.0396	-0.01167	-0.20616	9.53E-05	12200
0.0528	-0.01052	-0.18582	0.000103	16300
0.066	-0.00937	-0.16555	0.000102	20400
0.0792	-0.00823	-0.14537	9.48E-05	24400
0.0924	-0.00709	-0.12526	8.21E-05	28500
0.1056	-0.00596	-0.10522	6.62E-05	32600
0.1188	-0.00483	-0.08526	4.89E-05	36700
0.132	-0.00369	-0.06535	3.18E-05	40800
0.1452	-0.00258	-0.04551	1.7E-05	44800
0.1584	-0.00146	-0.02572	5.95E-06	48900
0.1716	-0.00034	-0.005965	3.48E-07	53000
0.1848	0.00078	0.01375	1.98E-06	57100
0.198	0.00189	0.03343	1.25E-05	61200
0.2112	0.00301	0.0531	3.38E-05	65300
0.2244	0.00412	0.07274	6.73E-05	69300
0.2376	0.00523	0.09238	0.000115	73400
0.2508	0.00634	0.11201	0.000178	77500
0.264	0.00745	0.13165	0.000259	81600

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 1.72E-05 m^3

w(b)= 0.01515 m
w(a)= 0.005614 m
delta nh= (w(b)-w(a))/INT
delta nh= 554 kN/m^2

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh=	**7850**	**kN/m^3**

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Table F12
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

B= 0.0254 m
delta Z= 0.0132 m

	Mi=0.068kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01818	-0.2677	0	0
0.0132	-0.01678	-0.2471	5.47E-05	4060
0.0264	-0.01539	. -0.22659	9.21E-05	8120
0.0396	-0.01399	-0.20616	0.000114	12100
0.0528	-0.01262	-0.18582	0.000124	16200
0.066	-0.01124	-0.16555	0.000123	20300
0.0792	-0.00987	-0.14537	0.000114	24300
0.0924	-0.0085	-0.12526	9.84E-05	28400
0.1056	-0.00714	-0.10522	7.93E-05	32500
0.1188	-0.00579	-0.08526	5.86E-05	36500
0.132	-0.00444	-0.06535	3.83E-05	40600
0.1452	-0.00309	-0.04551	2.04E-05	44600
0.1584	-0.00175	-0.02572	7.13E-06	48700
0.1716	-0.00041	-0.005965	4.2E-07	52800
0.1848	0.00093	0.01375	2.36E-06	56800
0.198	0.00227	0.03343	1.5E-05	60900
0.2112	0.00361	0.0531	4.05E-05	65000
0.2244	0.00494	0.07274	8.06E-05	69000
0.2376	0.00627	0.09238	0.000138	73100
0.2508	0.00761	0.11201	0.000214	77100
0.264	0.00894	0.13165	0.000311	81200

by Simpson's rule:

INT= 2.07E-05 m^3

w(b)= 0.01818 m
w(a)= 0.007472 m
delta nh= (w(b)-w(a))/INT
delta nh= 518 kN/m^2

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7820 kN/m^3

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Table F13
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Mi=0.079kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.0212	-0.2677	0	0
0.0132	-0.01957	-0.2471	6.38E-05	4040
0.0264	-0.01795	. -0.22659	0.000107	8090
0.0396	-0.01633	-0.20616	0.000133	12100
0.0528	-0.01472	-0.18582	0.000144	16100
0.066	-0.01311	-0.16555	0.000143	20200
0.0792	-0.01151	-0.14537	0.000133	24200
0.0924	-0.00992	-0.12526	0.000115	28300
0.1056	-0.00833	-0.10522	9.26E-05	32300
0.1188	-0.00675	-0.08526	6.84E-05	36400
0.132	-0.00518	-0.06535	4.47E-05	40400
0.1452	-0.0036	-0.04551	2.38E-05	44500
0.1584	-0.00204	-0.02572	8.31E-06	48500
0.1716	-0.00047	-0.005965	4.81E-07	52500
0.1848	0.00109	0.01375	2.77E-06	56600
0.198	0.00265	0.03343	1.75E-05	60600
0.2112	0.00421	0.0531	4.72E-05	64700
0.2244	0.00576	0.07274	9.4E-05	68700
0.2376	0.00732	0.09238	0.000161	72800
0.2508	0.00887	0.11201	0.000249	76800
0.264	0.01043	0.13165	0.000363	80900

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 2.41E-05 m^3

w(b)= 0.0212 m
w(a)= 0.009501 m
delta nh= (w(b)-w(a))/INT
delta nh= 485 kN/m^2

nh(initial)= 7300kN/m^3
nh= nh(inintial)+delta nh

nh= 7790 kN/m^3

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Table F14
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Mi=0.091kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02423	-0.2677	0	0
0.0132	-0.02236	-0.2471	7.29E-05	4030
0.0264	-0.02051	. -0.22659	0.000123	8060
0.0396	-0.01866	-0.20616	0.000152	12000
0.0528	-0.01682	-0.18582	0.000165	16100
0.066	-0.01498	-0.16555	0.000164	20100
0.0792	-0.01316	-0.14537	0.000152	24100
0.0924	-0.01134	-0.12526	0.000131	28200
0.1056	-0.00952	-0.10522	0.000106	32200
0.1188	-0.00772	-0.08526	7.82E-05	36200
0.132	-0.00591	-0.06535	5.1E-05	40300
0.1452	-0.00412	-0.04551	2.72E-05	44300
0.1584	-0.00233	-0.02572	9.49E-06	48300
0.1716	-0.00054	-0.005965	5.53E-07	52400
0.1848	0.00124	0.01375	3.15E-06	56400
0.198	0.00303	0.03343	2.01E-05	60400
0.2112	0.00481	0.0531	5.39E-05	64500
0.2244	0.00658	0.07274	0.000107	68500
0.2376	0.00836	0.09238	0.000183	72500
0.2508	0.01013	0.11201	0.000285	76600
0.264	0.01191	0.13165	0.000414	80600

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 2.75E-05 m^3

w(b)= 0.02423 m
w(a)= 0.011552 m
delta nh= (w(b)-w(a))/INT
delta nh= 460 kN/m^2

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7760 Kn/M^3

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Table F15

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.264m

	Mi=0.105kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02799	-0.2677	0	0
0.0132	-0.02583	-0.2471	8.43E-05	4010
0.0264	-0.02369	. -0.22659	0.000142	8030
0.0396	-0.02155	-0.20616	0.000176	12000
0.0528	-0.01943	-0.18582	0.000191	16000
0.066	-0.01731	-0.16555	0.000189	20000
0.0792	-0.01519	-0.14537	0.000175	24100
0.0924	-0.01309	-0.12526	0.000152	28100
0.1056	-0.011	-0.10522	0.000122	32100
0.1188	-0.00891	-0.08526	9.02E-05	36100
0.132	-0.00683	-0.06535	5.89E-05	40100
0.1452	-0.00476	-0.04551	3.15E-05	44100
0.1584	-0.00269	-0.02572	1.1E-05	48200
0.1716	-0.00062	-0.005965	6.35E-07	52200
0.1848	0.00144	0.01375	3.66E-06	56200
0.198	0.00349	0.03343	2.31E-05	60200
0.2112	0.00555	0.0531	6.22E-05	64200
0.2244	0.00761	0.07274	0.000124	68200
0.2376	0.00966	0.09238	0.000212	72300
0.2508	0.01171	0.11201	0.000329	76300
0.264	0.01376	0.13165	0.000478	80300

B= 0.0254 m
delta Z= 0.0132 m

by Simpson's rule:

INT= 3.18E-05 m^3

w(b)= 0.02799 m
w(a)= 0.014326 m
delta nh= (w(b)-w(a))/INT
delta nh= 429 kN/m^2

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7730 kN/m^3

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Table F16
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

B= 0.0254 m
delta Z= 0.0154 m

	Mi=0.011kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00193	-0.17117	0	0
0.0154	-0.00178	-0.15763	4.32E-06	4920
0.0308	-0.00163	-0.14421	7.24E-06	9850
0.0462	-0.00148	-0.13091	8.95E-06	14700
0.0616	-0.00133	-0.11771	9.64E-06	19700
0.077	-0.00118	-0.10463	9.51E-06	24600
0.0924	-0.00104	-0.09165	8.81E-06	29500
0.1078	-0.00089	-0.07878	7.56E-06	34400
0.1232	-0.00075	-0.06601	6.1E-06	39400
0.1386	-0.0006	-0.05334	4.44E-06	44300
0.154	-0.00046	-0.04075	2.89E-06	49200
0.1694	-0.00032	-0.02824	1.53E-06	54200
0.1848	-0.00018	-0.01579	5.25E-07	59100
0.2002	-0.00004	-0.00341	2.73E-08	64000
0.2156	0.0001	0.00892	1.92E-07	68900
0.231	0.00024	0.02122	1.18E-06	73900
0.2464	0.00038	0.03348	3.13E-06	78800
0.2618	0.00052	0.04573	6.23E-06	83700
0.2772	0.00065	0.05796	1.04E-05	88600
0.2926	0.00079	0.07018	1.62E-05	93600
0.308	0.00093	0.08241	2.36E-05	98500

by Simpson's rule:

INT= 1.86E-06 m^4

w(b)= 0.00193 m
w(a)= 0.000396 m
delta nh= (w(b)-w(a))/INT
delta nh= 827 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh=	8130	kN/m^3

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Table F17

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

B= 0.0254 m
delta Z= 0.0154 m

	Mi=0.023kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00387	-0.17117	0	0
0.0154	-0.00356	-0.15763	8.64E-06	4890
0.0308	-0.00326	. -0.14421	1.45E-05	9780
0.0462	-0.00296	-0.13091	1.79E-05	14600
0.0616	-0.00266	-0.11771	1.93E-05	19500
0.077	-0.00236	-0.10463	1.9E-05	24400
0.0924	-0.00207	-0.09165	1.75E-05	29300
0.1078	-0.00178	-0.07878	1.51E-05	34200
0.1232	-0.00149	-0.06601	1.21E-05	39100
0.1386	-0.00121	-0.05334	8.95E-06	44000
0.154	-0.00092	-0.04075	5.77E-06	48900
0.1694	-0.00064	-0.02824	3.06E-06	53700
0.1848	-0.00036	-0.01579	1.05E-06	58600
0.2002	-0.00008	-0.00341	5.46E-08	63500
0.2156	0.0002	0.00892	3.85E-07	68400
0.231	0.00048	0.02122	2.35E-06	73300
0.2464	0.00076	0.03348	6.27E-06	78200
0.2618	0.00103	0.04573	1.23E-05	83100
0.2772	0.00131	0.05796	2.1E-05	88000
0.2926	0.00159	0.07018	3.27E-05	92900
0.308	0.00186	0.08241	4.72E-05	97800

by Simpson's rule:

INT= 3.71E-06 m^4

w(b)= 0.00387 m
w(a)= 0.001024 m
delta nh= (w(b)-w(a))/INT
delta nh= 766 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\text{nh= 8070 kN/m^3}}$

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Table F18

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Mi=0.034kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.0058	-0.17117	0	0
0.0154	-0.00534	-0.15763	1.3E-05	4880
0.0308	-0.00489	. -0.14421	2.17E-05	9760
0.0462	-0.00444	-0.13091	2.69E-05	14600
0.0616	-0.00399	-0.11771	2.89E-05	19500
0.077	-0.00355	-0.10463	2.86E-05	24400
0.0924	-0.00311	-0.09165	2.63E-05	29200
0.1078	-0.00267	-0.07878	2.27E-05	34100
0.1232	-0.00224	-0.06601	1.82E-05	39000
0.1386	-0.00181	-0.05334	1.34E-05	43900
0.154	-0.00138	-0.04075	8.66E-06	48800
0.1694	-0.00096	-0.02824	4.59E-06	53600
0.1848	-0.00054	-0.01579	1.58E-06	58500
0.2002	-0.00012	-0.00341	8.19E-08	63400
0.2156	0.0003	0.00892	5.77E-07	68300
0.231	0.00072	0.02122	3.53E-06	73200
0.2464	0.00114	0.03348	9.4E-06	78000
0.2618	0.00155	0.04573	1.86E-05	82900
0.2772	0.00196	0.05796	3.15E-05	87800
0.2926	0.00238	0.07018	4.89E-05	92700
0.308	0.00279	0.08241	7.08E-05	97600

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 5.57E-06 m^4

w(b)= 0.0058 m
w(a)= 0.001624 m
delta nh= (w(b)-w(a))/INT
delta nh= 750 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8050 kN/m^3

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Table F19

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Mi=0.045kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00775	-0.17117	0	0
0.0154	-0.00714	-0.15763	1.73E-05	4870
0.0308	-0.00653	. -0.14421	2.9E-05	9750
0.0462	-0.00593	-0.13091	3.59E-05	14600
0.0616	-0.00533	-0.11771	3.86E-05	19500
0.077	-0.00474	-0.10463	3.82E-05	24300
0.0924	-0.00415	-0.09165	3.51E-05	29200
0.1078	-0.00357	-0.07878	3.03E-05	34100
0.1232	-0.00299	-0.06601	2.43E-05	39000
0.1386	-0.00242	-0.05334	1.79E-05	43800
0.154	-0.00185	-0.04075	1.16E-05	48700
0.1694	-0.00128	-0.02824	6.12E-06	53600
0.1848	-0.00072	-0.01579	2.1E-06	58500
0.2002	-0.00015	-0.00341	1.02E-07	63300
0.2156	0.0004	0.00892	7.69E-07	68200
0.231	0.00096	0.02122	4.71E-06	73100
0.2464	0.00152	0.03348	1.25E-05	78000
0.2618	0.00207	0.04573	2.48E-05	82800
0.2772	0.00263	0.05796	4.23E-05	87700
0.2926	0.00318	0.07018	6.53E-05	92600
0.308	0.00373	0.08241	9.47E-05	97500

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 7.44E-06 m^4

w(b)= 0.00775 m
w(a)= 0.002224 m
delta nh= (w(b)-w(a))/INT
delta nh= 742 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8040 kN/m^3

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Table F20

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Mi=0.057kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00969	-0.17117	0	0
0.0154	-0.00892	-0.15763	2.17E-05	4870
0.0308	-0.00816	-0.14421	3.62E-05	9740
0.0462	-0.00741	-0.13091	4.48E-05	14600
0.0616	-0.00666	-0.11771	4.83E-05	19400
0.077	-0.00592	-0.10463	4.77E-05	24300
0.0924	-0.00519	-0.09165	4.4E-05	29200
0.1078	-0.00446	-0.07878	3.79E-05	34000
0.1232	-0.00373	-0.06601	3.03E-05	38900
0.1386	-0.00302	-0.05334	2.23E-05	43800
0.154	-0.00231	-0.04075	1.45E-05	48700
0.1694	-0.00159	-0.02824	7.61E-06	53500
0.1848	-0.00089	-0.01579	2.6E-06	58400
0.2002	-0.00019	-0.00341	1.3E-07	63300
0.2156	0.00051	0.00892	9.81E-07	68100
0.231	0.0012	0.02122	5.88E-06	73000
0.2464	0.00189	0.03348	1.56E-05	77900
0.2618	0.00259	0.04573	3.1E-05	82800
0.2772	0.00328	0.05796	5.27E-05	87600
0.2926	0.00397	0.07018	8.15E-05	92500
0.308	0.00466	0.08241	0.000118	97400

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 9.29E-06 m^4

w(b)= 0.00969 m
w(a)= 0.002867 m
delta nh= (w(b)-w(a))/INT
delta nh= 734 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8030 kN/m^3

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Table F21

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

B= 0.0254 m
delta Z= 0.0154 m

	Mi=0.068kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01162	-0.17117	0	0
0.0154	-0.0107	-0.15763	2.6E-05	4860
0.0308	-0.00979	. -0.14421	4.35E-05	9725
0.0462	-0.00889	-0.13091	5.38E-05	14500
0.0616	-0.00799	-0.11771	5.79E-05	19400
0.077	-0.0071	-0.10463	5.72E-05	24300
0.0924	-0.00622	-0.09165	5.27E-05	29100
0.1078	-0.00535	-0.07878	4.54E-05	34000
0.1232	-0.00448	-0.06601	3.64E-05	38900
0.1386	-0.00362	-0.05334	2.68E-05	43700
0.154	-0.00277	-0.04075	1.74E-05	48600
0.1694	-0.00192	-0.02824	9.19E-06	53500
0.1848	-0.00107	-0.01579	3.12E-06	58300
0.2002	-0.00023	-0.00341	1.57E-07	63200
0.2156	0.00061	0.00892	1.17E-06	68100
0.231	0.00144	0.02122	7.06E-06	72900
0.2464	0.00227	0.03348	1.87E-05	77800
0.2618	0.0031	0.04573	3.71E-05	82700
0.2772	0.00394	0.05796	6.33E-05	87500
0.2926	0.00477	0.07018	9.8E-05	92400
0.308	0.00559	0.08241	0.000142	97250

by Simpson's rule:

INT= 1.12E-05 m^4

w(b)= 0.01162 m
w(a)= 0.003544 m
delta nh= (w(b)-w(a))/INT
delta nh= 724 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8020 kN/m^3

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Table F22

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Mi=0.079kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01355	-0.17117	0	0
0.0154	-0.01248	-0.15763	3.03E-05	4863
0.0308	-0.01142	-0.14421	5.07E-05	9725
0.0462	-0.01037	-0.13091	6.27E-05	14500
0.0616	-0.00932	-0.11771	6.76E-05	19400
0.077	-0.00829	-0.10463	6.68E-05	24300
0.0924	-0.00726	-0.09165	6.15E-05	29100
0.1078	-0.00624	-0.07878	5.3E-05	34000
0.1232	-0.00523	-0.06601	4.25E-05	38800
0.1386	-0.00422	-0.05334	3.12E-05	43700
0.154	-0.00323	-0.04075	2.03E-05	48600
0.1694	-0.00224	-0.02824	1.07E-05	53400
0.1848	-0.00125	-0.01579	3.65E-06	58300
0.2002	-0.00027	-0.00341	1.84E-07	63100
0.2156	0.00071	0.00892	1.37E-06	68000
0.231	0.00168	0.02122	8.24E-06	72900
0.2464	0.00265	0.03348	2.19E-05	77700
0.2618	0.00362	0.04573	4.33E-05	82600
0.2772	0.00459	0.05796	7.37E-05	87400
0.2926	0.00556	0.07018	0.000114	92300
0.308	0.00653	0.08241	0.000166	97200

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 1.3E-05 m^4

w(b)= 0.01355 m
w(a)= 0.004232 m
delta nh= (w(b)-w(a))/INT
delta nh= 716 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8020 kN/m^3

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Table F23
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Mi=0.091kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01549	-0.17117	0	0
0.0154	-0.01427	-0.15763	3.46E-05	4850
0.0308	-0.01305	-0.14421	5.8E-05	9700
0.0462	-0.01185	-0.13091	7.17E-05	14500
0.0616	-0.01065	-0.11771	7.72E-05	19400
0.077	-0.00947	-0.10463	7.63E-05	24200
0.0924	-0.00829	-0.09165	7.02E-05	29100
0.1078	-0.00713	-0.07878	6.06E-05	33900
0.1232	-0.00597	-0.06601	4.86E-05	38800
0.1386	-0.00482	-0.05334	3.56E-05	43600
0.154	-0.00369	-0.04075	2.32E-05	48500
0.1694	-0.00256	-0.02824	1.22E-05	53300
0.1848	-0.00143	-0.01579	4.17E-06	58200
0.2002	-0.00031	-0.00341	2.12E-07	63000
0.2156	0.00081	0.00892	1.56E-06	67900
0.231	0.00192	0.02122	9.41E-06	72800
0.2464	0.00303	0.03348	2.5E-05	77600
0.2618	0.00414	0.04573	4.96E-05	82500
0.2772	0.00525	0.05796	8.43E-05	87300
0.2926	0.00635	0.07018	0.00013	92200
0.308	0.00746	0.08241	0.000189	97000

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 1.49E-05 m^4

w(b)= 0.01549 m
w(a)= 0.005005 m
delta nh= (w(b)-w(a))/INT
delta nh= 705 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8010 kN/m^3

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Table F24
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Mi=0.105kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01789	-0.17117	0	0
0.0154	-0.01647	-0.15763	4E-05	4840
0.0308	-0.01507	-0.14421	6.69E-05	9690
0.0462	-0.01368	-0.13091	8.27E-05	14500
0.0616	-0.0123	-0.11771	8.92E-05	19300
0.077	-0.01093	-0.10463	8.81E-05	24200
0.0924	-0.00958	-0.09165	8.11E-05	29000
0.1078	-0.00823	-0.07878	6.99E-05	33900
0.1232	-0.00689	-0.06601	5.6E-05	38700
0.1386	-0.00557	-0.05334	4.12E-05	43600
0.154	-0.00426	-0.04075	2.67E-05	48400
0.1694	-0.00295	-0.02824	1.41E-05	53300
0.1848	-0.00165	-0.01579	4.81E-06	58100
0.2002	-0.00036	-0.00341	2.46E-07	63000
0.2156	0.00093	0.00892	1.79E-06	67800
0.231	0.00222	0.02122	1.09E-05	72700
0.2464	0.00349	0.03348	2.88E-05	77500
0.2618	0.00478	0.04573	5.72E-05	82400
0.2772	0.00606	0.05796	9.74E-05	87200
0.2926	0.00733	0.07018	0.000151	92100
0.308	0.00861	0.08241	0.000219	96900

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 1.72E-05 m^4

w(b)= 0.01789 m
w(a)= 0.005939 m
delta nh= (w(b)-w(a))/INT
delta nh= 696 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8000 kN/m^3

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Table F25

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Mi=0.119kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.0203	-0.17117	0	0
0.0154	-0.01869	-0.15763	4.54E-05	4840
0.0308	-0.0171	-0.14421	7.6E-05	9680
0.0462	-0.01553	-0.13091	9.39E-05	14500
0.0616	-0.01396	-0.11771	0.000101	19300
0.077	-0.01241	-0.10463	1E-04	24200
0.0924	-0.01087	-0.09165	9.21E-05	29000
0.1078	-0.00934	-0.07878	7.93E-05	33800
0.1232	-0.00783	-0.06601	6.37E-05	38700
0.1386	-0.00633	-0.05334	4.68E-05	43500
0.154	-0.00483	-0.04075	3.03E-05	48400
0.1694	-0.00335	-0.02824	1.6E-05	53200
0.1848	-0.00187	-0.01579	5.46E-06	58000
0.2002	-0.0004	-0.00341	2.73E-07	62900
0.2156	0.00106	0.00892	2.04E-06	67700
0.231	0.00252	0.02122	1.24E-05	72600
0.2464	0.00397	0.03348	3.28E-05	77400
0.2618	0.00542	0.04573	6.49E-05	82300
0.2772	0.00687	0.05796	0.00011	87100
0.2926	0.00832	0.07018	0.000171	91900
0.308	0.00977	0.08241	0.000248	96800

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 1.95E-05 m^4

w(b)= 0.0203 m
w(a)= 0.006952 m
delta nh= (w(b)-w(a))/INT
delta nh= 685 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7990 kN/m^3

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Table F26

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

B= 0.0254 m
delta Z= 0.0154 m

	Mi=0.133kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02269	-0.17117	0	0
0.0154	-0.0209	-0.15763	5.07E-05	4830
0.0308	-0.01912	. -0.14421	8.49E-05	9660
0.0462	-0.01736	-0.13091	0.000105	14400
0.0616	-0.01561	-0.11771	0.000113	19300
0.077	-0.01387	-0.10463	0.000112	24100
0.0924	-0.01215	-0.09165	0.000103	28900
0.1078	-0.01045	-0.07878	8.87E-05	33800
0.1232	-0.00875	-0.06601	7.12E-05	38600
0.1386	-0.00707	-0.05334	5.23E-05	43400
0.154	-0.0054	-0.04075	3.39E-05	48300
0.1694	-0.00374	-0.02824	1.79E-05	53100
0.1848	-0.00209	-0.01579	6.1E-06	57900
0.2002	-0.00045	-0.00341	3.07E-07	62800
0.2156	0.00118	0.00892	2.27E-06	67600
0.231	0.00281	0.02122	1.38E-05	72400
0.2464	0.00444	0.03348	3.66E-05	77300
0.2618	0.00606	0.04573	7.26E-05	82100
0.2772	0.00769	0.05796	0.000124	86900
0.2926	0.00931	0.07018	0.000191	91800
0.308	0.01093	0.08241	0.000277	96600

by Simpson's rule:

INT= 2.18E-05 m^4

w(b)= 0.02269 m
w(a)= 0.008089 m
delta nh= (w(b)-w(a))/INT
delta nh= 670 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7970 kN/m^3

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Table F27

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

B= 0.0254 m
delta Z= 0.0154 m

	Mi=0.147kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02509	-0.17117	0	0
0.0154	-0.02311	-0.15763	5.61E-05	4820
0.0308	-0.02114	-0.14421	9.39E-05	9652
0.0462	-0.01919	-0.13091	0.000116	14400
0.0616	-0.01726	-0.11771	0.000125	19200
0.077	-0.01534	-0.10463	0.000124	24100
0.0924	-0.01344	-0.09165	0.000114	28900
0.1078	-0.01155	-0.07878	9.81E-05	33700
0.1232	-0.00968	-0.06601	7.87E-05	38500
0.1386	-0.00782	-0.05334	5.78E-05	43400
0.154	-0.00597	-0.04075	3.75E-05	48200
0.1694	-0.00414	-0.02824	1.98E-05	53000
0.1848	-0.00232	-0.01579	6.77E-06	57800
0.2002	-0.00049	-0.00341	3.35E-07	62700
0.2156	0.00131	0.00892	2.52E-06	67500
0.231	0.00311	0.02122	1.52E-05	72300
0.2464	0.00491	0.03348	4.05E-05	77100
0.2618	0.0067	0.04573	8.02E-05	82000
0.2772	0.00849	0.05796	0.000136	86800
0.2926	0.01029	0.07018	0.000211	91600
0.308	0.01208	0.08241	0.000307	96400

by Simpson's rule:

INT= 2.41E-05 m^4

w(b)= 0.02509 m
w(a)= 0.00925 m
delta nh= (w(b)-w(a))/INT
delta nh= 658 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7960 kN/m^3

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Table F28

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Mi=0.161kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02749	-0.17117	0	0
0.0154	-0.02532	-0.15763	6.15E-05	4820
0.0308	-0.02316	-0.14421	0.000103	9630
0.0462	-0.02102	-0.13091	0.000127	14400
0.0616	-0.0189	-0.11771	0.000137	19200
0.077	-0.0168	-0.10463	0.000135	24000
0.0924	-0.01472	-0.09165	0.000125	28900
0.1078	-0.01265	-0.07878	0.000107	33700
0.1232	-0.0106	-0.06601	8.62E-05	38500
0.1386	-0.00857	-0.05334	6.34E-05	43300
0.154	-0.00654	-0.04075	4.1E-05	48100
0.1694	-0.00453	-0.02824	2.17E-05	53000
0.1848	-0.00254	-0.01579	7.41E-06	57800
0.2002	-0.00055	-0.00341	3.75E-07	62600
0.2156	0.00143	0.00892	2.75E-06	67400
0.231	0.00341	0.02122	1.67E-05	72200
0.2464	0.00538	0.03348	4.44E-05	77100
0.2618	0.00734	0.04573	8.79E-05	81900
0.2772	0.00931	0.05796	0.00015	86700
0.2926	0.01127	0.07018	0.000231	91500
0.308	0.01323	0.08241	0.000336	96300

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 2.64E-05 m^4

w(b)= 0.02749 m
w(a)= 0.010367 m
delta nh= (w(b)-w(a))/INT
delta nh= 649 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7950 kN/m^3

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Table F29
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Mi=0.175kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.0299	-0.17117	0	0
0.0154	-0.02754	-0.15763	6.69E-05	4810
0.0308	-0.02519	-0.14421	0.000112	9620
0.0462	-0.02287	-0.13091	0.000138	14400
0.0616	-0.02056	-0.11771	0.000149	19200
0.077	-0.01828	-0.10463	0.000147	24000
0.0924	-0.01601	-0.09165	0.000136	28800
0.1078	-0.01376	-0.07878	0.000117	33600
0.1232	-0.01153	-0.06601	9.38E-05	38500
0.1386	-0.00932	-0.05334	6.89E-05	43300
0.154	-0.00712	-0.04075	4.47E-05	48100
0.1694	-0.00493	-0.02824	2.36E-05	52900
0.1848	-0.00276	-0.01579	8.05E-06	57700
0.2002	-0.00059	-0.00341	4.03E-07	62500
0.2156	0.00156	0.00892	3E-06	67300
0.231	0.00371	0.02122	1.82E-05	72200
0.2464	0.00585	0.03348	4.83E-05	77000
0.2618	0.00799	0.04573	9.57E-05	81800
0.2772	0.01013	0.05796	0.000163	86600
0.2926	0.01226	0.07018	0.000252	91400
0.308	0.01439	0.08241	0.000365	96200

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 2.87E-05 m^4

w(b)= 0.0299 m
w(a)= 0.011561 m
delta nh= (w(b)-w(a))/INT
delta nh= 639 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7940 kN/m^3

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Table F30

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Mi=0.189kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.03229	-0.17117	0	0
0.0154	-0.02974	-0.15763	7.22E-05	4800
0.0308	-0.02721	-0.14421	0.000121	9610
0.0462	-0.0247	-0.13091	0.000149	14400
0.0616	-0.02221	-0.11771	0.000161	19200
0.077	-0.01974	-0.10463	0.000159	24000
0.0924	-0.01729	-0.09165	0.000146	28800
0.1078	-0.01487	-0.07878	0.000126	33600
0.1232	-0.01246	-0.06601	0.000101	38400
0.1386	-0.01006	-0.05334	7.44E-05	43200
0.154	-0.00769	-0.04075	4.83E-05	48000
0.1694	-0.00533	-0.02824	2.55E-05	52800
0.1848	-0.00298	-0.01579	8.7E-06	57600
0.2002	-0.00064	-0.00341	4.37E-07	62500
0.2156	0.00168	0.00892	3.23E-06	67300
0.231	0.004	0.02122	1.96E-05	72100
0.2464	0.00632	0.03348	5.21E-05	76900
0.2618	0.00863	0.04573	0.000103	81700
0.2772	0.01094	0.05796	0.000176	86500
0.2926	0.01324	0.07018	0.000272	91300
0.308	0.01555	0.08241	0.000395	96100

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 3.1E-05 m^4

w(b)= 0.03229 m
w(a)= 0.012753 m
delta nh= (w(b)-w(a))/INT
delta nh= 630 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7930 kN/m^3

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Table F31

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.308m

	Mi=0.211kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.03617	-0.17117	0	0
0.0154	-0.03331	-0.15763	8.09E-05	4800
0.0308	-0.03047	-0.14421	0.000135	9600
0.0462	-0.02766	-0.13091	0.000167	14400
0.0616	-0.02487	-0.11771	0.00018	19200
0.077	-0.02211	-0.10463	0.000178	24000
0.0924	-0.01937	-0.09165	0.000164	28800
0.1078	-0.01665	-0.07878	0.000141	33600
0.1232	-0.01395	-0.06601	0.000113	38400
0.1386	-0.01127	-0.05334	8.33E-05	43200
0.154	-0.00861	-0.04075	5.4E-05	48000
0.1694	-0.00597	-0.02824	2.86E-05	52800
0.1848	-0.00334	-0.01579	9.75E-06	57600
0.2002	-0.00072	-0.00341	4.92E-07	62400
0.2156	0.00189	0.00892	3.63E-06	67200
0.231	0.00448	0.02122	2.2E-05	72000
0.2464	0.00707	0.03348	5.83E-05	76800
0.2618	0.00966	0.04573	0.000116	81600
0.2772	0.01225	0.05796	0.000197	86400
0.2926	0.01483	0.07018	0.000305	91200
0.308	0.01741	0.08241	0.000442	96000

B= 0.0254 m
delta Z= 0.0154 m

by Simpson's rule:

INT= 3.47E-05 m^4

w(b)= 0.03617 m
w(a)= 0.014695 m
delta nh= (w(b)-w(a))/INT
delta nh= 619 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 7920 kN/m^3

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Table F32

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.011kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00183	-0.06676	0	0
0.022	-0.00169	-0.06035	2.24E-06	7430
0.044	-0.00155	-0.05418	3.7E-06	14800
0.066	-0.0014	-0.04824	4.46E-06	22200
0.088	-0.00126	-0.04253	4.72E-06	29700
0.11	-0.00112	-0.03704	4.56E-06	37100
0.132	-0.00099	-0.03176	4.15E-06	44500
0.154	-0.00085	-0.02672	3.5E-06	52000
0.176	-0.00071	-0.02187	2.73E-06	59400
0.198	-0.00058	-0.01721	1.98E-06	66800
0.22	-0.00044	-0.01271	1.23E-06	74300
0.242	-0.00031	-0.00838	6.29E-07	81700
0.264	-0.00017	-0.00418	1.88E-07	89100
0.286	-0.00004	-0.0001	1.14E-09	96600
0.308	0.00009	0.00388	1.08E-07	104000
0.33	0.00023	0.00778	5.91E-07	111000
0.352	0.00036	0.01162	1.47E-06	118000
0.374	0.00049	0.01543	2.83E-06	126000
0.396	0.00063	0.01921	4.79E-06	133000
0.418	0.00076	0.02298	7.3E-06	141000
0.44	0.00089	0.02674	1.05E-05	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 1.24E-06 m^4

w(b)= 0.00183 m
w(a)= 0.000243 m
delta nh= (w(b)-w(a))/INT
delta nh= 1280 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8580 kN/m^3

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Table F33

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

B= 0.0254 m
delta Z= 0.022 m

	Mi=0.023kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00366	-0.06676	0	0
0.022	-0.00338	-0.06035	4.49E-06	7410
0.044	-0.00309	-0.05418	7.37E-06	14800
0.066	-0.00281	-0.04824	8.95E-06	22200
0.088	-0.00253	-0.04253	9.47E-06	29600
0.11	-0.00225	-0.03704	9.17E-06	37000
0.132	-0.00197	-0.03176	8.26E-06	44500
0.154	-0.00169	-0.02672	6.95E-06	51900
0.176	-0.00142	-0.02187	5.47E-06	59300
0.198	-0.00115	-0.01721	3.92E-06	66700
0.22	-0.00088	-0.01271	2.46E-06	74100
0.242	-0.00061	-0.00838	1.24E-06	81600
0.264	-0.00034	-0.00418	3.75E-07	89000
0.286	-0.00008	-0.0001	2.29E-09	96400
0.308	0.00019	0.00388	2.27E-07	103000
0.33	0.00046	0.00778	1.18E-06	111000
0.352	0.00072	0.01162	2.94E-06	118000
0.374	0.00099	0.01543	5.71E-06	126000
0.396	0.00125	0.01921	9.51E-06	133000
0.418	0.00151	0.02298	1.45E-05	140000
0.44	0.00178	0.02674	2.09E-05	148000

by Simpson's rule:

INT= 2.48E-06 m^4

w(b)= 0.00366 m
w(a)= 0.000526 m
delta nh= (w(b)-w(a))/INT
delta nh= 1260 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8560 kN/m^3

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Table F34

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.034kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00549	-0.06676	0	0
0.022	-0.00506	-0.06035	6.72E-06	7410
0.044	-0.00464	. -0.05418	1.11E-05	14800
0.066	-0.00421	-0.04824	1.34E-05	22200
0.088	-0.00379	-0.04253	1.42E-05	29600
0.11	-0.00337	-0.03704	1.37E-05	37000
0.132	-0.00296	-0.03176	1.24E-05	44500
0.154	-0.00255	-0.02672	1.05E-05	51900
0.176	-0.00214	-0.02187	8.24E-06	59300
0.198	-0.00173	-0.01721	5.9E-06	66700
0.22	-0.00132	-0.01271	3.69E-06	74100
0.242	-0.00092	-0.00838	1.87E-06	81500
0.264	-0.00052	-0.00418	5.74E-07	89000
0.286	-0.00011	-0.0001	3.15E-09	96400
0.308	0.00028	0.00388	3.35E-07	103000
0.33	0.00068	0.00778	1.75E-06	111000
0.352	0.00108	0.01162	4.42E-06	118000
0.374	0.00148	0.01543	8.54E-06	126000
0.396	0.00188	0.01921	1.43E-05	133000
0.418	0.00227	0.02298	2.18E-05	140000
0.44	0.00267	0.02674	3.14E-05	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 3.72E-06 m^4

w(b)= 0.00549 m
w(a)= 0.000794 m
delta nh= (w(b)-w(a))/INT
delta nh= 1260 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8560 kN/m^3

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Table F35

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.045kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00734	-0.06676	0	0
0.022	-0.00677	-0.06035	8.99E-06	7410
0.044	-0.00619	-0.05418	1.48E-05	14800
0.066	-0.00563	-0.04824	1.79E-05	22200
0.088	-0.00507	-0.04253	1.9E-05	29600
0.11	-0.00451	-0.03704	1.84E-05	37000
0.132	-0.00395	-0.03176	1.66E-05	44500
0.154	-0.0034	-0.02672	1.4E-05	51900
0.176	-0.00285	-0.02187	1.1E-05	59300
0.198	-0.00231	-0.01721	7.87E-06	66700
0.22	-0.00177	-0.01271	4.95E-06	74100
0.242	-0.00123	-0.00838	2.49E-06	81600
0.264	-0.00069	-0.00418	7.61E-07	89000
0.286	-0.00015	-0.0001	4.29E-09	96400
0.308	0.00038	0.00388	4.54E-07	103000
0.33	0.00091	0.00778	2.34E-06	111000
0.352	0.00144	0.01162	5.89E-06	118000
0.374	0.00198	0.01543	1.14E-05	126000
0.396	0.00251	0.01921	1.91E-05	133000
0.418	0.00304	0.02298	2.92E-05	140000
0.44	0.00357	0.02674	4.2E-05	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 4.97E-06 m^4

w(b)= 0.00734 m
w(a)= 0.001057 m
delta nh= (w(b)-w(a))/INT
delta nh= 1260 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8560 kN/m^3

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Table F36

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

B= 0.0254 m
delta Z= 0.022 m

	Mi=0.057kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z)(w)(w(ad	kh (kN/m^2)
0	-0.00917	-0.06676	0	0
0.022	-0.00845	-0.06035	1.12E-05	7410
0.044	-0.00774	-0.05418	1.85E-05	14800
0.066	-0.00704	-0.04824	2.24E-05	22200
0.088	-0.00633	-0.04253	2.37E-05	29600
0.11	-0.00563	-0.03704	2.29E-05	37000
0.132	-0.00494	-0.03176	2.07E-05	44400
0.154	-0.00425	-0.02672	1.75E-05	51900
0.176	-0.00357	-0.02187	1.37E-05	59300
0.198	-0.00288	-0.01721	9.81E-06	66700
0.22	-0.00221	-0.01271	6.18E-06	74100
0.242	-0.00153	-0.00838	3.1E-06	81500
0.264	-0.00086	-0.00418	9.49E-07	88900
0.286	-0.000192	-0.0001	5.49E-09	96400
0.308	0.00048	0.00388	5.74E-07	103000
0.33	0.00114	0.00778	2.93E-06	111000
0.352	0.0018	0.01162	7.36E-06	118000
0.374	0.00247	0.01543	1.43E-05	126000
0.396	0.00313	0.01921	2.38E-05	133000
0.418	0.00379	0.02298	3.64E-05	140000
0.44	0.00446	0.02674	5.25E-05	148000

by Simpson's rule:

INT= 6.2E-06 m^4

w(b)= 0.00917 m
w(a)= 0.001341 m
delta nh= (w(b)-w(a))/INT
delta nh= 1260 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8560 kN/m^3

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Table F37

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.068kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.011	-0.06676	0	0
0.022	-0.01014	-0.06035	1.35E-05	7410
0.044	-0.00929	-0.05418	2.21E-05	14800
0.066	-0.00844	-0.04824	2.69E-05	22200
0.088	-0.00759	-0.04253	2.84E-05	29600
0.11	-0.00676	-0.03704	2.75E-05	37000
0.132	-0.00593	-0.03176	2.49E-05	44400
0.154	-0.0051	-0.02672	2.1E-05	51800
0.176	-0.00428	-0.02187	1.65E-05	59200
0.198	-0.00346	-0.01721	1.18E-05	66700
0.22	-0.00265	-0.01271	7.41E-06	74100
0.242	-0.00184	-0.00838	3.73E-06	81500
0.264	-0.00103	-0.00418	1.14E-06	88900
0.286	-0.00023	-0.0001	6.58E-09	96300
0.308	0.00057	0.00388	6.81E-07	103000
0.33	0.00137	0.00778	3.52E-06	111000
0.352	0.00217	0.01162	8.88E-06	118000
0.374	0.00296	0.01543	1.71E-05	125000
0.396	0.00376	0.01921	2.86E-05	133000
0.418	0.00455	0.02298	4.37E-05	140000
0.44	0.00535	0.02674	6.29E-05	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 7.44E-06 m^4

w(b)= 0.011 m
w(a)= 0.001639 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F38

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.079kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01283	-0.06676	0	0
0.022	-0.01183	-0.06035	1.57E-05	7410
0.044	-0.01083	-0.05418	2.58E-05	14800
0.066	-0.00984	-0.04824	3.13E-05	22200
0.088	-0.00886	-0.04253	3.32E-05	29600
0.11	-0.00788	-0.03704	3.21E-05	37000
0.132	-0.00691	-0.03176	2.9E-05	44400
0.154	-0.00595	-0.02672	2.45E-05	51800
0.176	-0.00499	-0.02187	1.92E-05	59200
0.198	-0.00404	-0.01721	1.38E-05	66600
0.22	-0.00309	-0.01271	8.64E-06	74100
0.242	-0.00214	-0.00838	4.34E-06	81500
0.264	-0.0012	-0.00418	1.32E-06	88900
0.286	-0.00027	-0.0001	7.72E-09	96300
0.308	0.00066	0.00388	7.89E-07	103000
0.33	0.00159	0.00778	4.08E-06	111000
0.352	0.00253	0.01162	1.03E-05	118000
0.374	0.00345	0.01543	1.99E-05	125000
0.396	0.00438	0.01921	3.33E-05	133000
0.418	0.00531	0.02298	5.1E-05	140000
0.44	0.00623	0.02674	7.33E-05	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 8.68E-06 m^4

w(b)= 0.01283 m
w(a)= 0.00193 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh (initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F39

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

B= 0.0254 m
delta Z= 0.022 m

	Mi=0.091kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01467	-0.06676	0	0
0.022	-0.01352	-0.06035	1.8E-05	7400
0.044	-0.01238	-0.05418	2.95E-05	14800
0.066	-0.01125	-0.04824	3.58E-05	22200
0.088	-0.01013	-0.04253	3.79E-05	29600
0.11	-0.00901	-0.03704	3.67E-05	37000
0.132	-0.00789	-0.03176	3.31E-05	44400
0.154	-0.00679	-0.02672	2.79E-05	51800
0.176	-0.0057	-0.02187	2.19E-05	59200
0.198	-0.00461	-0.01721	1.57E-05	66600
0.22	-0.00353	-0.01271	9.87E-06	74000
0.242	-0.00245	-0.00838	4.97E-06	81400
0.264	-0.00138	-0.00418	1.52E-06	88900
0.286	-0.00031	-0.0001	8.87E-09	96300
0.308	0.00076	0.00388	9.08E-07	103000
0.33	0.00182	0.00778	4.67E-06	111000
0.352	0.00289	0.01162	1.18E-05	118000
0.374	0.00395	0.01543	2.28E-05	125000
0.396	0.00501	0.01921	3.81E-05	133000
0.418	0.00607	0.02298	5.83E-05	140000
0.44	0.00712	0.02674	8.38E-05	148000

by Simpson's rule:

INT= 9.92E-06 m^4

w(b)= 0.01467 m
w(a)= 0.002226 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F40

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.105kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01693	-0.06676	0	0
0.022	-0.01561	-0.06035	2.07E-05	7400
0.044	-0.01429	-0.05418	3.41E-05	14800
0.066	-0.01299	-0.04824	4.14E-05	22200
0.088	-0.01169	-0.04253	4.38E-05	29600
0.11	-0.0104	-0.03704	4.24E-05	37000
0.132	-0.00912	-0.03176	3.82E-05	44400
0.154	-0.00785	-0.02672	3.23E-05	51800
0.176	-0.00658	-0.02187	2.53E-05	59200
0.198	-0.00533	-0.01721	1.82E-05	66600
0.22	-0.00407	-0.01271	1.14E-05	74000
0.242	-0.00283	-0.00838	5.74E-06	81400
0.264	-0.00159	-0.00418	1.75E-06	88800
0.286	-0.00035	-0.0001	1E-08	96200
0.308	0.00088	0.00388	1.05E-06	103000
0.33	0.00211	0.00778	5.42E-06	111000
0.352	0.00333	0.01162	1.36E-05	118000
0.374	0.00456	0.01543	2.63E-05	125000
0.396	0.00578	0.01921	4.4E-05	133000
0.418	0.007	0.02298	6.72E-05	140000
0.44	0.00823	0.02674	9.68E-05	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 1.15E-05 m^4

w(b)= 0.01693 m
w(a)= 0.00259 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F41

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.119kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01922	-0.06676	0	0
0.022	-0.01772	-0.06035	2.35E-05	7400
0.044	-0.01622	-0.05418	3.87E-05	14800
0.066	-0.01474	-0.04824	4.69E-05	22200
0.088	-0.01327	-0.04253	4.97E-05	29600
0.11	-0.01181	-0.03704	4.81E-05	37000
0.132	-0.01035	-0.03176	4.34E-05	44400
0.154	-0.00891	-0.02672	3.67E-05	51800
0.176	-0.00747	-0.02187	2.88E-05	59200
0.198	-0.00604	-0.01721	2.06E-05	66600
0.22	-0.00462	-0.01271	1.29E-05	74000
0.242	-0.00321	-0.00838	6.51E-06	81400
0.264	-0.0018	-0.00418	1.99E-06	88800
0.286	-0.0004	-0.0001	1.14E-08	96200
0.308	0.00099	0.00388	1.18E-06	103000
0.33	0.00239	0.00778	6.14E-06	111000
0.352	0.00378	0.01162	1.55E-05	118000
0.374	0.00517	0.01543	2.98E-05	125000
0.396	0.00656	0.01921	4.99E-05	133000
0.418	0.00795	0.02298	7.64E-05	140000
0.44	0.00934	0.02674	0.00011	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 1.3E-05 m^4

w(b)= 0.01922 m
w(a)= 0.00295 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F42

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.133kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02149	-0.06676	0	0
0.022	-0.01981	-0.06035	2.63E-05	7400
0.044	-0.01814	. -0.05418	4.32E-05	14800
0.066	-0.01648	-0.04824	5.25E-05	22200
0.088	-0.01484	-0.04253	5.55E-05	29600
0.11	-0.01319	-0.03704	5.37E-05	37000
0.132	-0.01157	-0.03176	4.85E-05	44400
0.154	-0.00996	-0.02672	4.1E-05	51800
0.176	-0.00835	-0.02187	3.21E-05	59200
0.198	-0.00676	-0.01721	2.3E-05	66600
0.22	-0.00517	-0.01271	1.45E-05	74000
0.242	-0.00359	-0.00838	7.28E-06	81400
0.264	-0.00202	-0.00418	2.23E-06	88800
0.286	-0.00045	-0.0001	1.29E-08	96200
0.308	0.00111	0.00388	1.33E-06	103000
0.33	0.00267	0.00778	6.85E-06	111000
0.352	0.00423	0.01162	1.73E-05	118000
0.374	0.00578	0.01543	3.34E-05	125000
0.396	0.00733	0.01921	5.58E-05	133000
0.418	0.00889	0.02298	8.54E-05	140000
0.44	0.01044	0.02674	0.000123	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 1.45E-05 m^4

w(b)= 0.02149 m
w(a)= 0.003301 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F43
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.147kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02376	-0.06676	0	0
0.022	-0.02189	-0.06035	2.91E-05	7400
0.044	-0.02006	-0.05418	4.78E-05	14800
0.066	-0.01822	-0.04824	5.8E-05	22200
0.088	-0.0164	-0.04253	6.14E-05	29600
0.11	-0.01459	-0.03704	5.94E-05	37000
0.132	-0.01279	-0.03176	5.36E-05	44400
0.154	-0.01101	-0.02672	4.53E-05	51800
0.176	-0.00924	-0.02187	3.56E-05	59200
0.198	-0.00747	-0.01721	2.55E-05	66600
0.22	-0.00572	-0.01271	1.6E-05	74000
0.242	-0.00397	-0.00838	8.05E-06	81400
0.264	-0.00223	-0.00418	2.46E-06	88800
0.286	-0.00049	-0.0001	1.4E-08	96200
0.308	0.00123	0.00388	1.47E-06	103000
0.33	0.00295	0.00778	7.57E-06	111000
0.352	0.00467	0.01162	1.91E-05	118000
0.374	0.00639	0.01543	3.69E-05	125000
0.396	0.00811	0.01921	6.17E-05	133000
0.418	0.00983	0.02298	9.44E-05	140000
0.44	0.01154	0.02674	0.000136	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 1.61E-05 m^4

w(b)= 0.02376 m
w(a)= 0.003648 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F44

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.161kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02603	-0.06676	0	0
0.022	-0.02399	-0.06035	3.19E-05	7400
0.044	-0.02197	. -0.05418	5.24E-05	14800
0.066	-0.01996	-0.04824	6.35E-05	22200
0.088	-0.01796	-0.04253	6.72E-05	29600
0.11	-0.01598	-0.03704	6.51E-05	37000
0.132	-0.01402	-0.03176	5.88E-05	44400
0.154	-0.01206	-0.02672	4.96E-05	51800
0.176	-0.01012	-0.02187	3.9E-05	59200
0.198	-0.00819	-0.01721	2.79E-05	66600
0.22	-0.00626	-0.01271	1.75E-05	74000
0.242	-0.00435	-0.00838	8.82E-06	81400
0.264	-0.00244	-0.00418	2.69E-06	88800
0.286	-0.00054	-0.0001	1.54E-08	96200
0.308	0.00135	0.00388	1.61E-06	103000
0.33	0.00324	0.00778	8.32E-06	111000
0.352	0.00512	0.01162	2.09E-05	118000
0.374	0.007	0.01543	4.04E-05	125000
0.396	0.00888	0.01921	6.76E-05	133000
0.418	0.01076	0.02298	0.000103	140000
0.44	0.01264	0.02674	0.000149	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 1.76E-05 m^4

w(b)= 0.02603 m
w(a)= 0.004001 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F45
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.175kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02831	-0.06676	0	0
0.022	-0.02609	-0.06035	3.46E-05	7400
0.044	-0.02389	. -0.05418	5.7E-05	14800
0.066	-0.02172	-0.04824	6.92E-05	22200
0.088	-0.01955	-0.04253	7.32E-05	29600
0.11	-0.01739	-0.03704	7.09E-05	37000
0.132	-0.01525	-0.03176	6.39E-05	44400
0.154	-0.01312	-0.02672	5.4E-05	51800
0.176	-0.01101	-0.02187	4.24E-05	59200
0.198	-0.0089	-0.01721	3.03E-05	66600
0.22	-0.00681	-0.01271	1.9E-05	74000
0.242	-0.00473	-0.00838	9.59E-06	81400
0.264	-0.00266	-0.00418	2.94E-06	88800
0.286	-0.00059	-0.0001	1.69E-08	96200
0.308	0.00147	0.00388	1.76E-06	103000
0.33	0.00352	0.00778	9.04E-06	111000
0.352	0.00557	0.01162	2.28E-05	118000
0.374	0.00762	0.01543	4.4E-05	125000
0.396	0.00966	0.01921	7.35E-05	133000
0.418	0.01171	0.02298	0.000112	140000
0.44	0.01375	0.02674	0.000162	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 1.91E-05 m^4

w(b)= 0.02831 m
w(a)= 0.004344 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F46

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

B= 0.0254 m
delta Z= 0.022 m

	Mi=0.189kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.03058	-0.06676	0	0
0.022	-0.02819	-0.06035	3.74E-05	7410
0.044	-0.02581	-0.05418	6.15E-05	14800
0.066	-0.02346	-0.04824	7.47E-05	22200
0.088	-0.02111	-0.04253	7.9E-05	29600
0.11	-0.01878	-0.03704	7.65E-05	37000
0.132	-0.01647	-0.03176	6.9E-05	44400
0.154	-0.01417	-0.02672	5.83E-05	51800
0.176	-0.01189	-0.02187	4.58E-05	59300
0.198	-0.00962	-0.01721	3.28E-05	66700
0.22	-0.00736	-0.01271	2.06E-05	74100
0.242	-0.00511	-0.00838	1.04E-05	81500
0.264	-0.00287	-0.00418	3.17E-06	88900
0.286	-0.00064	-0.0001	1.83E-08	96300
0.308	0.00158	0.00388	1.89E-06	103000
0.33	0.0038	0.00778	9.76E-06	111000
0.352	0.00602	0.01162	2.46E-05	118000
0.374	0.00823	0.01543	4.75E-05	126000
0.396	0.01044	0.01921	7.94E-05	133000
0.418	0.01265	0.02298	0.000122	140000
0.44	0.01486	0.02674	0.000175	148000

by Simpson's rule:

INT= 2.07E-05 m^4

w(b)= 0.03058 m
w(a)= 0.004552 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F47

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.211kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.03424	-0.06676	0	0
0.022	-0.03157	-0.06035	4.19E-05	7400
0.044	-0.02891	-0.05418	6.89E-05	14800
0.066	-0.02626	-0.04824	8.36E-05	22200
0.088	-0.02364	-0.04253	8.85E-05	29600
0.11	-0.02103	-0.03704	8.57E-05	37000
0.132	-0.01844	-0.03176	7.73E-05	44400
0.154	-0.01587	-0.02672	6.53E-05	51800
0.176	-0.01331	-0.02187	5.12E-05	59200
0.198	-0.01077	-0.01721	3.67E-05	66600
0.22	-0.00824	-0.01271	2.3E-05	74000
0.242	-0.00572	-0.00838	1.16E-05	81400
0.264	-0.00321	-0.00418	3.54E-06	88800
0.286	-0.00072	-0.0001	2.06E-08	96200
0.308	0.00177	0.00388	2.12E-06	103000
0.33	0.00426	0.00778	1.09E-05	111000
0.352	0.00674	0.01162	2.76E-05	118000
0.374	0.00921	0.01543	5.31E-05	125000
0.396	0.01169	0.01921	8.89E-05	133000
0.418	0.01416	0.02298	0.000136	140000
0.44	0.01663	0.02674	0.000196	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 2.32E-05 m^4

w(b)= 0.03424 m
w(a)= 0.005365 m
delta nh= (w(b)-w(a))/INT
delta nh= 1240 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8540 kN/m^3

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Table F48

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA = 2.0
LINEAR PART
PILE LENGTH = 0.440m

B= 0.0254 m
delta Z= 0.022 m

	Mi=0.234kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.0379	-0.06676	0	0
0.022	-0.03494	-0.06035	4.64E-05	7400
0.044	-0.03199	-0.05418	7.63E-05	14800
0.066	-0.02907	-0.04824	9.26E-05	22200
0.088	-0.02617	-0.04253	9.79E-05	29600
0.11	-0.02328	-0.03704	9.49E-05	37000
0.132	-0.02042	-0.03176	8.56E-05	44400
0.154	-0.01757	-0.02672	7.23E-05	51800
0.176	-0.01474	-0.02187	5.67E-05	59200
0.198	-0.01192	-0.01721	4.06E-05	66600
0.22	-0.00912	-0.01271	2.55E-05	74000
0.242	-0.00633	-0.00838	1.28E-05	81400
0.264	-0.00356	-0.00418	3.93E-06	88800
0.286	-0.00079	-0.0001	2.26E-08	96200
0.308	0.00196	0.00388	2.34E-06	103000
0.33	0.00471	0.00778	1.21E-05	111000
0.352	0.00746	0.01162	3.05E-05	118000
0.374	0.01019	0.01543	5.88E-05	125000
0.396	0.01294	0.01921	9.84E-05	133000
0.418	0.01568	0.02298	0.000151	140000
0.44	0.01841	0.02674	0.000217	148000

by Simpson's rule:

INT= 2.56E-05 m^4

w(b)= 0.0379 m
w(a)= 0.0059 m
delta nh= (w(b)-w(a))/INT
delta nh= 1240 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8540 kN/m^3

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Table F49

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

B= 0.0254 m
delta Z= 0.022 m

	Mi=0.257kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.04158	-0.06676	0	0
0.022	-0.03833	-0.06035	5.09E-05	7400
0.044	-0.0351	-0.05418	8.37E-05	14800
0.066	-0.03189	-0.04824	0.000102	22200
0.088	-0.02871	-0.04253	0.000107	29600
0.11	-0.02554	-0.03704	0.000104	37000
0.132	-0.02239	-0.03176	9.39E-05	44400
0.154	-0.01927	-0.02672	7.93E-05	51800
0.176	-0.01617	-0.02187	6.22E-05	59200
0.198	-0.01308	-0.01721	4.46E-05	66600
0.22	-0.01001	-0.01271	2.8E-05	74000
0.242	-0.00695	-0.00838	1.41E-05	81400
0.264	-0.0039	-0.00418	4.3E-06	88800
0.286	-0.00087	-0.0001	2.49E-08	96200
0.308	0.00215	0.00388	2.57E-06	103000
0.33	0.00517	0.00778	1.33E-05	111000
0.352	0.00818	0.01162	3.35E-05	118000
0.374	0.01119	0.01543	6.46E-05	125000
0.396	0.01419	0.01921	0.000108	133000
0.418	0.01719	0.02298	0.000165	140000
0.44	0.0202	0.02674	0.000238	148000

by Simpson's rule:

INT= 2.81E-05 m^4

w(b)= 0.04158 m
w(a)= 0.006438 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F50

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

B= 0.0254 m
delta Z= 0.022 m

	Mi=0.279kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.04524	-0.06676	0	0
0.022	-0.04171	-0.06035	5.54E-05	7400
0.044	-0.03819	-0.05418	9.1E-05	14800
0.066	-0.0347	-0.04824	0.00011	22200
0.088	-0.03124	-0.04253	0.000117	29600
0.11	-0.02779	-0.03704	0.000113	37000
0.132	-0.02437	-0.03176	0.000102	44400
0.154	-0.02097	-0.02672	8.63E-05	51800
0.176	-0.01759	-0.02187	6.77E-05	59200
0.198	-0.01423	-0.01721	4.85E-05	66600
0.22	-0.01089	-0.01271	3.05E-05	74000
0.242	-0.00756	-0.00838	1.53E-05	81400
0.264	-0.00425	-0.00418	4.69E-06	88800
0.286	-0.00095	-0.0001	2.72E-08	96200
0.308	0.00234	0.00388	2.8E-06	103000
0.33	0.00562	0.00778	1.44E-05	111000
0.352	0.0089	0.01162	3.64E-05	118000
0.374	0.01217	0.01543	7.02E-05	125000
0.396	0.01544	0.01921	0.000117	133000
0.418	0.01871	0.02298	0.00018	140000
0.44	0.02198	0.02674	0.000259	148000

by Simpson's rule:

INT= 3.06E-05 m^4

w(b)= 0.04524 m
w(a)= 0.006951 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F51

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.302kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.04891	-0.06676	0	0
0.022	-0.04508	-0.06035	5.99E-05	7400
0.044	-0.04129	-0.05418	9.84E-05	14800
0.066	-0.03751	-0.04824	0.000119	22200
0.088	-0.03377	-0.04253	0.000126	29600
0.11	-0.03004	-0.03704	0.000122	37000
0.132	-0.02634	-0.03176	0.00011	44400
0.154	-0.02267	-0.02672	9.33E-05	51800
0.176	-0.01901	-0.02187	7.32E-05	59200
0.198	-0.01538	-0.01721	5.24E-05	66600
0.22	-0.01177	-0.01271	3.29E-05	74000
0.242	-0.00817	-0.00838	1.66E-05	81400
0.264	-0.00459	-0.00418	5.07E-06	88800
0.286	-0.00102	-0.0001	2.92E-08	96200
0.308	0.00253	0.00388	3.02E-06	103000
0.33	0.00608	0.00778	1.56E-05	111000
0.352	0.00962	0.01162	3.93E-05	118000
0.374	0.01316	0.01543	7.59E-05	125000
0.396	0.01669	0.01921	0.000127	133000
0.418	0.02023	0.02298	0.000194	140000
0.44	0.02376	0.02674	0.00028	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 3.31E-05 m^4

w(b)= 0.04891 m
w(a)= 0.007497 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh=	8550	kN/m^3

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Table F52

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.324kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.05257	-0.06676	0	0
0.022	-0.04846	-0.06035	6.43E-05	7400
0.044	-0.04438	-0.05418	0.000106	14800
0.066	-0.04032	-0.04824	0.000128	22200
0.088	-0.03629	-0.04253	0.000136	29600
0.11	-0.03229	-0.03704	0.000132	37000
0.132	-0.02832	-0.03176	0.000119	44400
0.154	-0.02437	-0.02672	0.0001	51800
0.176	-0.02044	-0.02187	7.87E-05	59200
0.198	-0.01653	-0.01721	5.63E-05	66600
0.22	-0.01265	-0.01271	3.54E-05	74000
0.242	-0.00878	-0.00838	1.78E-05	81400
0.264	-0.00493	-0.00418	5.44E-06	88800
0.286	-0.00109	-0.0001	3.12E-08	96200
0.308	0.00272	0.00388	3.25E-06	103000
0.33	0.00654	0.00778	1.68E-05	111000
0.352	0.01034	0.01162	4.23E-05	118000
0.374	0.01415	0.01543	8.17E-05	125000
0.396	0.01794	0.01921	0.000136	133000
0.418	0.02174	0.02298	0.000209	140000
0.44	0.02554	0.02674	0.0003	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 3.56E-05 m^4

w(b)= 0.05257 m
w(a)= 0.008029 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F53

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.440m

	Mi=0.349kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.05661	-0.06676	0	0
0.022	-0.05218	-0.06035	6.93E-05	7406
0.044	-0.04778	. -0.05418	0.000114	14800
0.066	-0.04342	-0.04824	0.000138	22200
0.088	-0.03908	-0.04253	0.000146	29600
0.11	-0.03477	-0.03704	0.000142	37000
0.132	-0.03049	-0.03176	0.000128	44400
0.154	-0.02624	-0.02672	0.000108	51800
0.176	-0.02201	-0.02187	8.47E-05	59200
0.198	-0.0178	-0.01721	6.07E-05	66600
0.22	-0.01362	-0.01271	3.81E-05	74000
0.242	-0.00946	-0.00838	1.92E-05	81500
0.264	-0.00531	-0.00418	5.86E-06	88900
0.286	-0.00118	-0.0001	3.37E-08	96300
0.308	0.00293	0.00388	3.5E-06	103000
0.33	0.00704	0.00778	1.81E-05	111000
0.352	0.01114	0.01162	4.56E-05	118000
0.374	0.01523	0.01543	8.79E-05	125000
0.396	0.01932	0.01921	0.000147	133000
0.418	0.02341	0.02298	0.000225	140000
0.44	0.02749	0.02674	0.000323	148000

B= 0.0254 m
delta Z= 0.022 m

by Simpson's rule:

INT= 3.83E-05 m^4

w(b)= 0.05661 m
w(a)= 0.008564 m
delta nh= (w(b)-w(a))/INT
delta nh= 1250 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8550 kN/m^3

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Table F54
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.011kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00167	-0.05449	0	0
0.0242	-0.00154	-0.04872	1.82E-06	8310
0.0484	-0.00141	-0.04323	2.95E-06	16600
0.0726	-0.00128	-0.03802	3.53E-06	24900
0.0968	-0.00115	-0.03309	3.68E-06	33200
0.121	-0.00102	-0.02843	3.51E-06	41500
0.1452	-0.00089	-0.02404	3.11E-06	49800
0.1694	-0.00077	-0.0199	2.6E-06	58100
0.1936	-0.00065	-0.01601	2.01E-06	66500
0.2178	-0.00052	-0.01234	1.4E-06	74800
0.242	-0.00039	-0.00888	8.38E-07	83100
0.2662	-0.00028	-0.005601	4.17E-07	91400
0.2904	-0.00016	-0.00249	1.16E-07	99700
0.3146	-0.00003	0.00048	-4.5E-09	108000
0.3388	0.00009	0.00334	1.02E-07	116000
0.363	0.00021	0.00611	4.66E-07	124000
0.3872	0.00033	0.0088	1.12E-06	133000
0.4114	0.00045	0.01145	2.12E-06	141000
0.4356	0.00057	0.01407	3.49E-06	149000
0.4598	0.00069	0.01668	5.29E-06	157000
0.484	0.00081	0.01928	7.56E-06	166000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 1.02E-06 m^4

w(b)= 0.00167 m
w(a)= 0.000209 m
delta nh= (w(b)-w(a))/INT
delta nh= 1420 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh=	**8720**	**kN/m^3**

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Table F55

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.023kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00334	-0.05449	0	0
0.0242	-0.00307	-0.04872	3.62E-06	8280
0.0484	-0.00281	-0.04323	5.88E-06	16500
0.0726	-0.00256	-0.03802	7.07E-06	24800
0.0968	-0.0023	-0.03309	7.37E-06	33100
0.121	-0.00205	-0.02843	7.05E-06	41400
0.1452	-0.00179	-0.02404	6.25E-06	49700
0.1694	-0.00154	-0.0199	5.19E-06	57900
0.1936	-0.00129	-0.01601	4E-06	66200
0.2178	-0.00105	-0.01234	2.82E-06	74500
0.242	-0.00079	-0.00888	1.7E-06	82800
0.2662	-0.00056	-0.005601	8.35E-07	91100
0.2904	-0.00031	-0.00249	2.24E-07	99400
0.3146	-0.00007	0.00048	-1.1E-08	107000
0.3388	0.00017	0.00334	1.92E-07	115000
0.363	0.00041	0.00611	9.09E-07	124000
0.3872	0.00066	0.0088	2.25E-06	132000
0.4114	0.00089	0.01145	4.19E-06	140000
0.4356	0.00114	0.01407	6.99E-06	149000
0.4598	0.00138	0.01668	1.06E-05	157000
0.484	0.00162	0.01928	1.51E-05	165000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 2.05E-06 m^4

w(b)= 0.00334 m
w(a)= 0.000482 m
delta nh= (w(b)-w(a))/INT
delta nh= 1390 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8690 kN/m^3

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Table F56

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.034kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.005	-0.05449	0	0
0.0242	-0.00461	-0.04872	5.44E-06	8250
0.0484	-0.00422	. -0.04323	8.83E-06	16500
0.0726	-0.00384	-0.03802	1.06E-05	24700
0.0968	-0.00345	-0.03309	1.11E-05	33000
0.121	-0.00307	-0.02843	1.06E-05	41200
0.1452	-0.00269	-0.02404	9.39E-06	49500
0.1694	-0.00231	-0.0199	7.79E-06	57700
0.1936	-0.00194	-0.01601	6.01E-06	66000
0.2178	-0.00157	-0.01234	4.22E-06	74300
0.242	-0.00119	-0.00888	2.56E-06	82500
0.2662	-0.00083	-0.005601	1.24E-06	90800
0.2904	-0.00047	-0.00249	3.4E-07	99000
0.3146	-0.0001	0.00048	-1.5E-08	107000
0.3388	0.00026	0.00334	2.94E-07	115000
0.363	0.000622	0.00611	1.38E-06	123000
0.3872	0.000983	0.0088	3.35E-06	132000
0.4114	0.00134	0.01145	6.31E-06	140000
0.4356	0.0017	0.01407	1.04E-05	148000
0.4598	0.00206	0.01668	1.58E-05	156000
0.484	0.00242	0.01928	2.26E-05	165000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 3.07E-06 m^4

w(b)= 0.005 m
w(a)= 0.000809 m
delta nh= (w(b)-w(a))/INT
delta nh= 1360 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8660 kN/m^3

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Table F57

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.045kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00669	-0.05449	0	0
0.0242	-0.00616	-0.04872	7.26E-06	8240
0.0484	-0.00564	-0.04323	1.18E-05	16400
0.0726	-0.00512	-0.03802	1.41E-05	24700
0.0968	-0.00461	-0.03309	1.48E-05	32900
0.121	-0.0041	-0.02843	1.41E-05	41200
0.1452	-0.00359	-0.02404	1.25E-05	49400
0.1694	-0.00309	-0.0199	1.04E-05	57700
0.1936	-0.00259	-0.01601	8.03E-06	65900
0.2178	-0.00209	-0.01234	5.62E-06	74200
0.242	-0.0016	-0.00888	3.44E-06	82400
0.2662	-0.00111	-0.005601	1.65E-06	90700
0.2904	-0.00062	-0.00249	4.48E-07	98900
0.3146	-0.00014	0.00048	-2.1E-08	107000
0.3388	0.00035	0.00334	3.96E-07	115000
0.363	0.00083	0.00611	1.84E-06	123000
0.3872	0.00131	0.0088	4.46E-06	131000
0.4114	0.00179	0.01145	8.43E-06	140000
0.4356	0.00228	0.01407	1.4E-05	148000
0.4598	0.00276	0.01668	2.12E-05	156000
0.484	0.00324	0.01928	3.02E-05	164000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 4.1E-06 m^4

w(b)= 0.00669 m
w(a)= 0.001126 m
delta nh= (w(b)-w(a))/INT
delta nh= 1350 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8650 kN/m^3

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Table F58

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

B= 0.0254 m
delta Z= 0.0242 m

	Mi=0.057kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00836	-0.05449	0	0
0.0242	-0.0077	-0.04872	9.08E-06	8230
0.0484	-0.00705	. -0.04323	1.48E-05	16400
0.0726	-0.0064	-0.03802	1.77E-05	24700
0.0968	-0.00576	-0.03309	1.84E-05	32900
0.121	-0.00512	-0.02843	1.76E-05	41100
0.1452	-0.00449	-0.02404	1.57E-05	49400
0.1694	-0.00386	-0.0199	1.3E-05	57600
0.1936	-0.00324	-0.01601	1E-05	65900
0.2178	-0.00262	-0.01234	7.04E-06	74100
0.242	-0.002	-0.00888	4.3E-06	82300
0.2662	-0.00139	-0.005601	2.07E-06	90600
0.2904	-0.00078	-0.00249	5.64E-07	98800
0.3146	-0.00017	0.00048	-2.6E-08	107000
0.3388	0.00043	0.00334	4.87E-07	115000
0.363	0.00104	0.00611	2.31E-06	123000
0.3872	0.00164	0.0088	5.59E-06	131000
0.4114	0.00224	0.01145	1.06E-05	140000
0.4356	0.00284	0.01407	1.74E-05	148000
0.4598	0.00345	0.01668	2.65E-05	156000
0.484	0.00405	0.01928	3.78E-05	164000

<u>by Simpson's rule:</u>

INT= 5.13E-06 m^4

w(b)= 0.00836 m
w(a)= 0.001459 m
delta nh= (w(b)-w(a))/INT
delta nh= 1340 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8640 kN/m^3

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Table F59

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.068kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01002	-0.05449	0	0
0.0242	-0.00924	-0.04872	1.09E-05	8220
0.0484	-0.00846	-0.04323	1.77E-05	16400
0.0726	-0.00768	-0.03802	2.12E-05	24600
0.0968	-0.00691	-0.03309	2.21E-05	32900
0.121	-0.00615	-0.02843	2.12E-05	41100
0.1452	-0.00539	-0.02404	1.88E-05	49300
0.1694	-0.00464	-0.0199	1.56E-05	57500
0.1936	-0.00389	-0.01601	1.21E-05	65800
0.2178	-0.00314	-0.01234	8.44E-06	74000
0.242	-0.0024	-0.00888	5.16E-06	82200
0.2662	-0.00167	-0.005601	2.49E-06	90500
0.2904	-0.00094	-0.00249	6.8E-07	98700
0.3146	-0.00021	0.00048	-3.2E-08	106000
0.3388	0.00052	0.00334	5.88E-07	115000
0.363	0.00125	0.00611	2.77E-06	123000
0.3872	0.00197	0.0088	6.71E-06	131000
0.4114	0.00269	0.01145	1.27E-05	139000
0.4356	0.00341	0.01407	2.09E-05	148000
0.4598	0.00413	0.01668	3.17E-05	156000
0.484	0.00486	0.01928	4.54E-05	164000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 6.15E-06 m^4

w(b)= 0.01002 m
w(a)= 0.001797 m
delta nh= (w(b)-w(a))/INT
delta nh= 1330 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8630 kN/m^3

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Table F60

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.079kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01169	-0.05449	0	0
0.0242	-0.01078	-0.04872	1.27E-05	8220
0.0484	-0.00986	-0.04323	2.06E-05	16400
0.0726	-0.00896	-0.03802	2.47E-05	24600
0.0968	-0.00806	-0.03309	2.58E-05	32900
0.121	-0.00717	-0.02843	2.47E-05	41100
0.1452	-0.00629	-0.02404	2.2E-05	49300
0.1694	-0.00541	-0.0199	1.82E-05	57600
0.1936	-0.00453	-0.01601	1.4E-05	65800
0.2178	-0.00367	-0.01234	9.86E-06	74000
0.242	-0.0028	-0.00888	6.02E-06	82200
0.2662	-0.00195	-0.005601	2.91E-06	90500
0.2904	-0.00109	-0.00249	7.88E-07	98700
0.3146	-0.00024	0.00048	-3.6E-08	106000
0.3388	0.00061	0.00334	6.9E-07	115000
0.363	0.00145	0.00611	3.22E-06	123000
0.3872	0.00229	0.0088	7.8E-06	131000
0.4114	0.00314	0.01145	1.48E-05	139000
0.4356	0.00398	0.01407	2.44E-05	148000
0.4598	0.00482	0.01668	3.7E-05	156000
0.484	0.00566	0.01928	5.28E-05	164000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 7.17E-06 m^4

w(b)= 0.01169 m
w(a)= 0.002097 m
delta nh= (w(b)-w(a))/INT
delta nh= 1330 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8630 kN/m^3

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Table F61

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.091kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01336	-0.05449	0	0
0.0242	-0.01231	-0.04872	1.45E-05	8220
0.0484	-0.01127	-0.04323	2.36E-05	16400
0.0726	-0.01024	-0.03802	2.83E-05	24600
0.0968	-0.00921	-0.03309	2.95E-05	32900
0.121	-0.00819	-0.02843	2.82E-05	41100
0.1452	-0.00718	-0.02404	2.51E-05	49300
0.1694	-0.00618	-0.0199	2.08E-05	57500
0.1936	-0.00518	-0.01601	1.61E-05	65800
0.2178	-0.00419	-0.01234	1.13E-05	74000
0.242	-0.0032	-0.00888	6.88E-06	82200
0.2662	-0.00222	-0.005601	3.31E-06	90500
0.2904	-0.00125	-0.00249	9.04E-07	98700
0.3146	-0.00028	0.00048	-4.2E-08	106000
0.3388	0.00069	0.00334	7.81E-07	115000
0.363	0.00166	0.00611	3.68E-06	123000
0.3872	0.00263	0.0088	8.96E-06	131000
0.4114	0.00359	0.01145	1.69E-05	139000
0.4356	0.00455	0.01407	2.79E-05	148000
0.4598	0.00551	0.01668	4.23E-05	156000
0.484	0.00647	0.01928	6.04E-05	164000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 8.2E-06 m^4

w(b)= 0.01336 m
w(a)= 0.002402 m
delta nh= (w(b)-w(a))/INT
delta nh= 1330 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8630 kN/m^3

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Table F62

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.105kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	**kh (kN/m^2)**
0	-0.01543	-0.05449	0	0
0.0242	-0.01422	-0.04872	1.68E-05	8220
0.0484	-0.01302	-0.04323	2.72E-05	16400
0.0726	-0.01182	-0.03802	3.26E-05	24600
0.0968	-0.01064	-0.03309	3.41E-05	32800
0.121	-0.00946	-0.02843	3.25E-05	41100
0.1452	-0.00829	-0.02404	2.89E-05	49300
0.1694	-0.00713	-0.0199	2.4E-05	57500
0.1936	-0.00598	-0.01601	1.85E-05	65700
0.2178	-0.00484	-0.01234	1.3E-05	74000
0.242	-0.00369	-0.00888	7.93E-06	82200
0.2662	-0.00257	-0.005601	3.83E-06	90400
0.2904	-0.00144	-0.00249	1.04E-06	98600
0.3146	-0.00032	0.00048	-4.8E-08	106000
0.3388	0.0008	0.00334	9.05E-07	115000
0.363	0.00192	0.00611	4.26E-06	123000
0.3872	0.00303	0.0088	1.03E-05	131000
0.4114	0.00414	0.01145	1.95E-05	139000
0.4356	0.00525	0.01407	3.22E-05	148000
0.4598	0.00636	0.01668	4.88E-05	156000
0.484	0.00747	0.01928	6.97E-05	164000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 9.46E-06 m^4

w(b)= 0.01543 m
w(a)= 0.002815 m
delta nh= (w(b)-w(a))/INT
delta nh= 1330 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8630 kN/m^3

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Table F63

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

B= 0.0254 m
delta Z= 0.0242 m

	Mi=0.119kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01751	-0.05449	0	0
0.0242	-0.01614	-0.04872	1.9E-05	8213
0.0484	-0.01477	-0.04323	3.09E-05	16400
0.0726	-0.01342	-0.03802	3.7E-05	24600
0.0968	-0.01207	-0.03309	3.87E-05	32800
0.121	-0.01074	-0.02843	3.69E-05	41100
0.1452	-0.00941	-0.02404	3.28E-05	49300
0.1694	-0.00809	-0.0199	2.73E-05	57500
0.1936	-0.00679	-0.01601	2.1E-05	65700
0.2178	-0.00549	-0.01234	1.48E-05	73900
0.242	-0.00419	-0.00888	9E-06	82200
0.2662	-0.00291	-0.005601	4.34E-06	90400
0.2904	-0.00163	-0.00249	1.18E-06	98600
0.3146	-0.00036	0.00048	-5.4E-08	106000
0.3388	0.00091	0.00334	1.03E-06	115000
0.363	0.00217	0.00611	4.81E-06	123000
0.3872	0.00344	0.0088	1.17E-05	131000
0.4114	0.00469	0.01145	2.21E-05	139000
0.4356	0.00596	0.01407	3.65E-05	147000
0.4598	0.00722	0.01668	5.54E-05	156000
0.484	0.00848	0.01928	7.91E-05	164000

by Simpson's rule:

INT= 1.07E-05 m^4

w(b)= 0.01751 m
w(a)= 0.003246 m
delta nh= (w(b)-w(a))/INT
delta nh= 1320 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8620 kN/m^3

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Table F64

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.133kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01958	-0.05449	0	0
0.0242	-0.01804	-0.04872	2.13E-05	8220
0.0484	-0.01652	-0.04323	3.46E-05	16400
0.0726	-0.015	-0.03802	4.14E-05	24600
0.0968	-0.01349	-0.03309	4.32E-05	32800
0.121	-0.01201	-0.02843	4.13E-05	41100
0.1452	-0.01052	-0.02404	3.67E-05	49300
0.1694	-0.00905	-0.0199	3.05E-05	57500
0.1936	-0.00759	-0.01601	2.35E-05	65700
0.2178	-0.00614	-0.01234	1.65E-05	74000
0.242	-0.00469	-0.00888	1.01E-05	82200
0.2662	-0.00326	-0.005601	4.86E-06	90400
0.2904	-0.00183	-0.00249	1.32E-06	98600
0.3146	-0.0004	0.00048	-6E-08	106000
0.3388	0.00102	0.00334	1.15E-06	115000
0.363	0.00243	0.00611	5.39E-06	123000
0.3872	0.00384	0.0088	1.31E-05	131000
0.4114	0.00525	0.01145	2.47E-05	139000
0.4356	0.00666	0.01407	4.08E-05	148000
0.4598	0.00807	0.01668	6.19E-05	156000
0.484	0.00948	0.01928	8.85E-05	164000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 1.2E-05 m^4

w(b)= 0.01958 m
w(a)= 0.003597 m
delta nh= (w(b)-w(a))/INT
delta nh= 1330 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8630 kN/m^3

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Table F65

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.147kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02164	-0.05449	0	0
0.0242	-0.01995	-0.04872	2.35E-05	8220
0.0484	-0.01826	-0.04323	3.82E-05	16400
0.0726	-0.01659	-0.03802	4.58E-05	24600
0.0968	-0.01492	-0.03309	4.78E-05	32800
0.121	-0.01327	-0.02843	4.56E-05	41100
0.1452	-0.01164	-0.02404	4.06E-05	49300
0.1694	-0.01001	-0.0199	3.37E-05	57500
0.1936	-0.00839	-0.01601	2.6E-05	65700
0.2178	-0.00679	-0.01234	1.82E-05	74000
0.242	-0.00519	-0.00888	1.12E-05	82200
0.2662	-0.0036	-0.005601	5.37E-06	90400
0.2904	-0.00202	-0.00249	1.46E-06	98600
0.3146	-0.00045	0.00048	-6.8E-08	106000
0.3388	0.00112	0.00334	1.27E-06	115000
0.363	0.00269	0.00611	5.97E-06	123000
0.3872	0.00425	0.0088	1.45E-05	131000
0.4114	0.00581	0.01145	2.74E-05	139000
0.4356	0.00737	0.01407	4.52E-05	148000
0.4598	0.00893	0.01668	6.85E-05	156000
0.484	0.01048	0.01928	9.78E-05	164000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 1.33E-05 m^4

w(b)= 0.02164 m
w(a)= 0.003937 m
delta nh= (w(b)-w(a))/INT
delta nh= 1330 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8630 kN/m^3

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Table F66

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

B= 0.0254 m
delta Z= 0.0242 m

	Mi=0.161kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02371	-0.05449	0	0
0.0242	-0.02185	-0.04872	2.58E-05	8220
0.0484	-0.02	-0.04323	4.18E-05	16400
0.0726	-0.01817	-0.03802	5.02E-05	24600
0.0968	-0.01635	-0.03309	5.24E-05	32900
0.121	-0.01454	-0.02843	5E-05	41100
0.1452	-0.01275	-0.02404	4.45E-05	49300
0.1694	-0.01096	-0.0199	3.69E-05	57500
0.1936	-0.00919	-0.01601	2.85E-05	65800
0.2178	-0.00743	-0.01234	2E-05	74000
0.242	-0.00568	-0.00888	1.22E-05	82200
0.2662	-0.00394	-0.005601	5.87E-06	90400
0.2904	-0.00221	-0.00249	1.6E-06	98700
0.3146	-0.00049	0.00048	-7.4E-08	106000
0.3388	0.00123	0.00334	1.39E-06	115000
0.363	0.00295	0.00611	6.54E-06	123000
0.3872	0.00466	0.0088	1.59E-05	131000
0.4114	0.00636	0.01145	3E-05	139000
0.4356	0.00807	0.01407	4.95E-05	148000
0.4598	0.00978	0.01668	7.5E-05	156000
0.484	0.01148	0.01928	0.000107	164000

by Simpson's rule:

INT= 1.45E-05 m^4

w(b)= 0.02371 m
w(a)= 0.004281 m
delta nh= (w(b)-w(a))/INT
delta nh= 1330 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8630 kN/m^3

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Table F67
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

B= 0.0254 m
delta Z= 0.0242 m

	Mi=0.175kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02579	-0.05449	0	0
0.0242	-0.02377	-0.04872	2.8E-05	8222
0.0484	-0.02176	-0.04323	4.55E-05	16400
0.0726	-0.01976	-0.03802	5.45E-05	24600
0.0968	-0.01778	-0.03309	5.7E-05	32900
0.121	-0.01582	-0.02843	5.44E-05	41100
0.1452	-0.01387	-0.02404	4.84E-05	49300
0.1694	-0.01193	-0.0199	4.02E-05	57600
0.1936	-0.01	-0.01601	3.1E-05	65800
0.2178	-0.00809	-0.01234	2.17E-05	74000
0.242	-0.00618	-0.00888	1.33E-05	82200
0.2662	-0.00429	-0.005601	6.4E-06	90500
0.2904	-0.00241	-0.00249	1.74E-06	98700
0.3146	-0.00053	0.00048	-8E-08	106000
0.3388	0.00134	0.00334	1.52E-06	115000
0.363	0.0032	0.00611	7.1E-06	123000
0.3872	0.00506	0.0088	1.72E-05	131000
0.4114	0.00692	0.01145	3.26E-05	139000
0.4356	0.00878	0.01407	5.38E-05	148000
0.4598	0.01064	0.01668	8.16E-05	156000
0.484	0.01249	0.01928	0.000117	164000

by Simpson's rule:

INT= 1.58E-05 m^4

w(b)= 0.02579 m
w(a)= 0.004602 m
delta nh= (w(b)-w(a))/INT
delta nh= 1330 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8630 kN/m^3

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Table F68

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.189kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02786	-0.05449	0	0
0.0242	-0.02567	-0.04872	3.03E-05	8230
0.0484	-0.0235	-0.04323	4.92E-05	16400
0.0726	-0.02135	-0.03802	5.89E-05	24700
0.0968	-0.01921	-0.03309	6.15E-05	32900
0.121	-0.01709	-0.02843	5.88E-05	41100
0.1452	-0.01498	-0.02404	5.23E-05	49400
0.1694	-0.01288	-0.0199	4.34E-05	57600
0.1936	-0.0108	-0.01601	3.35E-05	65800
0.2178	-0.00873	-0.01234	2.35E-05	74100
0.242	-0.00668	-0.00888	1.44E-05	82300
0.2662	-0.00464	-0.005601	6.92E-06	90500
0.2904	-0.0026	-0.00249	1.88E-06	98800
0.3146	-0.00057	0.00048	-8.6E-08	107000
0.3388	0.00145	0.00334	1.64E-06	115000
0.363	0.00346	0.00611	7.67E-06	123000
0.3872	0.00547	0.0088	1.86E-05	131000
0.4114	0.00748	0.01145	3.52E-05	139000
0.4356	0.00948	0.01407	5.81E-05	148000
0.4598	0.01149	0.01668	8.81E-05	156000
0.484	0.01349	0.01928	0.000126	164000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 1.71E-05 m^4

w(b)= 0.02786 m
w(a)= 0.004915 m
delta nh= (w(b)-w(a))/INT
delta nh= 1340 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8640 kN/m^3

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Table F69

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.211kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.03119	-0.05449	0	0
0.0242	-0.02875	-0.04872	3.39E-05	8230
0.0484	-0.02632	-0.04323	5.51E-05	16400
0.0726	-0.0239	-0.03802	6.6E-05	24700
0.0968	-0.02151	-0.03309	6.89E-05	32900
0.121	-0.01913	-0.02843	6.58E-05	41100
0.1452	-0.01677	-0.02404	5.85E-05	49400
0.1694	-0.01443	-0.0199	4.86E-05	57600
0.1936	-0.01209	-0.01601	3.75E-05	65900
0.2178	-0.00978	-0.01234	2.63E-05	74100
0.242	-0.00748	-0.00888	1.61E-05	82300
0.2662	-0.00519	-0.005601	7.74E-06	90600
0.2904	-0.00291	-0.00249	2.1E-06	98800
0.3146	-0.00064	0.00048	-9.7E-08	107000
0.3388	0.00162	0.00334	1.83E-06	115000
0.363	0.00387	0.00611	8.58E-06	123000
0.3872	0.00613	0.0088	2.09E-05	131000
0.4114	0.00837	0.01145	3.94E-05	140000
0.4356	0.01062	0.01407	6.51E-05	148000
0.4598	0.01286	0.01668	9.86E-05	156000
0.484	0.01511	0.01928	0.000141	164000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 1.91E-05 m^4

w(b)= 0.03119 m
w(a)= 0.005415 m
delta nh= (w(b)-w(a))/INT
delta nh= 1340 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8640 kN/m^3

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Table F70

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.234kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.03453	-0.05449	0	0
0.0242	-0.03182	-0.04872	3.75E-05	8240
0.0484	-0.02913	. -0.04323	6.09E-05	16400
0.0726	-0.02646	-0.03802	7.3E-05	24700
0.0968	-0.02381	-0.03309	7.63E-05	32900
0.121	-0.02118	-0.02843	7.29E-05	41200
0.1452	-0.01856	-0.02404	6.48E-05	49400
0.1694	-0.01597	-0.0199	5.38E-05	57700
0.1936	-0.01339	-0.01601	4.15E-05	65900
0.2178	-0.01083	-0.01234	2.91E-05	74100
0.242	-0.00828	-0.00888	1.78E-05	82400
0.2662	-0.00575	-0.005601	8.57E-06	90600
0.2904	-0.00322	-0.00249	2.33E-06	98900
0.3146	-0.00071	0.00048	-1.1E-07	107000
0.3388	0.00179	0.00334	2.03E-06	115000
0.363	0.00429	0.00611	9.51E-06	123000
0.3872	0.00678	0.0088	2.31E-05	131000
0.4114	0.00927	0.01145	4.37E-05	140000
0.4356	0.01175	0.01407	7.2E-05	148000
0.4598	0.01424	0.01668	0.000109	156000
0.484	0.01672	0.01928	0.000156	164000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 2.12E-05 m^4

w(b)= 0.03453 m
w(a)= 0.005882 m
delta nh= (w(b)-w(a))/INT
delta nh= 1350 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8650 kN/m^3

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Table F71

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2

LINEAR PART

PILE LENGTH=0.484m

	Mi=0.257kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.03788	-0.05449	0	0
0.0242	-0.03491	-0.04872	4.12E-05	8240
0.0484	-0.03196	. -0.04323	6.69E-05	16400
0.0726	-0.02903	-0.03802	8.01E-05	24700
0.0968	-0.02612	-0.03309	8.37E-05	32900
0.121	-0.02323	-0.02843	7.99E-05	41200
0.1452	-0.02037	-0.02404	7.11E-05	49400
0.1694	-0.01752	-0.0199	5.91E-05	57700
0.1936	-0.01469	-0.01601	4.55E-05	65900
0.2178	-0.01188	-0.01234	3.19E-05	74200
0.242	-0.00908	-0.00888	1.95E-05	82400
0.2662	-0.0063	-0.005601	9.39E-06	90700
0.2904	-0.00354	-0.00249	2.56E-06	98900
0.3146	-0.00078	0.00048	-1.2E-07	107000
0.3388	0.00197	0.00334	2.23E-06	115000
0.363	0.00471	0.00611	1.04E-05	123000
0.3872	0.00744	0.0088	2.54E-05	131000
0.4114	0.01017	0.01145	4.79E-05	140000
0.4356	0.01289	0.01407	7.9E-05	148000
0.4598	0.01562	0.01668	0.00012	156000
0.484	0.01835	0.01928	0.000171	164000

B= 0.0254 m

delta Z= 0.0242 m

by Simpson's rule:

INT= 2.32E-05 m^4

w(b)= 0.03788 m

w(a)= 0.006336 m

delta nh= (w(b)-w(a))/INT

delta nh= 1350 kN/m^3

nh(initial)= 7300kN/m^3

nh= nh(initial)+delta nh

nh= 8650 kN/m^3

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Table F72

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.279kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.04122	-0.05449	0	0
0.0242	-0.03799	-0.04872	4.48E-05	8250
0.0484	-0.03477	. -0.04323	7.28E-05	16500
0.0726	-0.03159	-0.03802	8.72E-05	24700
0.0968	-0.02842	-0.03309	9.1E-05	33000
0.121	-0.02528	-0.02843	8.7E-05	41200
0.1452	-0.02216	-0.02404	7.74E-05	49500
0.1694	-0.01906	-0.0199	6.43E-05	57700
0.1936	-0.01598	-0.01601	4.95E-05	66000
0.2178	-0.01292	-0.01234	3.47E-05	74200
0.242	-0.00988	-0.00888	2.12E-05	82500
0.2662	-0.00686	-0.005601	1.02E-05	90700
0.2904	-0.00385	-0.00249	2.78E-06	99000
0.3146	-0.00085	0.00048	-1.3E-07	107000
0.3388	0.00214	0.00334	2.42E-06	115000
0.363	0.00512	0.00611	1.14E-05	123000
0.3872	0.00809	0.0088	2.76E-05	132000
0.4114	0.01106	0.01145	5.21E-05	140000
0.4356	0.01403	0.01407	8.6E-05	148000
0.4598	0.01699	0.01668	0.00013	156000
0.484	0.01996	0.01928	0.000186	165000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 2.53E-05 m^4

w(b)= 0.04122 m
w(a)= 0.006752 m
delta nh= (w(b)-w(a))/INT
delta nh= 1360 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8660 kN/m^3

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Table F73

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.302kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.04456	-0.05449	0	0
0.0242	-0.04106	-0.04872	4.84E-05	8250
0.0484	-0.03759	. -0.04323	7.87E-05	16500
0.0726	-0.03414	-0.03802	9.42E-05	24700
0.0968	-0.03072	-0.03309	9.84E-05	33000
0.121	-0.02733	-0.02843	9.4E-05	41200
0.1452	-0.02395	-0.02404	8.36E-05	49500
0.1694	-0.0206	-0.0199	6.94E-05	57800
0.1936	-0.01728	-0.01601	5.36E-05	66000
0.2178	-0.01397	-0.01234	3.75E-05	74300
0.242	-0.01068	-0.00888	2.3E-05	82500
0.2662	-0.00741	-0.005601	1.1E-05	90800
0.2904	-0.00416	-0.00249	3.01E-06	99000
0.3146	-0.00092	0.00048	-1.4E-07	107000
0.3388	0.00231	0.00334	2.61E-06	115000
0.363	0.00553	0.00611	1.23E-05	123000
0.3872	0.00875	0.0088	2.98E-05	132000
0.4114	0.01196	0.01145	5.63E-05	140000
0.4356	0.01517	0.01407	9.3E-05	148000
0.4598	0.01837	0.01668	0.000141	156000
0.484	0.02158	0.01928	0.000201	165000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 2.73E-05 m^4

w(b)= 0.04456 m
w(a)= 0.007171 m
delta nh= (w(b)-w(a))/INT
delta nh= 1360 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8660 kN/m^3

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Table F74

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

B= 0.0254 m
delta Z= 0.0242 m

	Mi=0.324kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.04789	-0.05449	0	0
0.0242	-0.04414	-0.04872	5.2E-05	8260
0.0484	-0.0404	-0.04323	8.45E-05	16500
0.0726	-0.0367	-0.03802	0.000101	24700
0.0968	-0.03302	-0.03309	0.000106	33000
0.121	-0.02937	-0.02843	0.000101	41300
0.1452	-0.02575	-0.02404	8.99E-05	49500
0.1694	-0.02215	-0.0199	7.47E-05	57800
0.1936	-0.01857	-0.01601	5.76E-05	66000
0.2178	-0.01502	-0.01234	4.04E-05	74300
0.242	-0.01148	-0.00888	2.47E-05	82600
0.2662	-0.00797	-0.005601	1.19E-05	90800
0.2904	-0.00447	-0.00249	3.23E-06	99100
0.3146	-0.00099	0.00048	-1.5E-07	107000
0.3388	0.00249	0.00334	2.82E-06	115000
0.363	0.00595	0.00611	1.32E-05	123000
0.3872	0.0094	0.0088	3.2E-05	132000
0.4114	0.01286	0.01145	6.06E-05	140000
0.4356	0.0163	0.01407	9.99E-05	148000
0.4598	0.01975	0.01668	0.000151	156000
0.484	0.02319	0.01928	0.000216	165000

by Simpson's rule:

INT= 2.94E-05 m^4

w(b)= 0.04789 m
w(a)= 0.007578 m
delta nh= (w(b)-w(a))/INT
delta nh= 1370 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8670 kN/m^3

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Table F75

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.2
LINEAR PART
PILE LENGTH=0.484m

	Mi=0.349kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.05157	-0.05449	0	0
0.0242	-0.04752	-0.04872	5.6E-05	8260
0.0484	-0.04351	-0.04323	9.1E-05	16500
0.0726	-0.03952	-0.03802	0.000109	24700
0.0968	-0.03556	-0.03309	0.000114	33000
0.121	-0.03163	-0.02843	0.000109	41300
0.1452	-0.02772	-0.02404	9.68E-05	49500
0.1694	-0.02385	-0.0199	8.04E-05	57800
0.1936	-0.01999	-0.01601	6.2E-05	66100
0.2178	-0.01616	-0.01234	4.34E-05	74300
0.242	-0.01236	-0.00888	2.66E-05	82600
0.2662	-0.00858	-0.005601	1.28E-05	90900
0.2904	-0.00481	-0.00249	3.48E-06	99100
0.3146	-0.00106	0.00048	-1.6E-07	107000
0.3388	0.00268	0.00334	3.03E-06	115000
0.363	0.00641	0.00611	1.42E-05	123000
0.3872	0.01012	0.0088	3.45E-05	132000
0.4114	0.01384	0.01145	6.52E-05	140000
0.4356	0.01755	0.01407	0.000108	148000
0.4598	0.02127	0.01668	0.000163	157000
0.484	0.02498	0.01928	0.000233	165000

B= 0.0254 m
delta Z= 0.0242 m

by Simpson's rule:

INT= 3.16E-05 m^4

w(b)= 0.05157 m
w(a)= 0.008047 m
delta nh= (w(b)-w(a))/INT
delta nh= 1370 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8670 kN/m^3

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Table F76
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Mi=0.011kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00153	-0.04666	0	0
0.0264	-0.00141	-0.04117	1.53E-06	9160
0.0528	-0.00129	. -0.03601	2.45E-06	18300
0.0792	-0.00117	-0.03119	2.89E-06	27500
0.1056	-0.00106	-0.0267	2.99E-06	36600
0.132	-0.00094	-0.02254	2.8E-06	45800
0.1584	-0.00082	-0.01869	2.43E-06	55000
0.1848	-0.00071	-0.01514	1.99E-06	64100
0.2112	-0.00059	-0.01187	1.48E-06	73300
0.2376	-0.00048	-0.00887	1.01E-06	82500
0.264	-0.00037	-0.00611	5.97E-07	91600
0.2904	-0.00025	-0.00357	2.59E-07	100000
0.3168	-0.00014	-0.00122	5.41E-08	110000
0.3432	-0.00003	0.00097	-1E-08	119000
0.3696	0.00008	0.00303	8.96E-08	128000
0.396	0.00019	0.00498	3.75E-07	137000
0.4224	0.0003	0.00685	8.68E-07	146000
0.4488	0.00041	0.00867	1.6E-06	155000
0.4752	0.00052	0.01046	2.58E-06	165000
0.5016	0.00063	0.01223	3.86E-06	174000
0.528	0.00074	0.014	5.47E-06	183000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 8.6E-07 m^4

w(b)= 0.00153 m
w(a)= 0.000222 m
delta nh= (w(b)-w(a))/INT
delta nh= 1520 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 8820 kN/m^3}}$

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Table F77

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.0254 m
delta Z= 0.0264 m

	Mi=0.023kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00307	-0.04666	0	0
0.0264	-0.00282	-0.04117	3.07E-06	9120
0.0528	-0.00258	. -0.03601	4.91E-06	18200
0.0792	-0.00235	-0.03119	5.81E-06	27300
0.1056	-0.00211	-0.0267	5.95E-06	36500
0.132	-0.00188	-0.02254	5.59E-06	45600
0.1584	-0.00164	-0.01869	4.86E-06	54700
0.1848	-0.00141	-0.01514	3.94E-06	63900
0.2112	-0.00119	-0.01187	2.98E-06	73000
0.2376	-0.00096	-0.00887	2.02E-06	82100
0.264	-0.00073	-0.00611	1.18E-06	91200
0.2904	-0.00051	-0.00357	5.29E-07	100000
0.3168	-0.00028	-0.00122	1.08E-07	109000
0.3432	-0.00006	0.00097	-2E-08	118000
0.3696	0.00016	0.00303	1.79E-07	127000
0.396	0.00038	0.00498	7.49E-07	136000
0.4224	0.0006	0.00685	1.74E-06	146000
0.4488	0.00082	0.00867	3.19E-06	155000
0.4752	0.00104	0.01046	5.17E-06	164000
0.5016	0.00126	0.01223	7.73E-06	173000
0.528	0.00148	0.014	1.09E-05	182000

by Simpson's rule:

INT= 1.72E-06 m^4

w(b)= 0.00307 m
w(a)= 0.000518 m
delta nh= (w(b)-w(a))/INT
delta nh= 1480 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8780 kN/m^3

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Table F78

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.0254 m
delta Z= 0.0264 m

	Mi=0.034kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00459	-0.04666	0	0
0.0264	-0.00424	-0.04117	4.61E-06	9100
0.0528	-0.00388	. -0.03601	7.38E-06	18200
0.0792	-0.00352	-0.03119	8.7E-06	27300
0.1056	-0.00317	-0.0267	8.94E-06	36400
0.132	-0.00282	-0.02254	8.39E-06	45500
0.1584	-0.00247	-0.01869	7.31E-06	54600
0.1848	-0.00212	-0.01514	5.93E-06	63700
0.2112	-0.00178	-0.01187	4.46E-06	72800
0.2376	-0.00144	-0.00887	3.03E-06	81900
0.264	-0.00109	-0.00611	1.76E-06	91000
0.2904	-0.00076	-0.00357	7.88E-07	100000
0.3168	-0.00043	-0.00122	1.66E-07	109000
0.3432	-0.00009	0.00097	-3E-08	118000
0.3696	0.00024	0.00303	2.69E-07	127000
0.396	0.00057	0.00498	1.12E-06	136000
0.4224	0.0009	0.00685	2.6E-06	145000
0.4488	0.00123	0.00867	4.79E-06	154000
0.4752	0.00156	0.01046	7.75E-06	163000
0.5016	0.00189	0.01223	1.16E-05	173000
0.528	0.00222	0.014	1.64E-05	182000

by Simpson's rule:

INT= 2.58E-06 m^4

w(b)= 0.00459 m
w(a)= 0.000808 m
delta nh= (w(b)-w(a))/INT
delta nh= 1460 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh=	8760	kN/m^3

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Table F79

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Mi=0.045kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00614	-0.04666	0	0
0.0264	-0.00566	-0.04117	6.15E-06	9094
0.0528	-0.00518	-0.03601	9.85E-06	18100
0.0792	-0.0047	-0.03119	1.16E-05	27200
0.1056	-0.00423	-0.0267	1.19E-05	36300
0.132	-0.00376	-0.02254	1.12E-05	45400
0.1584	-0.00329	-0.01869	9.74E-06	54500
0.1848	-0.00283	-0.01514	7.92E-06	63600
0.2112	-0.00238	-0.01187	5.97E-06	72700
0.2376	-0.00192	-0.00887	4.05E-06	81800
0.264	-0.00147	-0.00611	2.37E-06	90900
0.2904	-0.00102	-0.00357	1.06E-06	100000
0.3168	-0.00057	-0.00122	2.2E-07	109000
0.3432	-0.00012	0.00097	-4E-08	118000
0.3696	0.00032	0.00303	3.58E-07	127000
0.396	0.00076	0.00498	1.5E-06	136000
0.4224	0.0012	0.00685	3.47E-06	145000
0.4488	0.00165	0.00867	6.42E-06	154000
0.4752	0.00209	0.01046	1.04E-05	163000
0.5016	0.00253	0.01223	1.55E-05	172000
0.528	0.00297	0.014	2.2E-05	181000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 3.45E-06 m^4

w(b)= 0.00614 m
w(a)= 0.001119 m
delta nh= (w(b)-w(a))/INT
delta nh= 1450 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8750 kN/m^3

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Table F80

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.0254 m
delta Z= 0.0264 m

	Mi=0.057kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00768	-0.04666	0	0
0.0264	-0.00707	-0.04117	7.68E-06	9090
0.0528	-0.00647	. -0.03601	1.23E-05	18100
0.0792	-0.00588	-0.03119	1.45E-05	27200
0.1056	-0.00529	-0.0267	1.49E-05	36300
0.132	-0.0047	-0.02254	1.4E-05	45400
0.1584	-0.00412	-0.01869	1.22E-05	54500
0.1848	-0.00354	-0.01514	9.9E-06	63600
0.2112	-0.00297	-0.01187	7.45E-06	72700
0.2376	-0.00239	-0.00887	5.04E-06	81800
0.264	-0.00183	-0.00611	2.95E-06	90900
0.2904	-0.00127	-0.00357	1.32E-06	100000
0.3168	-0.00071	-0.00122	2.74E-07	109000
0.3432	-0.00016	0.00097	-5.3E-08	118000
0.3696	0.00039	0.00303	4.37E-07	127000
0.396	0.00095	0.00498	1.87E-06	136000
0.4224	0.0015	0.00685	4.34E-06	145000
0.4488	0.00206	0.00867	8.02E-06	154000
0.4752	0.00261	0.01046	1.3E-05	163000
0.5016	0.00316	0.01223	1.94E-05	172000
0.528	0.00371	0.014	2.74E-05	181000

by Simpson's rule:

INT= 4.31E-06 m^4

w(b)= 0.00768 m
w(a)= 0.001425 m
delta nh= (w(b)-w(a))/INT
delta nh= 1450 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 8750 kN/m^3}}$

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Table F81

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Mi=0.068kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.00921	-0.04666	0	0
0.0264	-0.00848	-0.04117	9.22E-06	9084
0.0528	-0.00776	-0.03601	1.48E-05	18100
0.0792	-0.00705	-0.03119	1.74E-05	27200
0.1056	-0.00634	-0.0267	1.79E-05	36300
0.132	-0.00564	-0.02254	1.68E-05	45400
0.1584	-0.00494	-0.01869	1.46E-05	54500
0.1848	-0.00425	-0.01514	1.19E-05	63600
0.2112	-0.00356	-0.01187	8.92E-06	72700
0.2376	-0.00288	-0.00887	6.07E-06	81800
0.264	-0.0022	-0.00611	3.55E-06	90900
0.2904	-0.00153	-0.00357	1.59E-06	99900
0.3168	-0.00085	-0.00122	3.29E-07	109000
0.3432	-0.00019	0.00097	-6.3E-08	118000
0.3696	0.00048	0.00303	5.38E-07	127000
0.396	0.00114	0.00498	2.25E-06	136000
0.4224	0.0018	0.00685	5.21E-06	145000
0.4488	0.00247	0.00867	9.61E-06	154000
0.4752	0.00313	0.01046	1.56E-05	163000
0.5016	0.00379	0.01223	2.33E-05	172000
0.528	0.00445	0.014	3.29E-05	181000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 5.17E-06 m^4

w(b)= 0.00921 m
w(a)= 0.001728 m
delta nh= (w(b)-w(a))/INT
delta nh= 1440 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8740 kN/m^3

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Table F82

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Mi=0.079kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01074	-0.04666	0	0
0.0264	-0.00989	-0.04117	1.07E-05	9080
0.0528	-0.00906	-0.03601	1.72E-05	18100
0.0792	-0.00822	-0.03119	2.03E-05	27200
0.1056	-0.00739	-0.0267	2.08E-05	36300
0.132	-0.00658	-0.02254	1.96E-05	45400
0.1584	-0.00576	-0.01869	1.71E-05	54500
0.1848	-0.00496	-0.01514	1.39E-05	63500
0.2112	-0.00415	-0.01187	1.04E-05	72600
0.2376	-0.00336	-0.00887	7.08E-06	81700
0.264	-0.00257	-0.00611	4.15E-06	90800
0.2904	-0.00178	-0.00357	1.85E-06	99900
0.3168	-0.00099	-0.00122	3.83E-07	109000
0.3432	-0.00022	0.00097	-7.3E-08	118000
0.3696	0.00056	0.00303	6.27E-07	127000
0.396	0.00133	0.00498	2.62E-06	136000
0.4224	0.00211	0.00685	6.11E-06	145000
0.4488	0.00288	0.00867	1.12E-05	154000
0.4752	0.00365	0.01046	1.81E-05	163000
0.5016	0.00442	0.01223	2.71E-05	172000
0.528	0.00519	0.014	3.84E-05	181000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 6.03E-06 m^4

w(b)= 0.01074 m
w(a)= 0.002045 m
delta nh= (w(b)-w(a))/INT
delta nh= 1440 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8740 kN/m^3

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Table F83

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.0254 m
delta Z= 0.0264 m

	Mi=0.091kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01228	-0.04666	0	0
0.0264	-0.01131	-0.04117	1.23E-05	9080
0.0528	-0.01035	-0.03601	1.97E-05	18100
0.0792	-0.00939	-0.03119	2.32E-05	27200
0.1056	-0.00845	-0.0267	2.38E-05	36300
0.132	-0.00752	-0.02254	2.24E-05	45400
0.1584	-0.00659	-0.01869	1.95E-05	54500
0.1848	-0.00566	-0.01514	1.58E-05	63500
0.2112	-0.00475	-0.01187	1.19E-05	72600
0.2376	-0.00384	-0.00887	8.09E-06	81700
0.264	-0.00293	-0.00611	4.73E-06	90800
0.2904	-0.00203	-0.00357	2.1E-06	99900
0.3168	-0.00114	-0.00122	4.41E-07	109000
0.3432	-0.00025	0.00097	-8.3E-08	118000
0.3696	0.00064	0.00303	7.17E-07	127000
0.396	0.00152	0.00498	3E-06	136000
0.4224	0.00241	0.00685	6.97E-06	145000
0.4488	0.00329	0.00867	1.28E-05	154000
0.4752	0.00417	0.01046	2.07E-05	163000
0.5016	0.00505	0.01223	3.1E-05	172000
0.528	0.00593	0.014	4.38E-05	181000

by Simpson's rule:

INT= 6.89E-06 m^4

w(b)= 0.01228 m
w(a)= 0.002355 m
delta nh= (w(b)-w(a))/INT
delta nh= 1440 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8740 kN/m^3

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Table F84
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Mi=0.105kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01417	-0.04666	0	0
0.0264	-0.01306	-0.04117	1.42E-05	9080
0.0528	-0.01195	-0.03601	2.27E-05	18100
0.0792	-0.01085	-0.03119	2.68E-05	27200
0.1056	-0.00976	-0.0267	2.75E-05	36300
0.132	-0.00868	-0.02254	2.58E-05	45400
0.1584	-0.0076	-0.01869	2.25E-05	54400
0.1848	-0.00654	-0.01514	1.83E-05	63500
0.2112	-0.00548	-0.01187	1.37E-05	72600
0.2376	-0.00443	-0.00887	9.34E-06	81700
0.264	-0.00339	-0.00611	5.47E-06	90800
0.2904	-0.00235	-0.00357	2.44E-06	99800
0.3168	-0.00132	-0.00122	5.1E-07	108000
0.3432	-0.00029	0.00097	-9.7E-08	118000
0.3696	0.00074	0.00303	8.29E-07	127000
0.396	0.00176	0.00498	3.47E-06	136000
0.4224	0.00278	0.00685	8.04E-06	145000
0.4488	0.00379	0.00867	1.47E-05	154000
0.4752	0.00481	0.01046	2.39E-05	163000
0.5016	0.00583	0.01223	3.58E-05	172000
0.528	0.00684	0.014	5.06E-05	181000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 7.96E-06 m^4

w(b)= 0.01417 m
w(a)= 0.002736 m
delta nh= (w(b)-w(a))/INT
delta nh= 1430 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8730 kN/m^3

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Table F85

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.0254 m
delta Z= 0.0264 m

	Mi=0.119kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01609	-0.04666	0	0
0.0264	-0.01482	-0.04117	1.61E-05	9070
0.0528	-0.01356	-0.03601	2.58E-05	18100
0.0792	-0.01231	-0.03119	3.04E-05	27200
0.1056	-0.01108	-0.0267	3.12E-05	36300
0.132	-0.00985	-0.02254	2.93E-05	45300
0.1584	-0.00863	-0.01869	2.55E-05	54400
0.1848	-0.00742	-0.01514	2.08E-05	63500
0.2112	-0.00622	-0.01187	1.56E-05	72600
0.2376	-0.00503	-0.00887	1.06E-05	81700
0.264	-0.00384	-0.00611	6.19E-06	90700
0.2904	-0.00266	-0.00357	2.76E-06	99800
0.3168	-0.00149	-0.00122	5.76E-07	108000
0.3432	-0.00033	0.00097	-1.1E-07	118000
0.3696	0.00084	0.00303	9.41E-07	127000
0.396	0.00199	0.00498	3.92E-06	136000
0.4224	0.00315	0.00685	9.11E-06	145000
0.4488	0.00431	0.00867	1.68E-05	154000
0.4752	0.00546	0.01046	2.71E-05	163000
0.5016	0.00661	0.01223	4.05E-05	172000
0.528	0.00777	0.014	5.74E-05	181000

by Simpson's rule:

INT= 9.03E-06 m^4

w(b)= 0.01609 m
w(a)= 0.003125 m
delta nh= (w(b)-w(a))/INT
delta nh= 1430 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8730 kN/m^3

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Table F86

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Mi=0.133kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01799	-0.04666	0	0
0.0264	-0.01657	-0.04117	1.8E-05	9074
0.0528	-0.01516	-0.03601	2.88E-05	18100
0.0792	-0.01377	-0.03119	3.4E-05	27200
0.1056	-0.01238	-0.0267	3.49E-05	36300
0.132	-0.01101	-0.02254	3.28E-05	45369
0.1584	-0.00965	-0.01869	2.86E-05	54400
0.1848	-0.00829	-0.01514	2.32E-05	63500
0.2112	-0.00695	-0.01187	1.74E-05	72600
0.2376	-0.00562	-0.00887	1.18E-05	81700
0.264	-0.00429	-0.00611	6.92E-06	90700
0.2904	-0.00298	-0.00357	3.09E-06	99800
0.3168	-0.00167	-0.00122	6.45E-07	108000
0.3432	-0.00036	0.00097	-1.2E-07	118000
0.3696	0.00094	0.00303	1.05E-06	127000
0.396	0.00223	0.00498	4.4E-06	136000
0.4224	0.00352	0.00685	1.02E-05	145000
0.4488	0.00482	0.00867	1.88E-05	154000
0.4752	0.00611	0.01046	3.04E-05	163000
0.5016	0.00739	0.01223	4.53E-05	172000
0.528	0.00868	0.014	6.42E-05	181000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 1.01E-05 m^4

w(b)= 0.01799 m
w(a)= 0.003492 m
delta nh= (w(b)-w(a))/INT
delta nh= 1430 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8730 kN/m^3

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Table F87

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Mi=0.147kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.01988	-0.04666	0	0
0.0264	-0.01832	-0.04117	1.99E-05	9080
0.0528	-0.01676	-0.03601	3.19E-05	18100
0.0792	-0.01522	-0.03119	3.76E-05	27200
0.1056	-0.01369	-0.0267	3.86E-05	36300
0.132	-0.01217	-0.02254	3.62E-05	45400
0.1584	-0.01067	-0.01869	3.16E-05	54400
0.1848	-0.00917	-0.01514	2.57E-05	63500
0.2112	-0.00769	-0.01187	1.93E-05	72600
0.2376	-0.00622	-0.00887	1.31E-05	81700
0.264	-0.00475	-0.00611	7.66E-06	90800
0.2904	-0.00329	-0.00357	3.41E-06	99800
0.3168	-0.00185	-0.00122	7.15E-07	108000
0.3432	-0.0004	0.00097	-1.3E-07	118000
0.3696	0.00103	0.00303	1.15E-06	127000
0.396	0.00247	0.00498	4.87E-06	136000
0.4224	0.00389	0.00685	1.13E-05	145000
0.4488	0.00532	0.00867	2.07E-05	154000
0.4752	0.00675	0.01046	3.36E-05	163000
0.5016	0.00818	0.01223	5.02E-05	172000
0.528	0.0096	0.014	7.1E-05	181000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 1.12E-05 m^4

w(b)= 0.01988 m
w(a)= 0.003839 m
delta nh= (w(b)-w(a))/INT
delta nh= 1430 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8730 kN/m^3

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Table F88

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.254 m
delta Z= 0.0264 m

	Mi=0.161kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02178	-0.04666	0	0
0.0264	-0.02007	-0.04117	2.18E-05	9070
0.0528	-0.01836	. -0.03601	3.49E-05	18100
0.0792	-0.01668	-0.03119	4.12E-05	27200
0.1056	-0.01499	-0.0267	4.23E-05	36300
0.132	-0.01334	-0.02254	3.97E-05	45400
0.1584	-0.01169	-0.01869	3.46E-05	54400
0.1848	-0.01005	-0.01514	2.81E-05	63500
0.2112	-0.00842	-0.01187	2.11E-05	72600
0.2376	-0.00681	-0.00887	1.44E-05	81700
0.264	-0.0052	-0.00611	8.39E-06	90800
0.2904	-0.00361	-0.00357	3.74E-06	99800
0.3168	-0.00202	-0.00122	7.81E-07	108000
0.3432	-0.00044	0.00097	-1.5E-07	118000
0.3696	0.00113	0.00303	1.27E-06	127000
0.396	0.0027	0.00498	5.32E-06	136000
0.4224	0.00427	0.00685	1.24E-05	145000
0.4488	0.00583	0.00867	2.27E-05	154000
0.4752	0.00739	0.01046	3.67E-05	163000
0.5016	0.00896	0.01223	5.5E-05	172000
0.528	0.01052	0.014	7.78E-05	181000

by Simpson's rule:

INT= 1.22E-05 m^4

w(b)= 0.02178 m
w(a)= 0.004195 m
delta nh= (w(b)-w(a))/INT
delta nh= 1430 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8730 kN/m^3

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Table F89

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4

LINEAR PART

PILE LENGTH=0.528m

	Mi=0.175kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02369	-0.04666	0	0
0.0264	-0.02183	-0.04117	2.37E-05	9080
0.0528	-0.01998	. -0.03601	3.8E-05	18100
0.0792	-0.01814	-0.03119	4.48E-05	27200
0.1056	-0.01632	-0.0267	4.6E-05	36300
0.132	-0.01451	-0.02254	4.32E-05	45400
0.1584	-0.01271	-0.01869	3.76E-05	54500
0.1848	-0.01093	-0.01514	3.06E-05	63500
0.2112	-0.00916	-0.01187	2.3E-05	72600
0.2376	-0.00741	-0.00887	1.56E-05	81700
0.264	-0.00566	-0.00611	9.13E-06	90800
0.2904	-0.00393	-0.00357	4.07E-06	99900
0.3168	-0.00219	-0.00122	8.46E-07	109000
0.3432	-0.00048	0.00097	-1.6E-07	118000
0.3696	0.00123	0.00303	1.38E-06	127000
0.396	0.00294	0.00498	5.8E-06	136000
0.4224	0.00464	0.00685	1.34E-05	145000
0.4488	0.00635	0.00867	2.47E-05	154000
0.4752	0.00804	0.01046	4E-05	163000
0.5016	0.00974	0.01223	5.98E-05	172000
0.528	0.01144	0.014	8.46E-05	181000

B= 0.0254 m

delta Z= 0.0264 m

<u>by Simpson's rule:</u>

INT= 1.33E-05 m^4

w(b)= 0.02369 m

w(a)= 0.004518 m

delta nh= (w(b)-w(a))/INT

delta nh= 1440 kN/m^3

nh(initial)= 7300kN/m^3

nh= nh(initial)+delta nh

nh= 8740 kN/m^3

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Table F90

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Mi=0.189kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02559	-0.04666	0	0
0.0264	-0.02358	-0.04117	2.56E-05	9080
0.0528	-0.02158	. -0.03601	4.1E-05	18100
0.0792	-0.01959	-0.03119	4.84E-05	27200
0.1056	-0.01762	-0.0267	4.97E-05	36300
0.132	-0.01567	-0.02254	4.66E-05	45400
0.1584	-0.01373	-0.01869	4.06E-05	54500
0.1848	-0.01181	-0.01514	3.3E-05	63600
0.2112	-0.00989	-0.01187	2.48E-05	72700
0.2376	-0.00799	-0.00887	1.68E-05	81700
0.264	-0.00611	-0.00611	9.86E-06	90800
0.2904	-0.00424	-0.00357	4.4E-06	99900
0.3168	-0.00237	-0.00122	9.16E-07	10900
0.3432	-0.00052	0.00097	-1.7E-07	118000
0.3696	0.00133	0.00303	1.49E-06	127000
0.396	0.00318	0.00498	6.27E-06	136000
0.4224	0.00502	0.00685	1.45E-05	145000
0.4488	0.00685	0.00867	2.67E-05	154000
0.4752	0.00869	0.01046	4.32E-05	163000
0.5016	0.01052	0.01223	6.45E-05	172000
0.528	0.01236	0.014	9.14E-05	181000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 1.44E-05 m^4

w(b)= 0.02559 m
w(a)= 0.004843 m
delta nh= (w(b)-w(a))/INT
delta nh= 1440 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8740 kN/m^3

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Table F91
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Mi=0.211kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.02866	-0.04666	0	0
0.0264	-0.0264	-0.04117	2.87E-05	9090
0.0528	-0.02416	-0.03601	4.59E-05	18100
0.0792	-0.02194	-0.03119	5.42E-05	27200
0.1056	-0.01974	-0.0267	5.57E-05	36300
0.132	-0.01755	-0.02254	5.22E-05	45400
0.1584	-0.01538	-0.01869	4.55E-05	54500
0.1848	-0.01322	-0.01514	3.7E-05	63600
0.2112	-0.01108	-0.01187	2.78E-05	72700
0.2376	-0.00896	-0.00887	1.89E-05	81800
0.264	-0.00685	-0.00611	1.1E-05	90900
0.2904	-0.00475	-0.00357	4.92E-06	100000
0.3168	-0.00266	-0.00122	1.03E-06	109000
0.3432	-0.00058	0.00097	-1.9E-07	118000
0.3696	0.00149	0.00303	1.67E-06	127000
0.396	0.00356	0.00498	7.02E-06	136000
0.4224	0.00562	0.00685	1.63E-05	145000
0.4488	0.00767	0.00867	2.98E-05	154000
0.4752	0.00973	0.01046	4.84E-05	163000
0.5016	0.01178	0.01223	7.23E-05	172000
0.528	0.01384	0.014	0.000102	181000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 1.61E-05 m^4

w(b)= 0.02866 m
w(a)= 0.005375 m
delta nh= (w(b)-w(a))/INT
delta nh= 1440 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8740 kN/m^3

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Table F92
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Mi=0.234kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.03173	-0.04666	0	0
0.0264	-0.02923	-0.04117	3.18E-05	9090
0.0528	-0.02675	-0.03601	5.09E-05	18100
0.0792	-0.02429	-0.03119	6E-05	27200
0.1056	-0.02185	-0.0267	6.16E-05	36300
0.132	-0.01942	-0.02254	5.78E-05	45400
0.1584	-0.01702	-0.01869	5.04E-05	54500
0.1848	-0.01464	-0.01514	4.1E-05	63600
0.2112	-0.01227	-0.01187	3.08E-05	72700
0.2376	-0.00992	-0.00887	2.09E-05	81800
0.264	-0.00758	-0.00611	1.22E-05	90900
0.2904	-0.00526	-0.00357	5.45E-06	100000
0.3168	-0.00294	-0.00122	1.14E-06	109000
0.3432	-0.00064	0.00097	-2.1E-07	118000
0.3696	0.00165	0.00303	1.85E-06	127000
0.396	0.00394	0.00498	7.77E-06	136000
0.4224	0.00622	0.00685	1.8E-05	145000
0.4488	0.00849	0.00867	3.3E-05	154000
0.4752	0.01077	0.01046	5.35E-05	163000
0.5016	0.01304	0.01223	8E-05	172000
0.528	0.01532	0.014	0.000113	181000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 1.78E-05 m^4

w(b)= 0.03173 m
w(a)= 0.00584 m
delta nh= (w(b)-w(a))/INT
delta nh= 1450 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8750 kN/m^3

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Table F93

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Mi=0.257kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.03481	-0.04666	0	0
0.0264	-0.03206	-0.04117	3.48E-05	9100
0.0528	-0.02934	-0.03601	5.58E-05	18200
0.0792	-0.02664	-0.03119	6.58E-05	27300
0.1056	-0.02397	-0.0267	6.76E-05	36400
0.132	-0.02131	-0.02254	6.34E-05	45500
0.1584	-0.01867	-0.01869	5.53E-05	54600
0.1848	-0.01606	-0.01514	4.49E-05	63700
0.2112	-0.01346	-0.01187	3.37E-05	72800
0.2376	-0.01088	-0.00887	2.29E-05	81900
0.264	-0.00831	-0.00611	1.34E-05	91000
0.2904	-0.00577	-0.00357	5.98E-06	100000
0.3168	-0.00323	-0.00122	1.25E-06	109000
0.3432	-0.00071	0.00097	-2.4E-07	118000
0.3696	0.00181	0.00303	2.03E-06	127000
0.396	0.00432	0.00498	8.52E-06	136000
0.4224	0.00682	0.00685	1.97E-05	145000
0.4488	0.00932	0.00867	3.63E-05	154000
0.4752	0.01182	0.01046	5.88E-05	163000
0.5016	0.01431	0.01223	8.78E-05	172000
0.528	0.01681	0.014	0.000124	182000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 1.95E-05 m^4

w(b)= 0.03481 m
w(a)= 0.006331 m
delta nh= (w(b)-w(a))/INT
delta nh= 1450 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8750 kN/m^3

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Table F94

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Mi=0.279kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.03787	-0.04666	0	0
0.0264	-0.03489	-0.04117	3.79E-05	9100
0.0528	-0.03193	. -0.03601	6.07E-05	18200
0.0792	-0.02899	-0.03119	7.16E-05	27300
0.1056	-0.02608	-0.0267	7.35E-05	36400
0.132	-0.02319	-0.02254	6.9E-05	45500
0.1584	-0.02032	-0.01869	6.02E-05	54600
0.1848	-0.01747	-0.01514	4.89E-05	63700
0.2112	-0.01464	-0.01187	3.67E-05	72800
0.2376	-0.01184	-0.00887	2.5E-05	81900
0.264	-0.00905	-0.00611	1.46E-05	91000
0.2904	-0.00627	-0.00357	6.5E-06	100000
0.3168	-0.00351	-0.00122	1.36E-06	109000
0.3432	-0.00077	0.00097	-2.6E-07	118000
0.3696	0.00197	0.00303	2.21E-06	127000
0.396	0.00469	0.00498	9.25E-06	136000
0.4224	0.00742	0.00685	2.15E-05	145000
0.4488	0.01014	0.00867	3.95E-05	154000
0.4752	0.01286	0.01046	6.39E-05	163000
0.5016	0.01557	0.01223	9.55E-05	173000
0.528	0.01829	0.014	0.000135	182000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 2.13E-05 m^4

w(b)= 0.03787 m
w(a)= 0.006783 m
delta nh= (w(b)-w(a))/INT
delta nh= 1460 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8760 kN/m^3

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Table F95

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

	Mi=0.302kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.04094	-0.04666	0	0
0.0264	-0.03771	-0.04117	4.1E-05	9110
0.0528	-0.03451	. -0.03601	6.56E-05	18200
0.0792	-0.03134	-0.03119	7.74E-05	27300
0.1056	-0.02819	-0.0267	7.95E-05	36400
0.132	-0.02506	-0.02254	7.46E-05	45500
0.1584	-0.02196	-0.01869	6.5E-05	54600
0.1848	-0.01888	-0.01514	5.28E-05	63700
0.2112	-0.01583	-0.01187	3.97E-05	72800
0.2376	-0.01279	-0.00887	2.7E-05	82000
0.264	-0.00978	-0.00611	1.58E-05	91100
0.2904	-0.00678	-0.00357	7.03E-06	100000
0.3168	-0.00379	-0.00122	1.46E-06	109000
0.3432	-0.00083	0.00097	-2.8E-07	118000
0.3696	0.00213	0.00303	2.39E-06	127000
0.396	0.00508	0.00498	1E-05	136000
0.4224	0.00802	0.00685	2.32E-05	145000
0.4488	0.01096	0.00867	4.26E-05	154000
0.4752	0.01389	0.01046	6.9E-05	164000
0.5016	0.01683	0.01223	0.000103	173000
0.528	0.01977	0.014	0.000146	182000

B= 0.0254 m
delta Z= 0.0264 m

by Simpson's rule:

INT= 2.3E-05 m^4

w(b)= 0.04094 m
w(a)= 0.007227 m
delta nh= (w(b)-w(a))/INT
delta nh= 1460 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8760 kN/m^3

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Table F96

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.0254 m
delta Z= 0.0264 m

	Mi=0.324kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.044	-0.04666	0	0
0.0264	-0.04053	-0.04117	4.41E-05	9110
0.0528	-0.03709	. -0.03601	7.05E-05	18200
0.0792	-0.03368	-0.03119	8.32E-05	27300
0.1056	-0.03029	-0.0267	8.54E-05	36400
0.132	-0.02694	-0.02254	8.02E-05	45500
0.1584	-0.02361	-0.01869	6.99E-05	54700
0.1848	-0.02029	-0.01514	5.68E-05	63800
0.2112	-0.01701	-0.01187	4.26E-05	72900
0.2376	-0.01375	-0.00887	2.9E-05	82000
0.264	-0.01051	-0.00611	1.7E-05	91100
0.2904	-0.00729	-0.00357	7.56E-06	100000
0.3168	-0.00408	-0.00122	1.58E-06	109000
0.3432	-0.00089	0.00097	-3E-07	118000
0.3696	0.00229	0.00303	2.56E-06	127000
0.396	0.00546	0.00498	1.08E-05	136000
0.4224	0.00862	0.00685	2.49E-05	145000
0.4488	0.01178	0.00867	4.58E-05	154000
0.4752	0.01494	0.01046	7.43E-05	164000
0.5016	0.01809	0.01223	0.000111	173000
0.528	0.02125	0.014	0.000157	182000

by Simpson's rule:

INT= 2.47E-05 m^4

w(b)= 0.044 m
w(a)= 0.007636 m
delta nh= (w(b)-w(a))/INT
delta nh= 1470 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

$\boxed{\textbf{nh= 8770 kN/m^3}}$

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Table F97
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN SANDY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.528m

B= 0.0254 m
delta Z= 0.0264 m

	Mi=0.349kNm	M=1.000kNm		
z (m)	w (m)	w(ad) (m)	z w w(ad)	kh (kN/m^2)
0	-0.04738	-0.04666	0	0
0.0264	-0.04365	-0.04117	4.74E-05	9100
0.0528	-0.03994	-0.03601	7.59E-05	18200
0.0792	-0.03627	-0.03119	8.96E-05	27300
0.1056	-0.03262	-0.0267	9.2E-05	36400
0.132	-0.02901	-0.02254	8.63E-05	45500
0.1584	-0.02542	-0.01869	7.53E-05	54600
0.1848	-0.02186	-0.01514	6.12E-05	63700
0.2112	-0.01832	-0.01187	4.59E-05	72800
0.2376	-0.01481	-0.00887	3.12E-05	81900
0.264	-0.01132	-0.00611	1.83E-05	91000
0.2904	-0.00785	-0.00357	8.14E-06	100000
0.3168	-0.0439	-0.00122	1.7E-05	109000
0.3432	-0.00096	0.00097	-3.2E-07	118000
0.3696	0.00246	0.00303	2.75E-06	127000
0.396	0.00588	0.00498	1.16E-05	136000
0.4224	0.00929	0.00685	2.69E-05	145000
0.4488	0.01269	0.00867	4.94E-05	154000
0.4752	0.01608	0.01046	7.99E-05	163000
0.5016	0.01948	0.01223	0.00012	173000
0.528	0.02288	0.014	0.000169	182000

by Simpson's rule:

INT= 2.69E-05 m^4

w(b)= 0.04738 m
w(a)= 0.008063 m
delta nh= (w(b)-w(a))/INT
delta nh= 1460 kN/m^3

nh(initial)= 7300kN/m^3
nh= nh(initial)+delta nh

nh= 8760 kN/m^3

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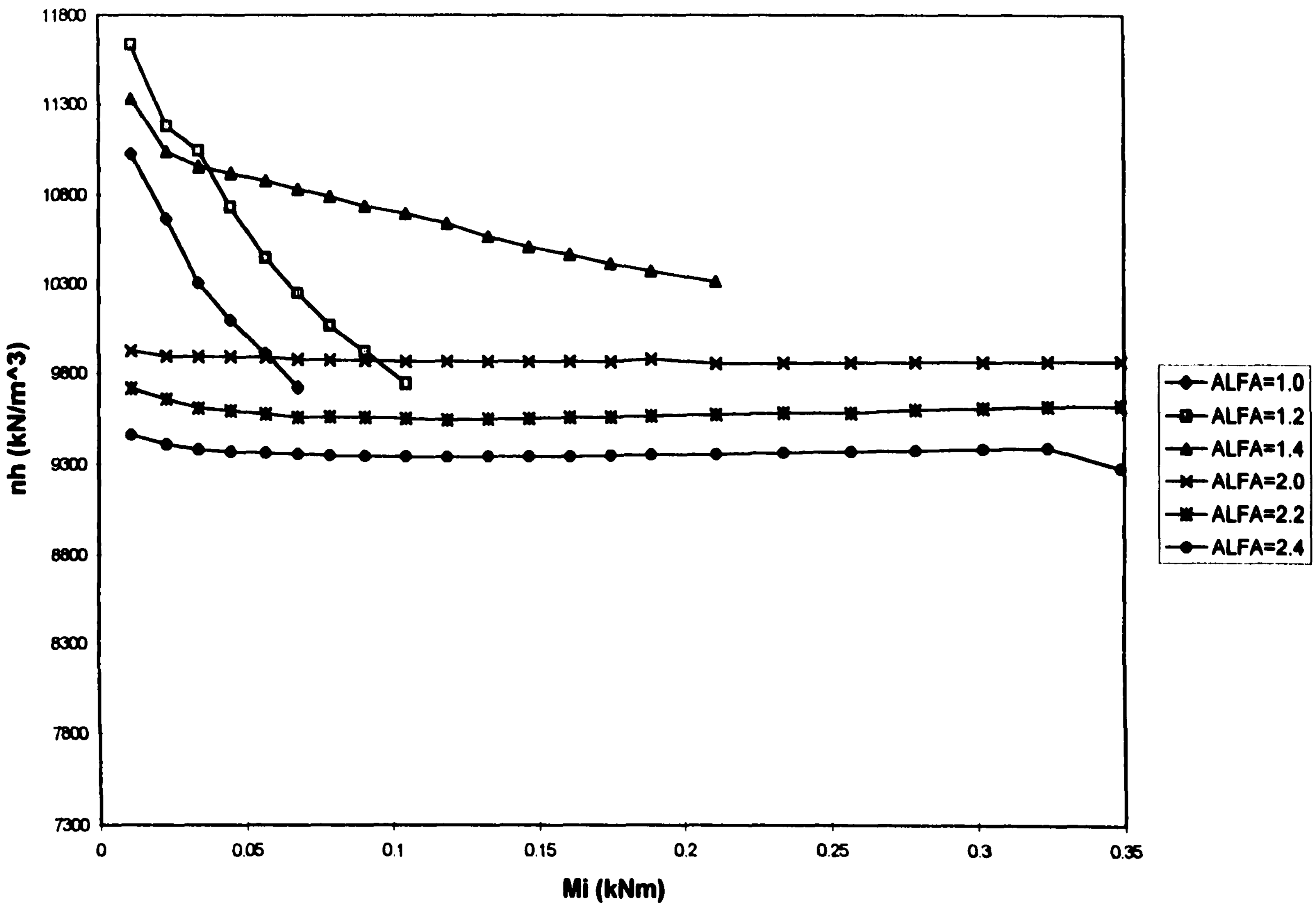

Figure F1. Bending Moment vs nh for Piles Embedded in Sandy Soil Subjected to Bending Moments

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APPENDIX G

Numerical Analysis for Piles Embedded in Clayey Soil Subjected to Horizontal Forces

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Table G1

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Pi=0.045kN	P=1.000 kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.002214	-0.0497	0.00011
0.018	-0.002046	-0.04593	9.4E-05
0.036	-0.001878	. -0.04217	7.92E-05
0.054	-0.00171	-0.0384	6.57E-05
0.072	-0.001543	-0.03465	5.35E-05
0.09	-0.001376	-0.0309	4.25E-05
0.108	-0.001209	-0.02715	3.28E-05
0.126	-0.001043	-0.02342	2.44E-05
0.144	-0.000877	-0.0197	1.73E-05
0.162	-0.000712	-0.01598	1.14E-05
0.18	-0.000546	-0.01227	6.7E-06
0.198	-0.000381	-0.00857	3.27E-06
0.216	-0.000217	-0.00487	1.06E-06
0.234	-0.000052	-0.00118	6.14E-08
0.252	0.000112	0.00251	2.81E-07
0.27	0.000276	0.00619	1.71E-06
0.288	0.000439	0.00987	4.33E-06
0.306	0.000604	0.01355	8.18E-06
0.324	0.000767	0.01723	1.32E-05
0.342	0.000931	0.02091	1.95E-05
0.36	0.001095	0.02458	2.69E-05

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 9.82E-06 m^3

w(b)= 0.002214 m
w(a)= 0.000573 m
delta kh= (w(b)-w(a))/INT
delta kh= 167 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\textbf{kh= 392 kN/m^2}}$

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Table G2

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Pi=0.089kN	P=1.000 kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.004428	-0.0497	0.00022
0.018	-0.004092	-0.04593	0.000188
0.036	-0.003756	-0.04217	0.000158
0.054	-0.003421	-0.0384	0.000131
0.072	-0.003086	-0.03465	0.000107
0.09	-0.002752	-0.0309	8.5E-05
0.108	-0.002419	-0.02715	6.57E-05
0.126	-0.002086	-0.02342	4.89E-05
0.144	-0.001754	-0.0197	3.46E-05
0.162	-0.001423	-0.01598	2.27E-05
0.18	-0.001093	-0.01227	1.34E-05
0.198	-0.000763	-0.00857	6.54E-06
0.216	-0.000434	-0.00487	2.11E-06
0.234	-0.000105	-0.00118	1.24E-07
0.252	0.000224	0.00251	5.62E-07
0.27	0.000552	0.00619	3.42E-06
0.288	0.000879	0.00987	8.68E-06
0.306	0.001207	0.01355	1.64E-05
0.324	0.001535	0.01723	2.64E-05
0.342	0.001862	0.02091	3.89E-05
0.36	0.002189	0.02458	5.38E-05

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 1.96E-05 m^3

w(b)= 0.004428 m
w(a)= 0.001915 m
delta kh= (w(b)-w(a))/INT
delta kh= 128 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 353 kN/m^2

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Table G3

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Pi=0.134kN	P=1.000 kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.006641	-0.0497	0.00033
0.018	-0.006138	-0.04593	0.000282
0.036	-0.005634	. -0.04217	0.000238
0.054	-0.005131	-0.0384	0.000197
0.072	-0.004629	-0.03465	0.00016
0.09	-0.004128	-0.0309	0.000128
0.108	-0.003628	-0.02715	9.85E-05
0.126	-0.003129	-0.02342	7.33E-05
0.144	-0.002632	-0.0197	5.19E-05
0.162	-0.002135	-0.01598	3.41E-05
0.18	-0.001639	-0.01227	2.01E-05
0.198	-0.001144	-0.00857	9.8E-06
0.216	-0.000651	-0.00487	3.17E-06
0.234	-0.000157	-0.00118	1.85E-07
0.252	0.000335	0.00251	8.41E-07
0.27	0.000827	0.00619	5.12E-06
0.288	0.001319	0.00987	1.3E-05
0.306	0.001811	0.01355	2.45E-05
0.324	0.002302	0.01723	3.97E-05
0.342	0.002793	0.02091	5.84E-05
0.36	0.003285	0.02458	8.07E-05

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 2.95E-05 m^3

w(b)= 0.006641 m
w(a)= 0.0035 m
delta kh= (w(b)-w(a))/INT
delta kh= 107 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 332 kN/m^2

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Table G4

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Pi=0.178kN	P=1.000 kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.008855	-0.0497	0.00044
0.018	-0.008184	-0.04593	0.000376
0.036	-0.007512	. -0.04217	0.000317
0.054	-0.006842	-0.0384	0.000263
0.072	-0.006173	-0.03465	0.000214
0.09	-0.005504	-0.0309	0.00017
0.108	-0.004838	-0.02715	0.000131
0.126	-0.004173	-0.02342	9.77E-05
0.144	-0.003509	-0.0197	6.91E-05
0.162	-0.002847	-0.01598	4.55E-05
0.18	-0.002186	-0.01227	2.68E-05
0.198	-0.001526	-0.00857	1.31E-05
0.216	-0.000867	-0.00487	4.22E-06
0.234	-0.000209	-0.00118	2.47E-07
0.252	0.000447	0.00251	1.12E-06
0.27	0.001103	0.00619	6.83E-06
0.288	0.001759	0.00987	1.74E-05
0.306	0.002414	0.01355	3.27E-05
0.324	0.003069	0.01723	5.29E-05
0.342	0.003725	0.02091	7.79E-05
0.36	0.004379	0.02458	0.000108

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 3.93E-05 m^3

w(b)= 0.008855 m
w(a)= 0.00555 m
delta kh= (w(b)-w(a))/INT
delta kh= 84 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 309 kN/m^2

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Table G5

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Pi=0.223kN	P=1.000 kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.011069	-0.0497	0.00055
0.018	-0.010229	-0.04593	0.00047
0.036	-0.00939	-0.04217	0.000396
0.054	-0.008552	-0.0384	0.000328
0.072	-0.007716	-0.03465	0.000267
0.09	-0.006881	-0.0309	0.000213
0.108	-0.006047	-0.02715	0.000164
0.126	-0.005216	-0.02342	0.000122
0.144	-0.004386	-0.0197	8.64E-05
0.162	-0.003558	-0.01598	5.69E-05
0.18	-0.002732	-0.01227	3.35E-05
0.198	-0.001907	-0.00857	1.63E-05
0.216	-0.001084	-0.00487	5.28E-06
0.234	-0.000262	-0.00118	3.09E-07
0.252	0.000559	0.00251	1.4E-06
0.27	0.001379	0.00619	8.54E-06
0.288	0.002199	0.00987	2.17E-05
0.306	0.003018	0.01355	4.09E-05
0.324	0.003837	0.01723	6.61E-05
0.342	0.004656	0.02091	9.74E-05
0.36	0.005475	0.02458	0.000135

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 4.91E-05 m^3

w(b)= 0.011069 m
w(a)= 0.008405 m
delta kh= (w(b)-w(a))/INT
delta kh= 54 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 279 kN/m^2

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Table G6

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Pi=0.267kN	P=1.000 kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.013283	-0.0497	0.00066
0.018	-0.012275	-0.04593	0.000564
0.036	-0.011268	. -0.04217	0.000475
0.054	-0.010263	-0.0384	0.000394
0.072	-0.009259	-0.03465	0.000321
0.09	-0.008257	-0.0309	0.000255
0.108	-0.007257	-0.02715	0.000197
0.126	-0.006259	-0.02342	0.000147
0.144	-0.005263	-0.0197	0.000104
0.162	-0.004269	-0.01598	6.82E-05
0.18	-0.003278	-0.01227	4.02E-05
0.198	-0.002289	-0.00857	1.96E-05
0.216	-0.001301	-0.00487	6.34E-06
0.234	-0.000315	-0.00118	3.72E-07
0.252	0.000671	0.00251	1.68E-06
0.27	0.001655	0.00619	1.02E-05
0.288	0.002638	0.00987	2.6E-05
0.306	0.003622	0.01355	4.91E-05
0.324	0.004604	0.01723	7.93E-05
0.342	0.005587	0.02091	0.000117
0.36	0.006569	0.02458	0.000161

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 5.89E-05 m^3

w(b)= 0.013283 m
w(a)= 0.01189 m
delta kh= (w(b)-w(a))/INT
delta kh= 24 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 249 kN/m^2

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Table G7

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Pi=0.312kN	P=1.000 kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.015497	-0.0497	0.00077
0.018	-0.014321	-0.04593	0.000658
0.036	-0.013147	.-0.04217	0.000554
0.054	-0.011973	-0.0384	0.00046
0.072	-0.010802	-0.03465	0.000374
0.09	-0.0096328	-0.0309	0.000298
0.108	-0.0084662	-0.02715	0.00023
0.126	-0.007302	-0.02342	0.000171
0.144	-0.006141	-0.0197	0.000121
0.162	-0.004982	-0.01598	7.96E-05
0.18	-0.003825	-0.01227	4.69E-05
0.198	-0.00267	-0.00857	2.29E-05
0.216	-0.001518	-0.00487	7.39E-06
0.234	-0.000367	-0.00118	4.33E-07
0.252	0.000782	0.00251	1.96E-06
0.27	0.00193	0.00619	1.19E-05
0.288	0.003078	0.00987	3.04E-05
0.306	0.004225	0.01355	5.72E-05
0.324	0.005372	0.01723	9.26E-05
0.342	0.006518	0.02091	0.000136
0.36	0.007665	0.02458	0.000188

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 6.87E-05 m^3

w(b)= 0.015497 m
w(a)= 0.016217 m
delta kh= (w(b)-w(a))/INT
delta kh= -10 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\text{kh= 215 kN/m^2}}$

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Table G8
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Pi=0.045kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.001853	-0.04161	7.71E-05
0.0216	-0.001711	-0.03842	6.57E-05
0.0432	-0.001569	-0.03523	5.53E-05
0.0648	-0.001427	-0.03205	4.57E-05
0.0864	-0.001286	-0.02888	3.71E-05
0.108	-0.001145	-0.02572	2.94E-05
0.1296	-0.001005	-0.02257	2.27E-05
0.1512	-0.000866	-0.01944	1.68E-05
0.1728	-0.000727	-0.01632	1.19E-05
0.1944	-0.000589	-0.01322	7.79E-06
0.216	-0.000451	-0.01013	4.57E-06
0.2376	-0.000314	-0.00705	2.21E-06
0.2592	-0.000177	-0.00398	7.04E-07
0.2808	-0.000041	-0.00093	3.81E-08
0.3024	0.000095	0.00212	2.01E-07
0.324	0.00023	0.00517	1.19E-06
0.3456	0.000366	0.00821	3E-06
0.3672	0.000501	0.01124	5.63E-06
0.3888	0.000636	0.01428	9.08E-06
0.4104	0.000771	0.01731	1.33E-05
0.432	0.000906	0.02035	1.84E-05

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 8.18E-06 m^3

w(b)= 0.001853 m
w(a)= 0.000354 m
delta kh= (w(b)-w(a))/INT
delta kh= 183 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**408**	**kN/m^2**

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Table G9
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Pi=0.089kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.003707	-0.04161	0.000154
0.0216	-0.003422	-0.03842	0.000131
0.0432	-0.003138	. -0.03523	0.000111
0.0648	-0.002855	-0.03205	9.15E-05
0.0864	-0.002572	-0.02888	7.43E-05
0.108	-0.002291	-0.02572	5.89E-05
0.1296	-0.002011	-0.02257	4.54E-05
0.1512	-0.001732	-0.01944	3.37E-05
0.1728	-0.001454	-0.01632	2.37E-05
0.1944	-0.001178	-0.01322	1.56E-05
0.216	-0.000902	-0.01013	9.14E-06
0.2376	-0.000628	-0.00705	4.43E-06
0.2592	-0.000355	-0.00398	1.41E-06
0.2808	-0.000083	-0.00093	7.72E-08
0.3024	0.000189	0.00212	4.01E-07
0.324	0.00046	0.00517	2.38E-06
0.3456	0.000731	0.00821	6E-06
0.3672	0.001002	0.01124	1.13E-05
0.3888	0.001272	0.01428	1.82E-05
0.4104	0.001542	0.01731	2.67E-05
0.432	0.001812	0.02035	3.69E-05

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 1.64E-05 m^3

w(b)= 0.003707 m
w(a)= 0.001118 m
delta kh= (w(b)-w(a))/INT
delta kh= 158 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 383 kN/m^2

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Table G10

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Pi=0.134kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.00556	-0.04161	0.000231
0.0216	-0.005133	-0.03842	0.000197
0.0432	-0.004707	-0.03523	0.000166
0.0648	-0.004282	-0.03205	0.000137
0.0864	-0.003858	-0.02888	0.000111
0.108	-0.003436	-0.02572	8.84E-05
0.1296	-0.003016	-0.02257	6.81E-05
0.1512	-0.002598	-0.01944	5.05E-05
0.1728	-0.002181	-0.01632	3.56E-05
0.1944	-0.001766	-0.01322	2.33E-05
0.216	-0.001354	-0.01013	1.37E-05
0.2376	-0.000942	-0.00705	6.64E-06
0.2592	-0.000532	-0.00398	2.12E-06
0.2808	-0.000124	-0.00093	1.15E-07
0.3024	0.000284	0.00212	6.02E-07
0.324	0.00069	0.00517	3.57E-06
0.3456	0.001097	0.00821	9.01E-06
0.3672	0.001502	0.01124	1.69E-05
0.3888	0.001908	0.01428	2.72E-05
0.4104	0.002313	0.01731	4E-05
0.432	0.002719	0.02035	5.53E-05

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 2.45E-05 m^3

w(b)= 0.00556 m
w(a)= 0.002029 m
delta kh= (w(b)-w(a))/INT
delta kh= 144 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 369 kN/m^2

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Table G11

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Pi=0.178kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.007414	-0.04161	0.000308
0.0216	-0.006844	-0.03842	0.000263
0.0432	-0.006276	-0.03523	0.000221
0.0648	-0.005709	-0.03205	0.000183
0.0864	-0.005144	-0.02888	0.000149
0.108	-0.004582	-0.02572	0.000118
0.1296	-0.004021	-0.02257	9.08E-05
0.1512	-0.003463	-0.01944	6.73E-05
0.1728	-0.002908	-0.01632	4.75E-05
0.1944	-0.002355	-0.01322	3.11E-05
0.216	-0.001805	-0.01013	1.83E-05
0.2376	-0.001256	-0.00705	8.85E-06
0.2592	-0.000709	-0.00398	2.82E-06
0.2808	-0.000165	-0.00093	1.53E-07
0.3024	0.000378	0.00212	8.01E-07
0.324	0.000921	0.00517	4.76E-06
0.3456	0.001462	0.00821	1.2E-05
0.3672	0.002003	0.01124	2.25E-05
0.3888	0.002543	0.01428	3.63E-05
0.4104	0.003084	0.01731	5.34E-05
0.432	0.003625	0.02035	7.38E-05

B= 0.0254 m
delta Z= 0.0216 m

<u>by Simpson's rule:</u>

INT= 3.27E-05 m^3

w(b)= 0.007414 m
w(a)= 0.003215 m
delta kh= (w(b)-w(a))/INT
delta kh= 128 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**353**	**kN/m^2**

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Table G12

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Pi=0.223kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.009267	-0.04161	0.000386
0.0216	-0.008556	-0.03842	0.000329
0.0432	-0.007845	-0.03523	0.000276
0.0648	-0.007137	-0.03205	0.000229
0.0864	-0.006431	-0.02888	0.000186
0.108	-0.005727	-0.02572	0.000147
0.1296	-0.005027	-0.02257	0.000113
0.1512	-0.004329	-0.01944	8.42E-05
0.1728	-0.003635	-0.01632	5.93E-05
0.1944	-0.002944	-0.01322	3.89E-05
0.216	-0.002256	-0.01013	2.29E-05
0.2376	-0.00157	-0.00705	1.11E-05
0.2592	-0.000887	-0.00398	3.53E-06
0.2808	-0.000206	-0.00093	1.92E-07
0.3024	0.000473	0.00212	1E-06
0.324	0.001151	0.00517	5.95E-06
0.3456	0.001828	0.00821	1.5E-05
0.3672	0.002504	0.01124	2.81E-05
0.3888	0.003179	0.01428	4.54E-05
0.4104	0.003856	0.01731	6.67E-05
0.432	0.004531	0.02035	9.22E-05

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 4.09E-05 m^3

w(b)= 0.009267 m
w(a)= 0.004443 m
delta kh= (w(b)-w(a))/INT
delta kh= 118 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 343 kN/m^2

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Table G13

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Pi=0.267kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.01112	-0.04161	0.000463
0.0216	-0.010267	-0.03842	0.000394
0.0432	-0.009414	. -0.03523	0.000332
0.0648	-0.008564	-0.03205	0.000274
0.0864	-0.007717	-0.02888	0.000223
0.108	-0.006872	-0.02572	0.000177
0.1296	-0.006032	-0.02257	0.000136
0.1512	-0.005195	-0.01944	0.000101
0.1728	-0.004362	-0.01632	7.12E-05
0.1944	-0.003533	-0.01322	4.67E-05
0.216	-0.002707	-0.01013	2.74E-05
0.2376	-0.001885	-0.00705	1.33E-05
0.2592	-0.001065	-0.00398	4.24E-06
0.2808	-0.000248	-0.00093	2.31E-07
0.3024	0.000567	0.00212	1.2E-06
0.324	0.00138	0.00517	7.13E-06
0.3456	0.002193	0.00821	1.8E-05
0.3672	0.003005	0.01124	3.38E-05
0.3888	0.003816	0.01428	5.45E-05
0.4104	0.004626	0.01731	8.01E-05
0.432	0.005437	0.02035	0.000111

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 4.91E-05 m^3

w(b)= 0.01112 m
w(a)= 0.006021 m
delta kh= (w(b)-w(a))/INT
delta kh= 104 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 329 kN/m^2

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Table G14
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Pi=0.312kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.012974	-0.04161	0.00054
0.0216	-0.011978	-0.03842	0.00046
0.0432	-0.010984	-0.03523	0.000387
0.0648	-0.009991	-0.03205	0.00032
0.0864	-0.009003	-0.02888	0.00026
0.108	-0.008018	-0.02572	0.000206
0.1296	-0.007037	-0.02257	0.000159
0.1512	-0.006061	-0.01944	0.000118
0.1728	-0.005089	-0.01632	8.31E-05
0.1944	-0.004122	-0.01322	5.45E-05
0.216	-0.003158	-0.01013	3.2E-05
0.2376	-0.002199	-0.00705	1.55E-05
0.2592	-0.001242	-0.00398	4.94E-06
0.2808	-0.000289	-0.00093	2.69E-07
0.3024	0.000662	0.00212	1.4E-06
0.324	0.001611	0.00517	8.33E-06
0.3456	0.002559	0.00821	2.1E-05
0.3672	0.003505	0.01124	3.94E-05
0.3888	0.004452	0.01428	6.36E-05
0.4104	0.005397	0.01731	9.34E-05
0.432	0.006343	0.02035	0.000129

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 5.73E-05 m^3

w(b)= 0.012974 m
w(a)= 0.007985 m
delta kh= (w(b)-w(a))/INT
delta kh= 87 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 312 kN/m^2

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Table G15
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Pi=0.356kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.014827	-0.04161	0.000617
0.0216	-0.013689	-0.03842	0.000526
0.0432	-0.012553	. -0.03523	0.000442
0.0648	-0.011419	-0.03205	0.000366
0.0864	-0.010289	-0.02888	0.000297
0.108	-0.009163	-0.02572	0.000236
0.1296	-0.008042	-0.02257	0.000182
0.1512	-0.006927	-0.01944	0.000135
0.1728	-0.005816	-0.01632	9.49E-05
0.1944	-0.00471	-0.01322	6.23E-05
0.216	-0.003609	-0.01013	3.66E-05
0.2376	-0.002513	-0.00705	1.77E-05
0.2592	-0.001419	-0.00398	5.65E-06
0.2808	-0.00033	-0.00093	3.07E-07
0.3024	0.000756	0.00212	1.6E-06
0.324	0.001841	0.00517	9.52E-06
0.3456	0.002924	0.00821	2.4E-05
0.3672	0.004006	0.01124	4.5E-05
0.3888	0.005088	0.01428	7.27E-05
0.4104	0.006169	0.01731	0.000107
0.432	0.007249	0.02035	0.000148

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 6.55E-05 m^3

w(b)= 0.014827 m
w(a)= 0.0105 m
delta kh= (w(b)-w(a))/INT
delta kh= 66 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 291 kN/m^2

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Table G16

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Pi=0.401kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.016681	-0.04161	0.000694
0.0216	-0.0154	-0.03842	0.000592
0.0432	-0.014122	. -0.03523	0.000498
0.0648	-0.012846	-0.03205	0.000412
0.0864	-0.011575	-0.02888	0.000334
0.108	-0.010309	-0.02572	0.000265
0.1296	-0.009048	-0.02257	0.000204
0.1512	-0.007793	-0.01944	0.000151
0.1728	-0.006543	-0.01632	0.000107
0.1944	-0.005299	-0.01322	7.01E-05
0.216	-0.004061	-0.01013	4.11E-05
0.2376	-0.002827	-0.00705	1.99E-05
0.2592	-0.001597	-0.00398	6.36E-06
0.2808	-0.000372	-0.00093	3.46E-07
0.3024	0.000851	0.00212	1.8E-06
0.324	0.002071	0.00517	1.07E-05
0.3456	0.003289	0.00821	2.7E-05
0.3672	0.004507	0.01124	5.07E-05
0.3888	0.005724	0.01428	8.17E-05
0.4104	0.006939	0.01731	0.00012
0.432	0.008156	0.02035	0.000166

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 7.36E-05 m^3

w(b)= 0.016681 m
w(a)= 0.015875 m
delta kh= (w(b)-w(a))/INT
delta kh= 11 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 236 kN/m^2

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Table G17

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Pi=0.045kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.0016	-0.03593	5.75E-05
0.0252	-0.001475	-0.03312	4.89E-05
0.0504	-0.00135	-0.03032	4.09E-05
0.0756	-0.001226	-0.02753	3.38E-05
0.1008	-0.001103	-0.02475	2.73E-05
0.126	-0.000979	-0.02199	2.15E-05
0.1512	-0.000858	-0.01926	1.65E-05
0.1764	-0.000737	-0.01655	1.22E-05
0.2016	-0.000617	-0.01387	8.56E-06
0.2268	-0.000499	-0.01119	5.58E-06
0.252	-0.000381	-0.00855	3.26E-06
0.2772	-0.000264	-0.00593	1.57E-06
0.3024	-0.000148	-0.00332	4.91E-07
0.3276	-0.000032	-0.00072	2.3E-08
0.3528	0.000083	0.00186	1.54E-07
0.378	0.000198	0.00444	8.79E-07
0.4032	0.000312	0.007	2.18E-06
0.4284	0.000426	0.00957	4.08E-06
0.4536	0.00054	0.01213	6.55E-06
0.4788	0.000654	0.01468	9.6E-06
0.504	0.000768	0.01724	1.32E-05

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 7.01E-06 m^3

w(b)= 0.0016 m
w(a)= 0.000444 m
delta kh= (w(b)-w(a))/INT
delta kh= 165 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 390 kN/m^2

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Table G18

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Pi=0.089kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.003201	-0.03593	0.000115
0.0252	-0.002951	-0.03312	9.77E-05
0.0504	-0.002701	.-0.03032	8.19E-05
0.0756	-0.002452	-0.02753	6.75E-05
0.1008	-0.002205	-0.02475	5.46E-05
0.126	-0.001959	-0.02199	4.31E-05
0.1512	-0.001716	-0.01926	3.31E-05
0.1764	-0.001475	-0.01655	2.44E-05
0.2016	-0.001235	-0.01387	1.71E-05
0.2268	-0.000997	-0.01119	1.12E-05
0.252	-0.000762	-0.00855	6.52E-06
0.2772	-0.000528	-0.00593	3.13E-06
0.3024	-0.000295	-0.00332	9.79E-07
0.3276	-0.000064	-0.00072	4.61E-08
0.3528	0.000166	0.00186	3.09E-07
0.378	0.000395	0.00444	1.75E-06
0.4032	0.000624	0.007	4.37E-06
0.4284	0.000852	0.00957	8.15E-06
0.4536	0.00108	0.01213	1.31E-05
0.4788	0.001308	0.01468	1.92E-05
0.504	0.001536	0.01724	2.65E-05

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 1.4E-05 m^3

w(b)= 0.003201 m
w(a)= 0.001136 m
delta kh= (w(b)-w(a))/INT
delta kh= 147 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**372**	**kN/m^2**

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Table G19

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Pi=0.134kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.004801	-0.03593	0.000172
0.0252	-0.004426	-0.03312	0.000147
0.0504	-0.004051	-0.03032	0.000123
0.0756	-0.003678	-0.02753	0.000101
0.1008	-0.003308	-0.02475	8.19E-05
0.126	-0.002939	-0.02199	6.46E-05
0.1512	-0.002574	-0.01926	4.96E-05
0.1764	-0.002212	-0.01655	3.66E-05
0.2016	-0.001852	-0.01387	2.57E-05
0.2268	-0.001496	-0.01119	1.67E-05
0.252	-0.001143	-0.00855	9.77E-06
0.2772	-0.000792	-0.00593	4.7E-06
0.3024	-0.000443	-0.00332	1.47E-06
0.3276	-0.000096	-0.00072	6.91E-08
0.3528	0.000249	0.00186	4.63E-07
0.378	0.000593	0.00444	2.63E-06
0.4032	0.000936	0.007	6.55E-06
0.4284	0.001278	0.00957	1.22E-05
0.4536	0.00162	0.01213	1.97E-05
0.4788	0.001962	0.01468	2.88E-05
0.504	0.002304	0.01724	3.97E-05

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 2.1E-05 m^3

w(b)= 0.004801 m
w(a)= 0.001927 m
delta kh= (w(b)-w(a))/INT
delta kh= 137 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 362 kN/m^2

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Table G20

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Pi=0.178kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.006402	-0.03593	0.00023
0.0252	-0.005901	-0.03312	0.000195
0.0504	-0.005402	-0.03032	0.000164
0.0756	-0.004904	-0.02753	0.000135
0.1008	-0.00441	-0.02475	0.000109
0.126	-0.003919	-0.02199	8.62E-05
0.1512	-0.003432	-0.01926	6.61E-05
0.1764	-0.002949	-0.01655	4.88E-05
0.2016	-0.00247	-0.01387	3.43E-05
0.2268	-0.001995	-0.01119	2.23E-05
0.252	-0.001524	-0.00855	1.3E-05
0.2772	-0.001056	-0.00593	6.26E-06
0.3024	-0.000591	-0.00332	1.96E-06
0.3276	-0.000128	-0.00072	9.22E-08
0.3528	0.000332	0.00186	6.18E-07
0.378	0.000791	0.00444	3.51E-06
0.4032	0.001248	0.007	8.74E-06
0.4284	0.001704	0.00957	1.63E-05
0.4536	0.00216	0.01213	2.62E-05
0.4788	0.002616	0.01468	3.84E-05
0.504	0.003072	0.01724	5.3E-05

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 2.81E-05 m^3

w(b)= 0.006402 m
w(a)= 0.002831 m
delta kh= (w(b)-w(a))/INT
delta kh= 127 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\textbf{kh= 352 kN/m^2}}$

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Table G21

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Pi=0.223kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.008002	-0.03593	0.000288
0.0252	-0.007377	-0.03312	0.000244
0.0504	-0.006752	-0.03032	0.000205
0.0756	-0.006131	-0.02753	0.000169
0.1008	-0.005513	-0.02475	0.000136
0.126	-0.004899	-0.02199	0.000108
0.1512	-0.004291	-0.01926	8.26E-05
0.1764	-0.003687	-0.01655	6.1E-05
0.2016	-0.003088	-0.01387	4.28E-05
0.2268	-0.002494	-0.01119	2.79E-05
0.252	-0.001905	-0.00855	1.63E-05
0.2772	-0.001319	-0.00593	7.82E-06
0.3024	-0.000738	-0.00332	2.45E-06
0.3276	-0.00016	-0.00072	1.15E-07
0.3528	0.000415	0.00186	7.72E-07
0.378	0.000988	0.00444	4.39E-06
0.4032	0.001559	0.007	1.09E-05
0.4284	0.002131	0.00957	2.04E-05
0.4536	0.0027	0.01213	3.28E-05
0.4788	0.00327	0.01468	4.8E-05
0.504	0.003839	0.01724	6.62E-05

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 3.51E-05 m^3

w(b)= 0.008002 m
w(a)= 0.003824 m
delta kh= (w(b)-w(a))/INT
delta kh= 119 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 344 kN/m^2

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Table G22

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Pi=0.267kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.009603	-0.03593	0.000345
0.0252	-0.008852	-0.03312	0.000293
0.0504	-0.008103	. -0.03032	0.000246
0.0756	-0.007357	-0.02753	0.000203
0.1008	-0.006615	-0.02475	0.000164
0.126	-0.005879	-0.02199	0.000129
0.1512	-0.005148	-0.01926	9.92E-05
0.1764	-0.004424	-0.01655	7.32E-05
0.2016	-0.003705	-0.01387	5.14E-05
0.2268	-0.002993	-0.01119	3.35E-05
0.252	-0.002285	-0.00855	1.95E-05
0.2772	-0.001583	-0.00593	9.39E-06
0.3024	-0.000886	-0.00332	2.94E-06
0.3276	-0.000192	-0.00072	1.38E-07
0.3528	0.000498	0.00186	9.26E-07
0.378	0.001186	0.00444	5.27E-06
0.4032	0.001872	0.007	1.31E-05
0.4284	0.002557	0.00957	2.45E-05
0.4536	0.003241	0.01213	3.93E-05
0.4788	0.003924	0.01468	5.76E-05
0.504	0.004607	0.01724	7.94E-05

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 4.21E-05 m^3

w(b)= 0.009603 m
w(a)= 0.005027 m
delta kh= (w(b)-w(a))/INT
delta kh= 109 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	334	kN/m^2

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Table G23

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Pi=0.312kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.011203	-0.03593	0.000403
0.0252	-0.010327	-0.03312	0.000342
0.0504	-0.009453	-0.03032	0.000287
0.0756	-0.008583	-0.02753	0.000236
0.1008	-0.007718	-0.02475	0.000191
0.126	-0.006859	-0.02199	0.000151
0.1512	-0.006006	-0.01926	0.000116
0.1764	-0.005161	-0.01655	8.54E-05
0.2016	-0.004323	-0.01387	6E-05
0.2268	-0.003491	-0.01119	3.91E-05
0.252	-0.002666	-0.00855	2.28E-05
0.2772	-0.001847	-0.00593	1.1E-05
0.3024	-0.001034	-0.00332	3.43E-06
0.3276	-0.000224	-0.00072	1.61E-07
0.3528	0.000581	0.00186	1.08E-06
0.378	0.001384	0.00444	6.14E-06
0.4032	0.002184	0.007	1.53E-05
0.4284	0.002983	0.00957	2.85E-05
0.4536	0.003781	0.01213	4.59E-05
0.4788	0.004578	0.01468	6.72E-05
0.504	0.005375	0.01724	9.27E-05

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 4.91E-05 m^3

w(b)= 0.011203 m
w(a)= 0.006406 m
delta kh= (w(b)-w(a))/INT
delta kh= 98 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 323 kN/m^2

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Table G24

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Pi=0.356kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.012804	-0.03593	0.00046
0.0252	-0.011802	-0.03312	0.000391
0.0504	-0.010803	-0.03032	0.000328
0.0756	-0.009809	-0.02753	0.00027
0.1008	-0.00882	-0.02475	0.000218
0.126	-0.007838	-0.02199	0.000172
0.1512	-0.006864	-0.01926	0.000132
0.1764	-0.005898	-0.01655	9.76E-05
0.2016	-0.00494	-0.01387	6.85E-05
0.2268	-0.00399	-0.01119	4.46E-05
0.252	-0.003047	-0.00855	2.61E-05
0.2772	-0.002111	-0.00593	1.25E-05
0.3024	-0.001181	-0.00332	3.92E-06
0.3276	-0.000256	-0.00072	1.84E-07
0.3528	0.000664	0.00186	1.24E-06
0.378	0.001581	0.00444	7.02E-06
0.4032	0.002496	0.007	1.75E-05
0.4284	0.003409	0.00957	3.26E-05
0.4536	0.004321	0.01213	5.24E-05
0.4788	0.005232	0.01468	7.68E-05
0.504	0.006143	0.01724	0.000106

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 5.61E-05 m^3

w(b)= 0.012804 m
w(a)= 0.008023 m
delta kh= (w(b)-w(a))/INT
delta kh= 85 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 310 kN/m^2

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Table G25

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Pi=0.401kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.014404	-0.03593	0.000518
0.0252	-0.013278	-0.03312	0.00044
0.0504	-0.012154	-0.03032	0.000369
0.0756	-0.011035	-0.02753	0.000304
0.1008	-0.009923	-0.02475	0.000246
0.126	-0.008818	-0.02199	0.000194
0.1512	-0.007723	-0.01926	0.000149
0.1764	-0.006636	-0.01655	0.00011
0.2016	-0.005558	-0.01387	7.71E-05
0.2268	-0.004489	-0.01119	5.02E-05
0.252	-0.003428	-0.00855	2.93E-05
0.2772	-0.002375	-0.00593	1.41E-05
0.3024	-0.001329	-0.00332	4.41E-06
0.3276	-0.000288	-0.00072	2.07E-07
0.3528	0.000747	0.00186	1.39E-06
0.378	0.001779	0.00444	7.9E-06
0.4032	0.002808	0.007	1.97E-05
0.4284	0.003835	0.00957	3.67E-05
0.4536	0.004861	0.01213	5.9E-05
0.4788	0.005886	0.01468	8.64E-05
0.504	0.006911	0.01724	0.000119

B= 0.0254 m
delta Z= 0.0252 m

<u>by Simpson's rule:</u>

INT= 6.31E-05 m^3

w(b)= 0.014404 m
w(a)= 0.009983 m
delta kh= (w(b)-w(a))/INT
delta kh= 70 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 295 kN/m^2

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Table G26

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Pi=0.445kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.016005	-0.03593	0.000575
0.0252	-0.014753	-0.03312	0.000489
0.0504	-0.013504	. -0.03032	0.000409
0.0756	-0.012261	-0.02753	0.000338
0.1008	-0.011025	-0.02475	0.000273
0.126	-0.009798	-0.02199	0.000215
0.1512	-0.008581	-0.01926	0.000165
0.1764	-0.007373	-0.01655	0.000122
0.2016	-0.006175	-0.01387	8.56E-05
0.2268	-0.004988	-0.01119	5.58E-05
0.252	-0.003809	-0.00855	3.26E-05
0.2772	-0.002639	-0.00593	1.56E-05
0.3024	-0.001477	-0.00332	4.9E-06
0.3276	-0.00032	-0.00072	2.3E-07
0.3528	0.00083	0.00186	1.54E-06
0.378	0.001977	0.00444	8.78E-06
0.4032	0.003119	0.007	2.18E-05
0.4284	0.004261	0.00957	4.08E-05
0.4536	0.005401	0.01213	6.55E-05
0.4788	0.00654	0.01468	9.6E-05
0.504	0.007679	0.01724	0.000132

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 7.01E-05 m^3

w(b)= 0.016005 m
w(a)= 0.012347 m
delta kh= (w(b)-w(a))/INT
delta kh= 52 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 277 kN/m^2

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Table G27

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

B= 0.0254 m
delta Z= 0.0252 m

	Pi=0.501kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.017989	-0.03593	0.000646
0.0252	-0.016582	-0.03312	0.000549
0.0504	-0.015179	. -0.03032	0.00046
0.0756	-0.013782	-0.02753	0.000379
0.1008	-0.012392	-0.02475	0.000307
0.126	-0.011013	-0.02199	0.000242
0.1512	-0.009645	-0.01926	0.000186
0.1764	-0.008287	-0.01655	0.000137
0.2016	-0.006941	-0.01387	9.63E-05
0.2268	-0.005606	-0.01119	6.27E-05
0.252	-0.004281	-0.00855	3.66E-05
0.2772	-0.002966	-0.00593	1.76E-05
0.3024	-0.001659	-0.00332	5.51E-06
0.3276	-0.00036	-0.00072	2.59E-07
0.3528	0.000933	0.00186	1.74E-06
0.378	0.002222	0.00444	9.87E-06
0.4032	0.003507	0.007	2.45E-05
0.4284	0.004789	0.00957	4.58E-05
0.4536	0.006071	0.01213	7.36E-05
0.4788	0.007351	0.01468	0.000108
0.504	0.008631	0.01724	0.000149

by Simpson's rule:

INT= 7.88E-05 m^3

w(b)= 0.017989 m
w(a)= 0.018256 m
delta kh= (w(b)-w(a))/INT
delta kh= -3 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 222 kN/m^2

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Table G28

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

B= 0.0254 m
delta Z= 0.0288 m

	Pi=0.045kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.001416	-0.03179	4.5E-05
0.0288	-0.001302	-0.02924	3.81E-05
0.0576	-0.001189	-0.02669	3.17E-05
0.0864	-0.001076	-0.02417	2.6E-05
0.1152	-0.000965	-0.02166	2.09E-05
0.144	-0.000855	-0.01919	1.64E-05
0.1728	-0.000746	-0.01675	1.25E-05
0.2016	-0.000639	-0.01434	9.16E-06
0.2304	-0.000533	-0.01197	6.38E-06
0.2592	-0.000429	-0.00962	4.13E-06
0.288	-0.000326	-0.00731	2.38E-06
0.3168	-0.000224	-0.00503	1.13E-06
0.3456	-0.000123	-0.00277	3.41E-07
0.3744	-0.000024	-0.00053	1.27E-08
0.4032	0.000075	0.00169	1.27E-07
0.432	0.000173	0.00389	6.73E-07
0.4608	0.000271	0.00609	1.65E-06
0.4896	0.000369	0.00828	3.06E-06
0.5184	0.000466	0.01046	4.87E-06
0.5472	0.000563	0.01264	7.12E-06
0.576	0.00066	0.01482	9.78E-06

by Simpson's rule:

INT= 6.14E-06 m^3

w(b)= 0.001416 m
w(a)= 0.000366 m
delta kh= (w(b)-w(a))/INT
delta kh= 171 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\text{kh= 396 kN/m^2}}$

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Table G29

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Pi=0.089kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.002832	-0.03179	9E-05
0.0288	-0.002605	-0.02924	7.62E-05
0.0576	-0.002378	-0.02669	6.35E-05
0.0864	-0.002153	-0.02417	5.2E-05
0.1152	-0.001929	-0.02166	4.18E-05
0.144	-0.001709	-0.01919	3.28E-05
0.1728	-0.001492	-0.01675	2.5E-05
0.2016	-0.001277	-0.01434	1.83E-05
0.2304	-0.001066	-0.01197	1.28E-05
0.2592	-0.000857	-0.00962	8.24E-06
0.288	-0.000651	-0.00731	4.76E-06
0.3168	-0.000448	-0.00503	2.25E-06
0.3456	-0.000247	-0.00277	6.84E-07
0.3744	-0.000047	-0.00053	2.49E-08
0.4032	0.00015	0.00169	2.54E-07
0.432	0.000347	0.00389	1.35E-06
0.4608	0.000542	0.00609	3.3E-06
0.4896	0.000737	0.00828	6.1E-06
0.5184	0.000932	0.01046	9.75E-06
0.5472	0.001126	0.01264	1.42E-05
0.576	0.001321	0.01482	1.96E-05

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 1.23E-05 m^3

w(b)= 0.002832 m
w(a)= 0.000986 m
delta kh= (w(b)-w(a))/INT
delta kh= 150 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 375 kN/m^2

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Table G30

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

B= 0.0254 m
delta Z= 0.0288 m

	Pi=0.134kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.004248	-0.03179	0.000135
0.0288	-0.003907	-0.02924	0.000114
0.0576	-0.003567	-0.02669	9.52E-05
0.0864	-0.003229	-0.02417	7.8E-05
0.1152	-0.002894	-0.02166	6.27E-05
0.144	-0.002564	-0.01919	4.92E-05
0.1728	-0.002238	-0.01675	3.75E-05
0.2016	-0.001916	-0.01434	2.75E-05
0.2304	-0.001599	-0.01197	1.91E-05
0.2592	-0.001286	-0.00962	1.24E-05
0.288	-0.000977	-0.00731	7.14E-06
0.3168	-0.000672	-0.00503	3.38E-06
0.3456	-0.000369	-0.00277	1.02E-06
0.3744	-0.000071	-0.00053	3.76E-08
0.4032	0.000226	0.00169	3.82E-07
0.432	0.00052	0.00389	2.02E-06
0.4608	0.000814	0.00609	4.96E-06
0.4896	0.001106	0.00828	9.16E-06
0.5184	0.001398	0.01046	1.46E-05
0.5472	0.001689	0.01264	2.13E-05
0.576	0.001981	0.01482	2.94E-05

by Simpson's rule:

INT= 1.84E-05 m^3

w(b)= 0.004248 m
w(a)= 0.001788 m
delta kh= (w(b)-w(a))/INT
delta kh= 134 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 359 kN/m^2

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Table G31

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Pi=0.178kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.005665	-0.03179	0.00018
0.0288	-0.005209	-0.02924	0.000152
0.0576	-0.004756	-0.02669	0.000127
0.0864	-0.004305	-0.02417	0.000104
0.1152	-0.003859	-0.02166	8.36E-05
0.144	-0.003419	-0.01919	6.56E-05
0.1728	-0.002984	-0.01675	5E-05
0.2016	-0.002554	-0.01434	3.66E-05
0.2304	-0.002132	-0.01197	2.55E-05
0.2592	-0.001714	-0.00962	1.65E-05
0.288	-0.001303	-0.00731	9.52E-06
0.3168	-0.000896	-0.00503	4.51E-06
0.3456	-0.000493	-0.00277	1.37E-06
0.3744	-0.000095	-0.00053	5.04E-08
0.4032	0.000301	0.00169	5.09E-07
0.432	0.000694	0.00389	2.7E-06
0.4608	0.001085	0.00609	6.61E-06
0.4896	0.001475	0.00828	1.22E-05
0.5184	0.001863	0.01046	1.95E-05
0.5472	0.002252	0.01264	2.85E-05
0.576	0.002641	0.01482	3.91E-05

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 2.46E-05 m^3

w(b)= 0.005665 m
w(a)= 0.002689 m
delta kh= (w(b)-w(a))/INT
delta kh= 121 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 346 kN/m^2

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Table G32

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Pi=0.223kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.007081	-0.03179	0.000225
0.0288	-0.006511	-0.02924	0.00019
0.0576	-0.005945	-0.02669	0.000159
0.0864	-0.005382	-0.02417	0.00013
0.1152	-0.004824	-0.02166	0.000104
0.144	-0.004274	-0.01919	8.2E-05
0.1728	-0.003729	-0.01675	6.25E-05
0.2016	-0.003194	-0.01434	4.58E-05
0.2304	-0.002665	-0.01197	3.19E-05
0.2592	-0.002143	-0.00962	2.06E-05
0.288	-0.001628	-0.00731	1.19E-05
0.3168	-0.001119	-0.00503	5.63E-06
0.3456	-0.000616	-0.00277	1.71E-06
0.3744	-0.000118	-0.00053	6.25E-08
0.4032	0.000376	0.00169	6.35E-07
0.432	0.000867	0.00389	3.37E-06
0.4608	0.001356	0.00609	8.26E-06
0.4896	0.001843	0.00828	1.53E-05
0.5184	0.002329	0.01046	2.44E-05
0.5472	0.002816	0.01264	3.56E-05
0.576	0.003301	0.01482	4.89E-05

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 3.07E-05 m^3

w(b)= 0.007081 m
w(a)= 0.003668 m
delta kh= (w(b)-w(a))/INT
delta kh= 111 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 336 kN/m^2

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Table G33

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

B= 0.0254 m
delta Z= 0.0288 m

	Pi=0.267kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.008497	-0.03179	0.00027
0.0288	-0.007814	-0.02924	0.000228
0.0576	-0.007133	-0.02669	0.00019
0.0864	-0.006458	-0.02417	0.000156
0.1152	-0.005789	-0.02166	0.000125
0.144	-0.005128	-0.01919	9.84E-05
0.1728	-0.004476	-0.01675	7.5E-05
0.2016	-0.003832	-0.01434	5.5E-05
0.2304	-0.003198	-0.01197	3.83E-05
0.2592	-0.002572	-0.00962	2.47E-05
0.288	-0.001953	-0.00731	1.43E-05
0.3168	-0.001343	-0.00503	6.76E-06
0.3456	-0.000739	-0.00277	2.05E-06
0.3744	-0.000142	-0.00053	7.53E-08
0.4032	0.000451	0.00169	7.62E-07
0.432	0.001041	0.00389	4.05E-06
0.4608	0.001627	0.00609	9.91E-06
0.4896	0.002212	0.00828	1.83E-05
0.5184	0.002796	0.01046	2.92E-05
0.5472	0.003379	0.01264	4.27E-05
0.576	0.003962	0.01482	5.87E-05

by Simpson's rule:

INT= 3.68E-05 m^3

w(b)= 0.008497 m
w(a)= 0.004778 m
delta kh= (w(b)-w(a))/INT
delta kh= 101 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 326 kN/m^2

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Table G34

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Pi=0.312kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.009913	-0.03179	0.000315
0.0288	-0.009116	-0.02924	0.000267
0.0576	-0.008322	-0.02669	0.000222
0.0864	-0.007534	-0.02417	0.000182
0.1152	-0.006754	-0.02166	0.000146
0.144	-0.005983	-0.01919	0.000115
0.1728	-0.005222	-0.01675	8.75E-05
0.2016	-0.004471	-0.01434	6.41E-05
0.2304	-0.003731	-0.01197	4.47E-05
0.2592	-0.003	-0.00962	2.89E-05
0.288	-0.002279	-0.00731	1.67E-05
0.3168	-0.001567	-0.00503	7.88E-06
0.3456	-0.000863	-0.00277	2.39E-06
0.3744	-0.000165	-0.00053	8.75E-08
0.4032	0.000527	0.00169	8.91E-07
0.432	0.001214	0.00389	4.72E-06
0.4608	0.001899	0.00609	1.16E-05
0.4896	0.002581	0.00828	2.14E-05
0.5184	0.003261	0.01046	3.41E-05
0.5472	0.003942	0.01264	4.98E-05
0.576	0.004622	0.01482	6.85E-05

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 4.3E-05 m^3

w(b)= 0.009913 m
w(a)= 0.006086 m
delta kh= (w(b)-w(a))/INT
delta kh= 89 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 314 kN/m^2

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Table G35
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Pi=0.356kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.011329	-0.03179	0.00036
0.0288	-0.010418	-0.02924	0.000305
0.0576	-0.009511	-0.02669	0.000254
0.0864	-0.008611	-0.02417	0.000208
0.1152	-0.007719	-0.02166	0.000167
0.144	-0.006838	-0.01919	0.000131
0.1728	-0.005968	-0.01675	1E-04
0.2016	-0.005109	-0.01434	7.33E-05
0.2304	-0.004263	-0.01197	5.1E-05
0.2592	-0.003429	-0.00962	3.3E-05
0.288	-0.002605	-0.00731	1.9E-05
0.3168	-0.001791	-0.00503	9.01E-06
0.3456	-0.000986	-0.00277	2.73E-06
0.3744	-0.000189	-0.00053	1E-07
0.4032	0.000602	0.00169	1.02E-06
0.432	0.001388	0.00389	5.4E-06
0.4608	0.002169	0.00609	1.32E-05
0.4896	0.002949	0.00828	2.44E-05
0.5184	0.003727	0.01046	3.9E-05
0.5472	0.004505	0.01264	5.69E-05
0.576	0.005282	0.01482	7.83E-05

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 4.91E-05 m^3

w(b)= 0.011329 m
w(a)= 0.00755 m
delta kh= (w(b)-w(a))/INT
delta kh= 77 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 302 kN/m^2

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Table G36

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Pi=0.401kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.012745	-0.03179	0.000405
0.0288	-0.011721	-0.02924	0.000343
0.0576	-0.0107	-0.02669	0.000286
0.0864	-0.009687	-0.02417	0.000234
0.1152	-0.008684	-0.02166	0.000188
0.144	-0.007693	-0.01919	0.000148
0.1728	-0.006714	-0.01675	0.000112
0.2016	-0.005748	-0.01434	8.24E-05
0.2304	-0.004796	-0.01197	5.74E-05
0.2592	-0.003857	-0.00962	3.71E-05
0.288	-0.002931	-0.00731	2.14E-05
0.3168	-0.002015	-0.00503	1.01E-05
0.3456	-0.001109	-0.00277	3.07E-06
0.3744	-0.000213	-0.00053	1.13E-07
0.4032	0.000677	0.00169	1.14E-06
0.432	0.001561	0.00389	6.07E-06
0.4608	0.002441	0.00609	1.49E-05
0.4896	0.003318	0.00828	2.75E-05
0.5184	0.004193	0.01046	4.39E-05
0.5472	0.005068	0.01264	6.41E-05
0.576	0.005942	0.01482	8.81E-05

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 5.53E-05 m^3

w(b)= 0.012745 m
w(a)= 0.009145 m
delta kh= (w(b)-w(a))/INT
delta kh= 65 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 290 kN/m^2

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Table G37

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Pi=0.445kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.014161	-0.03179	0.00045
0.0288	-0.013023	-0.02924	0.000381
0.0576	-0.011889	. -0.02669	0.000317
0.0864	-0.010764	-0.02417	0.00026
0.1152	-0.009649	-0.02166	0.000209
0.144	-0.008547	-0.01919	0.000164
0.1728	-0.007459	-0.01675	0.000125
0.2016	-0.006387	-0.01434	9.16E-05
0.2304	-0.005329	-0.01197	6.38E-05
0.2592	-0.004286	-0.00962	4.12E-05
0.288	-0.003256	-0.00731	2.38E-05
0.3168	-0.002239	-0.00503	1.13E-05
0.3456	-0.001233	-0.00277	3.42E-06
0.3744	-0.000236	-0.00053	1.25E-07
0.4032	0.000752	0.00169	1.27E-06
0.432	0.001734	0.00389	6.75E-06
0.4608	0.002712	0.00609	1.65E-05
0.4896	0.003687	0.00828	3.05E-05
0.5184	0.004659	0.01046	4.87E-05
0.5472	0.005631	0.01264	7.12E-05
0.576	0.006602	0.01482	9.78E-05

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 6.14E-05 m^3

w(b)= 0.014161 m
w(a)= 0.011009 m
delta kh= (w(b)-w(a))/INT
delta kh= 51 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	276	kN/m^2

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Table G38

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Pi=0.501kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.015917	-0.03179	0.000506
0.0288	-0.014638	-0.02924	0.000428
0.0576	-0.013363	-0.02669	0.000357
0.0864	-0.012098	-0.02417	0.000292
0.1152	-0.010845	-0.02166	0.000235
0.144	-0.009607	-0.01919	0.000184
0.1728	-0.008385	-0.01675	0.00014
0.2016	-0.007179	-0.01434	0.000103
0.2304	-0.00599	-0.01197	7.17E-05
0.2592	-0.004817	-0.00962	4.63E-05
0.288	-0.00366	-0.00731	2.68E-05
0.3168	-0.002517	-0.00503	1.27E-05
0.3456	-0.001386	-0.00277	3.84E-06
0.3744	-0.000266	-0.00053	1.41E-07
0.4032	0.000845	0.00169	1.43E-06
0.432	0.001949	0.00389	7.58E-06
0.4608	0.003049	0.00609	1.86E-05
0.4896	0.004144	0.00828	3.43E-05
0.5184	0.005237	0.01046	5.48E-05
0.5472	0.006329	0.01264	8E-05
0.576	0.007421	0.01482	0.00011

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 6.9E-05 m^3

w(b)= 0.015917 m
w(a)= 0.013964 m
delta kh= (w(b)-w(a))/INT
delta kh= 28 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 253 kN/m^2

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Table G39

NUMERICAL ANALYSIS OF LATERELLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA 1.8
LINEAR PART
PILE LENGTH=0.648m

B= 0.0254 m
delta Z= 0.0324 m

	Pi=0.045kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.001279	-0.02871	3.67E-05
0.0324	-0.001172	-0.02631	3.08E-05
0.0648	-0.001066	. -0.02393	2.55E-05
0.0972	-0.000961	-0.02158	2.07E-05
0.1296	-0.000858	-0.01926	1.65E-05
0.162	-0.000756	-0.01698	1.28E-05
0.1944	-0.000657	-0.01475	9.69E-06
0.2268	-0.000559	-0.01256	7.02E-06
0.2592	-0.000464	-0.01043	4.84E-06
0.2916	-0.000371	-0.00833	3.09E-06
0.324	-0.000279	-0.00628	1.75E-06
0.3564	-0.00019	-0.00427	8.11E-07
0.3888	-0.000102	-0.00229	2.34E-07
0.4212	-0.000015	-0.00035	5.25E-09
0.4536	0.00007	0.00157	1.1E-07
0.486	0.000155	0.00348	5.39E-07
0.5184	0.000239	0.00536	1.28E-06
0.5508	0.000322	0.00724	2.33E-06
0.5832	0.000406	0.00911	3.7E-06
0.6156	0.000489	0.01098	5.37E-06
0.648	0.000572	0.01285	7.35E-06

by Simpson's rule:

INT= 5.46E-06 m^3

w(b)= 0.001279 m
w(a)= 0.000301 m
delta kh= (w(b)-w(a))/INT
delta kh= 179 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 404 kN/m^2

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Table G40

NUMERICAL ANALYSIS OF LATERELLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA 1.8
LINEAR PART
PILE LENGTH=0.648m

B= 0.0254 m
delta Z= 0.0324 m

	Pi=0.089kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.002557	-0.02871	7.34E-05
0.0324	-0.002344	-0.02631	6.17E-05
0.0648	-0.002132	-0.02393	5.1E-05
0.0972	-0.001922	-0.02158	4.15E-05
0.1296	-0.001716	-0.01926	3.31E-05
0.162	-0.001513	-0.01698	2.57E-05
0.1944	-0.001314	-0.01475	1.94E-05
0.2268	-0.001119	-0.01256	1.41E-05
0.2592	-0.000929	-0.01043	9.69E-06
0.2916	-0.000742	-0.00833	6.18E-06
0.324	-0.000559	-0.00628	3.51E-06
0.3564	-0.00038	-0.00427	1.62E-06
0.3888	-0.000204	-0.00229	4.67E-07
0.4212	-0.000031	-0.00035	1.09E-08
0.4536	0.00014	0.00157	2.2E-07
0.486	0.000309	0.00348	1.08E-06
0.5184	0.000478	0.00536	2.56E-06
0.5508	0.000645	0.00724	4.67E-06
0.5832	0.000812	0.00911	7.4E-06
0.6156	0.000978	0.01098	1.07E-05
0.648	0.001144	0.01285	1.47E-05

by Simpson's rule:

INT= 1.09E-05 m^3

w(b)= 0.002557 m
w(a)= 0.000732 m
delta kh= (w(b)-w(a))/INT
delta kh= 167 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 392 kN/m^2

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Table G41

NUMERICAL ANALYSIS OF LATERELLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA 1.8
LINEAR PART
PILE LENGTH=0.648m

B= 0.0254 m
delta Z= 0.0324 m

	Pi=0.134kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.003836	-0.02871	0.00011
0.0324	-0.003516	-0.02631	9.25E-05
0.0648	-0.003198	. -0.02393	7.65E-05
0.0972	-0.002883	-0.02158	6.22E-05
0.1296	-0.002574	-0.01926	4.96E-05
0.162	-0.002269	-0.01698	3.85E-05
0.1944	-0.001971	-0.01475	2.91E-05
0.2268	-0.001679	-0.01256	2.11E-05
0.2592	-0.001393	-0.01043	1.45E-05
0.2916	-0.001113	-0.00833	9.27E-06
0.324	-0.000839	-0.00628	5.27E-06
0.3564	-0.000571	-0.00427	2.44E-06
0.3888	-0.000306	-0.00229	7.01E-07
0.4212	-0.000046	-0.00035	1.61E-08
0.4536	0.00021	0.00157	3.3E-07
0.486	0.000464	0.00348	1.61E-06
0.5184	0.000716	0.00536	3.84E-06
0.5508	0.000967	0.00724	7E-06
0.5832	0.001217	0.00911	1.11E-05
0.6156	0.001467	0.01098	1.61E-05
0.648	0.001717	0.01285	2.21E-05

by Simpson's rule:

INT= 1.64E-05 m^3

w(b)= 0.003836 m
w(a)= 0.001292 m
delta kh= (w(b)-w(a))/INT
delta kh= 155 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 380 kN/m^2

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Table G42

NUMERICAL ANALYSIS OF LATERELLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA 1.8
LINEAR PART
PILE LENGTH=0.648m

B= 0.0254 m
delta Z= 0.0324 m

	Pi=0.178kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.005115	-0.02871	0.000147
0.0324	-0.004688	-0.02631	0.000123
0.0648	-0.004264	. -0.02393	0.000102
0.0972	-0.003845	-0.02158	8.3E-05
0.1296	-0.003432	-0.01926	6.61E-05
0.162	-0.003026	-0.01698	5.14E-05
0.1944	-0.002628	-0.01475	3.88E-05
0.2268	-0.002238	-0.01256	2.81E-05
0.2592	-0.001857	-0.01043	1.94E-05
0.2916	-0.001484	-0.00833	1.24E-05
0.324	-0.001119	-0.00628	7.03E-06
0.3564	-0.000761	-0.00427	3.25E-06
0.3888	-0.000409	-0.00229	9.37E-07
0.4212	-0.000062	-0.00035	2.17E-08
0.4536	0.00028	0.00157	4.4E-07
0.486	0.000619	0.00348	2.15E-06
0.5184	0.000955	0.00536	5.12E-06
0.5508	0.001289	0.00724	9.33E-06
0.5832	0.001623	0.00911	1.48E-05
0.6156	0.001956	0.01098	2.15E-05
0.648	0.002289	0.01285	2.94E-05

by Simpson's rule:

INT= 2.18E-05 m^3

w(b)= 0.005115 m
w(a)= 0.002007 m
delta kh= (w(b)-w(a))/INT
delta kh= 142 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 367 kN/m^2

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Table G43

NUMERICAL ANALYSIS OF LATERELLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA 1.8
LINEAR PART
PILE LENGTH=0.648m

B= 0.0254 m
delta Z= 0.0324 m

	Pi=0.223kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.006393	-0.02871	0.000184
0.0324	-0.00586	-0.02631	0.000154
0.0648	-0.00533	. -0.02393	0.000128
0.0972	-0.004806	-0.02158	0.000104
0.1296	-0.004289	-0.01926	8.26E-05
0.162	-0.003782	-0.01698	6.42E-05
0.1944	-0.003285	-0.01475	4.85E-05
0.2268	-0.002798	-0.01256	3.51E-05
0.2592	-0.002322	-0.01043	2.42E-05
0.2916	-0.001855	-0.00833	1.55E-05
0.324	-0.001399	-0.00628	8.79E-06
0.3564	-0.000951	-0.00427	4.06E-06
0.3888	-0.000511	-0.00229	1.17E-06
0.4212	-0.000077	-0.00035	2.7E-08
0.4536	0.00035	0.00157	5.5E-07
0.486	0.000774	0.00348	2.69E-06
0.5184	0.001194	0.00536	6.4E-06
0.5508	0.001612	0.00724	1.17E-05
0.5832	0.002029	0.00911	1.85E-05
0.6156	0.002445	0.01098	2.68E-05
0.648	0.002861	0.01285	3.68E-05

by Simpson's rule:

INT= 2.73E-05 m^3

w(b)= 0.006393 m
w(a)= 0.002766 m
delta kh= (w(b)-w(a))/INT
delta kh= 133 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 358 kN/m^2

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Table G44

NUMERICAL ANALYSIS OF LATERELLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA 1.8
LINEAR PART
PILE LENGTH=0.648m

	Pi=0.267kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.007672	-0.02871	0.00022
0.0324	-0.007032	-0.02631	0.000185
0.0648	-0.006396	-0.02393	0.000153
0.0972	-0.005767	-0.02158	0.000124
0.1296	-0.005147	-0.01926	9.91E-05
0.162	-0.004539	-0.01698	7.71E-05
0.1944	-0.003942	-0.01475	5.81E-05
0.2268	-0.003358	-0.01256	4.22E-05
0.2592	-0.002786	-0.01043	2.91E-05
0.2916	-0.002227	-0.00833	1.86E-05
0.324	-0.001679	-0.00628	1.05E-05
0.3564	-0.001141	-0.00427	4.87E-06
0.3888	-0.000613	-0.00229	1.4E-06
0.4212	-0.000093	-0.00035	3.26E-08
0.4536	0.000421	0.00157	6.61E-07
0.486	0.000929	0.00348	3.23E-06
0.5184	0.001433	0.00536	7.68E-06
0.5508	0.001935	0.00724	1.4E-05
0.5832	0.002435	0.00911	2.22E-05
0.6156	0.002934	0.01098	3.22E-05
0.648	0.003433	0.01285	4.41E-05

B= 0.0254 m
delta Z= 0.0324 m

by Simpson's rule:

INT= 3.28E-05 m^3

w(b)= 0.007672 m
w(a)= 0.003685 m
delta kh= (w(b)-w(a))/INT
delta kh= 122 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 347 kN/m^2

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Table G45

NUMERICAL ANALYSIS OF LATERELLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA 1.8
LINEAR PART
PILE LENGTH=0.648m

B= 0.0254 m
delta Z= 0.0324 m

	Pi=0.312kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.008951	-0.02871	0.000257
0.0324	-0.008204	-0.02631	0.000216
0.0648	-0.007462	-0.02393	0.000179
0.0972	-0.006728	-0.02158	0.000145
0.1296	-0.006005	-0.01926	0.000116
0.162	-0.005295	-0.01698	8.99E-05
0.1944	-0.004599	-0.01475	6.78E-05
0.2268	-0.003917	-0.01256	4.92E-05
0.2592	-0.00325	-0.01043	3.39E-05
0.2916	-0.002598	-0.00833	2.16E-05
0.324	-0.001958	-0.00628	1.23E-05
0.3564	-0.001331	-0.00427	5.68E-06
0.3888	-0.000715	-0.00229	1.64E-06
0.4212	-0.000108	-0.00035	3.78E-08
0.4536	0.000491	0.00157	7.71E-07
0.486	0.001083	0.00348	3.77E-06
0.5184	0.001672	0.00536	8.96E-06
0.5508	0.002257	0.00724	1.63E-05
0.5832	0.002841	0.00911	2.59E-05
0.6156	0.003423	0.01098	3.76E-05
0.648	0.004005	0.01285	5.15E-05

<u>by Simpson's rule:</u>

INT= 3.82E-05 m^3

w(b)= 0.008951 m
w(a)= 0.004682 m
delta kh= (w(b)-w(a))/INT
delta kh= 112 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 337 kN/m^2

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Table G46

NUMERICAL ANALYSIS OF LATERELLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA 1.8
LINEAR PART
PILE LENGTH=0.648m

B= 0.0254 m
delta Z= 0.0324 m

	Pi=0.356kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.010229	-0.02871	0.000294
0.0324	-0.009376	-0.02631	0.000247
0.0648	-0.008528	-0.02393	0.000204
0.0972	-0.007689	-0.02158	0.000166
0.1296	-0.006863	-0.01926	0.000132
0.162	-0.006051	-0.01698	0.000103
0.1944	-0.005256	-0.01475	7.75E-05
0.2268	-0.004477	-0.01256	5.62E-05
0.2592	-0.003715	-0.01043	3.87E-05
0.2916	-0.002969	-0.00833	2.47E-05
0.324	-0.002238	-0.00628	1.41E-05
0.3564	-0.001522	-0.00427	6.5E-06
0.3888	-0.000817	-0.00229	1.87E-06
0.4212	-0.000124	-0.00035	4.34E-08
0.4536	0.000561	0.00157	8.81E-07
0.486	0.001238	0.00348	4.31E-06
0.5184	0.001911	0.00536	1.02E-05
0.5508	0.002579	0.00724	1.87E-05
0.5832	0.003246	0.00911	2.96E-05
0.6156	0.003912	0.01098	4.3E-05
0.648	0.004578	0.01285	5.88E-05

by Simpson's rule:

INT= 4.37E-05 m^3

w(b)= 0.010229 m
w(a)= 0.005865 m
delta kh= (w(b)-w(a))/INT
delta kh= 100 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 325 kN/m^2

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Table G47

NUMERICAL ANALYSIS OF LATERELLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA 1.8
LINEAR PART
PILE LENGTH=0.648m

	Pi=0.401kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.011508	-0.02871	0.00033
0.0324	-0.010548	-0.02631	0.000278
0.0648	-0.009594	-0.02393	0.00023
0.0972	-0.00865	-0.02158	0.000187
0.1296	-0.007721	-0.01926	0.000149
0.162	-0.006807	-0.01698	0.000116
0.1944	-0.005913	-0.01475	8.72E-05
0.2268	-0.005036	-0.01256	6.33E-05
0.2592	-0.004179	-0.01043	4.36E-05
0.2916	-0.003339	-0.00833	2.78E-05
0.324	-0.002518	-0.00628	1.58E-05
0.3564	-0.001712	-0.00427	7.31E-06
0.3888	-0.000919	-0.00229	2.1E-06
0.4212	-0.000139	-0.00035	4.87E-08
0.4536	0.000631	0.00157	9.91E-07
0.486	0.001393	0.00348	4.85E-06
0.5184	0.002149	0.00536	1.15E-05
0.5508	0.002902	0.00724	2.1E-05
0.5832	0.003652	0.00911	3.33E-05
0.6156	0.004401	0.01098	4.83E-05
0.648	0.005149	0.01285	6.62E-05

B= 0.0254 m
delta Z= 0.0324 m

by Simpson's rule:

INT= 4.92E-05 m^3

w(b)= 0.011508 m
w(a)= 0.007135 m
delta kh= (w(b)-w(a))/INT
delta kh= 89 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 314 kN/m^2

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Table G48

NUMERICAL ANALYSIS OF LATERELLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA 1.8
LINEAR PART
PILE LENGTH=0.648m

	Pi=0.445kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.012787	-0.02871	0.000367
0.0324	-0.01172	-0.02631	0.000308
0.0648	-0.01066	. -0.02393	0.000255
0.0972	-0.009612	-0.02158	0.000207
0.1296	-0.008579	-0.01926	0.000165
0.162	-0.007564	-0.01698	0.000128
0.1944	-0.006569	-0.01475	9.69E-05
0.2268	-0.005596	-0.01256	7.03E-05
0.2592	-0.004643	-0.01043	4.84E-05
0.2916	-0.003711	-0.00833	3.09E-05
0.324	-0.002798	-0.00628	1.76E-05
0.3564	-0.001902	-0.00427	8.12E-06
0.3888	-0.001022	-0.00229	2.34E-06
0.4212	-0.000155	-0.00035	5.43E-08
0.4536	0.000701	0.00157	1.1E-06
0.486	0.001548	0.00348	5.39E-06
0.5184	0.002388	0.00536	1.28E-05
0.5508	0.003225	0.00724	2.33E-05
0.5832	0.004058	0.00911	3.7E-05
0.6156	0.00489	0.01098	5.37E-05
0.648	0.005722	0.01285	7.35E-05

B= 0.0254 m
delta Z= 0.0324 m

by Simpson's rule:

INT= 5.46E-05 m^3

w(b)= 0.012787 m
w(a)= 0.008576 m
delta kh= (w(b)-w(a))/INT
delta kh= 77 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 302 kN/m^2

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Table G49

NUMERICAL ANALYSIS OF LATERELLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA 1.8
LINEAR PART
PILE LENGTH=0.648m

	Pi=0.501kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.014372	-0.02871	0.000413
0.0324	-0.013174	-0.02631	0.000347
0.0648	-0.011982	. -0.02393	0.000287
0.0972	-0.010803	-0.02158	0.000233
0.1296	-0.009643	-0.01926	0.000186
0.162	-0.008502	-0.01698	0.000144
0.1944	-0.007384	-0.01475	0.000109
0.2268	-0.006289	-0.01256	7.9E-05
0.2592	-0.005219	-0.01043	5.44E-05
0.2916	-0.004171	-0.00833	3.47E-05
0.324	-0.003145	-0.00628	1.98E-05
0.3564	-0.002138	-0.00427	9.13E-06
0.3888	-0.001148	-0.00229	2.63E-06
0.4212	-0.000174	-0.00035	6.09E-08
0.4536	0.000788	0.00157	1.24E-06
0.486	0.001739	0.00348	6.05E-06
0.5184	0.002685	0.00536	1.44E-05
0.5508	0.003624	0.00724	2.62E-05
0.5832	0.004561	0.00911	4.16E-05
0.6156	0.005497	0.01098	6.04E-05
0.648	0.006432	0.01285	8.27E-05

B= 0.0254 m
delta Z= 0.0324 m

by Simpson's rule:

INT= 6.14E-05 m^3

w(b)= 0.014372 m
w(a)= 0.010893 m
delta kh= (w(b)-w(a))/INT
delta kh= 57 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	282	kN/m^2

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Table G50

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Pi=0.045kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.001175	-0.02638	3.1E-05
0.036	-0.001072	-0.02408	2.58E-05
0.072	-0.000971	. -0.02179	2.12E-05
0.108	-0.00087	-0.01954	1.7E-05
0.144	-0.000772	-0.01734	1.34E-05
0.18	-0.000677	-0.01519	1.03E-05
0.216	-0.000584	-0.01311	7.66E-06
0.252	-0.000494	-0.01108	5.47E-06
0.288	-0.000406	-0.00913	3.71E-06
0.324	-0.000322	-0.00723	2.33E-06
0.36	-0.00024	-0.0054	1.3E-06
0.396	-0.00016	-0.0036	5.76E-07
0.432	-0.000083	-0.00186	1.54E-07
0.468	-0.000007	-0.00016	1.12E-09
0.504	0.000067	0.0015	1.01E-07
0.54	0.00014	0.00314	4.4E-07
0.576	0.000212	0.00476	1.01E-06
0.612	0.000284	0.00637	1.81E-06
0.648	0.000355	0.00797	2.83E-06
0.684	0.000426	0.00957	4.08E-06
0.72	0.000497	0.01116	5.55E-06

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 4.92E-06 m^3

w(b)= 0.001175 m
w(a)= 0.000395 m
delta kh= (w(b)-w(a))/INT
delta kh= 158 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 383 kN/m^2

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Table G51

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Pi=0.089kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.00235	-0.02638	6.2E-05
0.036	-0.002145	-0.02408	5.17E-05
0.072	-0.001941	-0.02179	4.23E-05
0.108	-0.001741	-0.01954	3.4E-05
0.144	-0.001545	-0.01734	2.68E-05
0.18	-0.001353	-0.01519	2.06E-05
0.216	-0.001168	-0.01311	1.53E-05
0.252	-0.000987	-0.01108	1.09E-05
0.288	-0.000813	-0.00913	7.42E-06
0.324	-0.000644	-0.00723	4.66E-06
0.36	-0.00048	-0.0054	2.59E-06
0.396	-0.000321	-0.0036	1.16E-06
0.432	-0.000166	-0.00186	3.09E-07
0.468	-0.000015	-0.00016	2.4E-09
0.504	0.000134	0.0015	2.01E-07
0.54	0.00028	0.00314	8.79E-07
0.576	0.000424	0.00476	2.02E-06
0.612	0.000568	0.00637	3.62E-06
0.648	0.00071	0.00797	5.66E-06
0.684	0.000852	0.00957	8.15E-06
0.72	0.000994	0.01116	1.11E-05

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 9.85E-06 m^3

w(b)= 0.00235 m
w(a)= 0.000923 m
delta kh= (w(b)-w(a))/INT
delta kh= 145 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**370**	**kN/m^2**

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Table G52

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

B= 0.0254 m
delta Z= 0.036 m

	Pi=0.134kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.003525	-0.02638	9.3E-05
0.036	-0.003217	-0.02408	7.75E-05
0.072	-0.002912	-0.02179	6.35E-05
0.108	-0.002611	-0.01954	5.1E-05
0.144	-0.002317	-0.01734	4.02E-05
0.18	-0.002029	-0.01519	3.08E-05
0.216	-0.001751	-0.01311	2.3E-05
0.252	-0.001481	-0.01108	1.64E-05
0.288	-0.001219	-0.00913	1.11E-05
0.324	-0.000966	-0.00723	6.98E-06
0.36	-0.00072	-0.0054	3.89E-06
0.396	-0.000481	-0.0036	1.73E-06
0.432	-0.000249	-0.00186	4.63E-07
0.468	-0.000022	-0.00016	3.52E-09
0.504	0.000201	0.0015	3.02E-07
0.54	0.00042	0.00314	1.32E-06
0.576	0.000637	0.00476	3.03E-06
0.612	0.000851	0.00637	5.42E-06
0.648	0.001065	0.00797	8.49E-06
0.684	0.001279	0.00957	1.22E-05
0.72	0.001492	0.01116	1.67E-05

by Simpson's rule:

INT= 1.48E-05 m^3

w(b)= 0.003525 m
w(a)= 0.001548 m
delta kh= (w(b)-w(a))/INT
delta kh= 134 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 359 kN/m^2

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Table G53

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Pi=0.178kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.0047	-0.02638	0.000124
0.036	-0.004289	-0.02408	0.000103
0.072	-0.003882	. -0.02179	8.46E-05
0.108	-0.003481	-0.01954	6.8E-05
0.144	-0.003089	-0.01734	5.36E-05
0.18	-0.002707	-0.01519	4.11E-05
0.216	-0.002335	-0.01311	3.06E-05
0.252	-0.001975	-0.01108	2.19E-05
0.288	-0.001626	-0.00913	1.48E-05
0.324	-0.001288	-0.00723	9.31E-06
0.36	-0.00096	-0.0054	5.18E-06
0.396	-0.000642	-0.0036	2.31E-06
0.432	-0.000332	-0.00186	6.18E-07
0.468	-0.000029	-0.00016	4.64E-09
0.504	0.000268	0.0015	4.02E-07
0.54	0.00056	0.00314	1.76E-06
0.576	0.000849	0.00476	4.04E-06
0.612	0.001135	0.00637	7.23E-06
0.648	0.00142	0.00797	1.13E-05
0.684	0.001705	0.00957	1.63E-05
0.72	0.001989	0.01116	2.22E-05

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 1.97E-05 m^3

w(b)= 0.0047 m
w(a)= 0.00223 m
delta kh= (w(b)-w(a))/INT
delta kh= 125 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 350 kN/m^2

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Table G54
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Pi=0.223kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.005875	-0.02638	0.000155
0.036	-0.005362	-0.02408	0.000129
0.072	-0.004853	-0.02179	0.000106
0.108	-0.004352	-0.01954	8.5E-05
0.144	-0.003861	-0.01734	6.69E-05
0.18	-0.003383	-0.01519	5.14E-05
0.216	-0.002919	-0.01311	3.83E-05
0.252	-0.002469	-0.01108	2.74E-05
0.288	-0.002032	-0.00913	1.86E-05
0.324	-0.001609	-0.00723	1.16E-05
0.36	-0.0012	-0.0054	6.48E-06
0.396	-0.000802	-0.0036	2.89E-06
0.432	-0.000415	-0.00186	7.72E-07
0.468	-0.000036	-0.00016	5.76E-09
0.504	0.000335	0.0015	5.03E-07
0.54	0.0007	0.00314	2.2E-06
0.576	0.001061	0.00476	5.05E-06
0.612	0.001419	0.00637	9.04E-06
0.648	0.001775	0.00797	1.41E-05
0.684	0.002131	0.00957	2.04E-05
0.72	0.002486	0.01116	2.77E-05

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 2.46E-05 m^3

w(b)= 0.005875 m
w(a)= 0.002999 m
delta kh= (w(b)-w(a))/INT
delta kh= 117 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 342 kN/m^2

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Table G55

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Pi=0.267kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.007051	-0.02638	0.000186
0.036	-0.006434	-0.02408	0.000155
0.072	-0.005824	.-0.02179	0.000127
0.108	-0.005222	-0.01954	0.000102
0.144	-0.004634	-0.01734	8.04E-05
0.18	-0.004059	-0.01519	6.17E-05
0.216	-0.003503	-0.01311	4.59E-05
0.252	-0.002962	-0.01108	3.28E-05
0.288	-0.002439	-0.00913	2.23E-05
0.324	-0.001932	-0.00723	1.4E-05
0.36	-0.00144	-0.0054	7.78E-06
0.396	-0.000963	-0.0036	3.47E-06
0.432	-0.000498	-0.00186	9.26E-07
0.468	-0.000044	-0.00016	7.04E-09
0.504	0.000402	0.0015	6.03E-07
0.54	0.00084	0.00314	2.64E-06
0.576	0.001273	0.00476	6.06E-06
0.612	0.001703	0.00637	1.08E-05
0.648	0.002131	0.00797	1.7E-05
0.684	0.002557	0.00957	2.45E-05
0.72	0.002983	0.01116	3.33E-05

B= 0.0254 m
delta Z= 0.036 m

<u>by Simpson's rule:</u>

INT= 2.95E-05 m^3

w(b)= 0.007051 m
w(a)= 0.003853 m
delta kh= (w(b)-w(a))/INT
delta kh= 108 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\text{kh= 333 kN/m^2}}$

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Table G56

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

B= 0.0254 m
delta Z= 0.036 m

	Pi=0.312kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.008226	-0.02638	0.000217
0.036	-0.007507	-0.02408	0.000181
0.072	-0.006794	-0.02179	0.000148
0.108	-0.006093	-0.01954	0.000119
0.144	-0.005406	-0.01734	9.37E-05
0.18	-0.004737	-0.01519	7.2E-05
0.216	-0.004086	-0.01311	5.36E-05
0.252	-0.003456	-0.01108	3.83E-05
0.288	-0.002845	-0.00913	2.6E-05
0.324	-0.002254	-0.00723	1.63E-05
0.36	-0.00168	-0.0054	9.07E-06
0.396	-0.001123	-0.0036	4.04E-06
0.432	-0.000581	-0.00186	1.08E-06
0.468	-0.000051	-0.00016	8.16E-09
0.504	0.000469	0.0015	7.04E-07
0.54	0.00098	0.00314	3.08E-06
0.576	0.001486	0.00476	7.07E-06
0.612	0.001987	0.00637	1.27E-05
0.648	0.002486	0.00797	1.98E-05
0.684	0.002983	0.00957	2.85E-05
0.72	0.00348	0.01116	3.88E-05

by Simpson's rule:

INT= 3.45E-05 m^3

w(b)= 0.008226 m
w(a)= 0.004775 m
delta kh= (w(b)-w(a))/INT
delta kh= 100 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\text{kh= 325 kN/m^2}}$

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Table G57

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Pi=0.356kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.009401	-0.02638	0.000248
0.036	-0.008579	-0.02408	0.000207
0.072	-0.007764	-0.02179	0.000169
0.108	-0.006963	-0.01954	0.000136
0.144	-0.006178	-0.01734	0.000107
0.18	-0.005413	-0.01519	8.22E-05
0.216	-0.00467	-0.01311	6.12E-05
0.252	-0.003949	-0.01108	4.38E-05
0.288	-0.003252	-0.00913	2.97E-05
0.324	-0.002576	-0.00723	1.86E-05
0.36	-0.00192	-0.0054	1.04E-05
0.396	-0.001284	-0.0036	4.62E-06
0.432	-0.000664	-0.00186	1.24E-06
0.468	-0.000058	-0.00016	9.28E-09
0.504	0.000536	0.0015	8.04E-07
0.54	0.00112	0.00314	3.52E-06
0.576	0.001698	0.00476	8.08E-06
0.612	0.002271	0.00637	1.45E-05
0.648	0.002841	0.00797	2.26E-05
0.684	0.003409	0.00957	3.26E-05
0.72	0.003978	0.01116	4.44E-05

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 3.94E-05 m^3

w(b)= 0.009401 m
w(a)= 0.005867 m
delta kh= (w(b)-w(a))/INT
delta kh= 90 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**315**	**kN/m^2**

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Table G58
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Pi=0.401kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.010576	-0.02638	0.000279
0.036	-0.009652	-0.02408	0.000232
0.072	-0.008735	-0.02179	0.00019
0.108	-0.007833	-0.01954	0.000153
0.144	-0.00695	-0.01734	0.000121
0.18	-0.006089	-0.01519	9.25E-05
0.216	-0.005254	-0.01311	6.89E-05
0.252	-0.004443	-0.01108	4.92E-05
0.288	-0.003658	-0.00913	3.34E-05
0.324	-0.002898	-0.00723	2.1E-05
0.36	-0.00216	-0.0054	1.17E-05
0.396	-0.001444	-0.0036	5.2E-06
0.432	-0.000747	-0.00186	1.39E-06
0.468	-0.000065	-0.00016	1.04E-08
0.504	0.000603	0.0015	9.05E-07
0.54	0.00126	0.00314	3.96E-06
0.576	0.001909	0.00476	9.09E-06
0.612	0.002554	0.00637	1.63E-05
0.648	0.003196	0.00797	2.55E-05
0.684	0.003836	0.00957	3.67E-05
0.72	0.004475	0.01116	4.99E-05

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 4.43E-05 m^3

w(b)= 0.010576 m
w(a)= 0.007048 m
delta kh= (w(b)-w(a))/INT
delta kh= 80 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**305**	**kN/m^2**

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Table G59

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Pi=0.445kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.011751	-0.02638	0.00031
0.036	-0.010724	-0.02408	0.000258
0.072	-0.009706	-0.02179	0.000211
0.108	-0.008704	-0.01954	0.00017
0.144	-0.007723	-0.01734	0.000134
0.18	-0.006767	-0.01519	0.000103
0.216	-0.005838	-0.01311	7.65E-05
0.252	-0.004937	-0.01108	5.47E-05
0.288	-0.004065	-0.00913	3.71E-05
0.324	-0.003219	-0.00723	2.33E-05
0.36	-0.0024	-0.0054	1.3E-05
0.396	-0.001605	-0.0036	5.78E-06
0.432	-0.000829	-0.00186	1.54E-06
0.468	-0.000073	-0.00016	1.17E-08
0.504	0.000669	0.0015	1E-06
0.54	0.0014	0.00314	4.4E-06
0.576	0.002122	0.00476	1.01E-05
0.612	0.002838	0.00637	1.81E-05
0.648	0.003551	0.00797	2.83E-05
0.684	0.004262	0.00957	4.08E-05
0.72	0.004972	0.01116	5.55E-05

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 4.92E-05 m^3

w(b)= 0.011751 m
w(a)= 0.008389 m
delta kh= (w(b)-w(a))/INT
delta kh= 68 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 293 kN/m^2

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Table G60

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Pi=0.490kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.012926	-0.02638	0.000341
0.036	-0.011796	-0.02408	0.000284
0.072	-0.010677	. -0.02179	0.000233
0.108	-0.009574	-0.01954	0.000187
0.144	-0.008495	-0.01734	0.000147
0.18	-0.007443	-0.01519	0.000113
0.216	-0.006422	-0.01311	8.42E-05
0.252	-0.005431	-0.01108	6.02E-05
0.288	-0.004471	-0.00913	4.08E-05
0.324	-0.003542	-0.00723	2.56E-05
0.36	-0.002641	-0.0054	1.43E-05
0.396	-0.001765	-0.0036	6.35E-06
0.432	-0.000913	-0.00186	1.7E-06
0.468	-0.00008	-0.00016	1.28E-08
0.504	0.000736	0.0015	1.1E-06
0.54	0.00154	0.00314	4.84E-06
0.576	0.002334	0.00476	1.11E-05
0.612	0.003122	0.00637	1.99E-05
0.648	0.003906	0.00797	3.11E-05
0.684	0.004688	0.00957	4.49E-05
0.72	0.005469	0.01116	6.1E-05

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 5.42E-05 m^3

w(b)= 0.012926 m
w(a)= 0.009948 m
delta kh= (w(b)-w(a))/INT
delta kh= 55 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\textbf{kh= 280 kN/m^2}}$

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Table G61
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Pi=0.534kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.014101	-0.02638	0.000372
0.036	-0.012869	-0.02408	0.00031
0.072	-0.011647	. -0.02179	0.000254
0.108	-0.010444	-0.01954	0.000204
0.144	-0.009267	-0.01734	0.000161
0.18	-0.008119	-0.01519	0.000123
0.216	-0.007005	-0.01311	9.18E-05
0.252	-0.005924	-0.01108	6.56E-05
0.288	-0.004878	-0.00913	4.45E-05
0.324	-0.003864	-0.00723	2.79E-05
0.36	-0.002881	-0.0054	1.56E-05
0.396	-0.001926	-0.0036	6.93E-06
0.432	-0.000996	-0.00186	1.85E-06
0.468	-0.000087	-0.00016	1.39E-08
0.504	0.000803	0.0015	1.2E-06
0.54	0.00168	0.00314	5.28E-06
0.576	0.002547	0.00476	1.21E-05
0.612	0.003406	0.00637	2.17E-05
0.648	0.004261	0.00797	3.4E-05
0.684	0.005114	0.00957	4.89E-05
0.72	0.005966	0.01116	6.66E-05

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 5.91E-05 m^3

w(b)= 0.014101 m
w(a)= 0.011668 m
delta kh= (w(b)-w(a))/INT
delta kh= 41 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 266 kN/m^2

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Table G62

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Pi=0.579kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.015276	-0.02638	0.000403
0.036	-0.013941	-0.02408	0.000336
0.072	-0.012618	-0.02179	0.000275
0.108	-0.011315	-0.01954	0.000221
0.144	-0.010039	-0.01734	0.000174
0.18	-0.008797	-0.01519	0.000134
0.216	-0.007589	-0.01311	9.95E-05
0.252	-0.006418	-0.01108	7.11E-05
0.288	-0.005284	-0.00913	4.82E-05
0.324	-0.004186	-0.00723	3.03E-05
0.36	-0.003121	-0.0054	1.69E-05
0.396	-0.002086	-0.0036	7.51E-06
0.432	-0.001079	-0.00186	2.01E-06
0.468	-0.000095	-0.00016	1.52E-08
0.504	0.00087	0.0015	1.31E-06
0.54	0.00182	0.00314	5.71E-06
0.576	0.002759	0.00476	1.31E-05
0.612	0.003689	0.00637	2.35E-05
0.648	0.004616	0.00797	3.68E-05
0.684	0.00554	0.00957	5.3E-05
0.72	0.006464	0.01116	7.21E-05

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 6.4E-05 m^3

w(b)= 0.015276 m
w(a)= 0.013975 m
delta kh= (w(b)-w(a))/INT
delta kh= 20 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	245	kN/m^2

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Table G63

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.045kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.001038	-0.02332	2.42E-05
0.0432	-0.000936	-0.02102	1.97E-05
0.0864	-0.000836	-0.01877	1.57E-05
0.1296	-0.000738	-0.01657	1.22E-05
0.1728	-0.000644	-0.01445	9.31E-06
0.216	-0.000554	-0.01243	6.89E-06
0.2592	-0.000468	-0.01051	4.92E-06
0.3024	-0.000387	-0.00869	3.36E-06
0.3456	-0.000311	-0.00698	2.17E-06
0.3888	-0.000239	-0.00537	1.28E-06
0.432	-0.000172	-0.00386	6.64E-07
0.4752	-0.000108	-0.00243	2.62E-07
0.5184	-0.000048	-0.00107	5.14E-08
0.5616	0.000009	0.00022	1.98E-09
0.6048	0.000065	0.00146	9.49E-08
0.648	0.000118	0.00265	3.13E-07
0.6912	0.00017	0.00382	6.49E-07
0.7344	0.000221	0.00496	1.1E-06
0.7776	0.000272	0.0061	1.66E-06
0.8208	0.000322	0.00722	2.32E-06
0.864	0.000372	0.00835	3.11E-06

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 4.14E-06 m^3

w(b)= 0.001038 m
w(a)= 0.0002 m
delta kh= (w(b)-w(a))/INT
delta kh= 202 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	427	kN/m^2

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Table G64

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.089kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.002077	-0.02332	4.84E-05
0.0432	-0.001873	-0.02102	3.94E-05
0.0864	-0.001672	-0.01877	3.14E-05
0.1296	-0.001476	-0.01657	2.45E-05
0.1728	-0.001287	-0.01445	1.86E-05
0.216	-0.001107	-0.01243	1.38E-05
0.2592	-0.000936	-0.01051	9.84E-06
0.3024	-0.000774	-0.00869	6.73E-06
0.3456	-0.000622	-0.00698	4.34E-06
0.3888	-0.000479	-0.00537	2.57E-06
0.432	-0.000344	-0.00386	1.33E-06
0.4752	-0.000216	-0.00243	5.25E-07
0.5184	-0.000096	-0.00107	1.03E-07
0.5616	0.000019	0.00022	4.18E-09
0.6048	0.000129	0.00146	1.88E-07
0.648	0.000236	0.00265	6.25E-07
0.6912	0.00034	0.00382	1.3E-06
0.7344	0.000442	0.00496	2.19E-06
0.7776	0.000543	0.0061	3.31E-06
0.8208	0.000643	0.00722	4.64E-06
0.864	0.000744	0.00835	6.21E-06

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 8.28E-06 m^3

w(b)= 0.002077 m
w(a)= 0.000515 m
delta kh= (w(b)-w(a))/INT
delta kh= 189 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 414 kN/m^2

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Table G65

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.134kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.003115	-0.02332	7.26E-05
0.0432	-0.002809	-0.02102	5.9E-05
0.0864	-0.002507	-0.01877	4.71E-05
0.1296	-0.002214	-0.01657	3.67E-05
0.1728	-0.001931	-0.01445	2.79E-05
0.216	-0.001661	-0.01243	2.06E-05
0.2592	-0.001404	-0.01051	1.48E-05
0.3024	-0.001162	-0.00869	1.01E-05
0.3456	-0.000933	-0.00698	6.51E-06
0.3888	-0.000718	-0.00537	3.86E-06
0.432	-0.000515	-0.00386	1.99E-06
0.4752	-0.000324	-0.00243	7.87E-07
0.5184	-0.000143	-0.00107	1.53E-07
0.5616	0.000029	0.00022	6.38E-09
0.6048	0.000195	0.00146	2.85E-07
0.648	0.000355	0.00265	9.41E-07
0.6912	0.00051	0.00382	1.95E-06
0.7344	0.000663	0.00496	3.29E-06
0.7776	0.000815	0.0061	4.97E-06
0.8208	0.000965	0.00722	6.97E-06
0.864	0.001116	0.00835	9.32E-06

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 1.24E-05 m^3

w(b)= 0.003115 m
w(a)= 0.00087 m
delta kh= (w(b)-w(a))/INT
delta kh= 181 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**406**	**kN/m^2**

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Table G66
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.178kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.004154	-0.02332	9.69E-05
0.0432	-0.003746	-0.02102	7.87E-05
0.0864	-0.003343	. -0.01877	6.27E-05
0.1296	-0.002952	-0.01657	4.89E-05
0.1728	-0.002575	-0.01445	3.72E-05
0.216	-0.002214	-0.01243	2.75E-05
0.2592	-0.001872	-0.01051	1.97E-05
0.3024	-0.001549	-0.00869	1.35E-05
0.3456	-0.001244	-0.00698	8.68E-06
0.3888	-0.000957	-0.00537	5.14E-06
0.432	-0.000687	-0.00386	2.65E-06
0.4752	-0.000432	-0.00243	1.05E-06
0.5184	-0.000191	-0.00107	2.04E-07
0.5616	0.000039	0.00022	8.58E-09
0.6048	0.000259	0.00146	3.78E-07
0.648	0.000473	0.00265	1.25E-06
0.6912	0.00068	0.00382	2.6E-06
0.7344	0.000884	0.00496	4.38E-06
0.7776	0.001086	0.0061	6.62E-06
0.8208	0.001287	0.00722	9.29E-06
0.864	0.001487	0.00835	1.24E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 1.66E-05 m^3

w(b)= 0.004154 m
w(a)= 0.001273 m
delta kh= (w(b)-w(a))/INT
delta kh= 174 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 399 kN/m^2

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Table G67

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.223kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.005192	-0.02332	0.000121
0.0432	-0.004682	-0.02102	9.84E-05
0.0864	-0.004179	-0.01877	7.84E-05
0.1296	-0.003689	-0.01657	6.11E-05
0.1728	-0.003219	-0.01445	4.65E-05
0.216	-0.002768	-0.01243	3.44E-05
0.2592	-0.00234	-0.01051	2.46E-05
0.3024	-0.001936	-0.00869	1.68E-05
0.3456	-0.001555	-0.00698	1.09E-05
0.3888	-0.001197	-0.00537	6.43E-06
0.432	-0.000859	-0.00386	3.32E-06
0.4752	-0.000541	-0.00243	1.31E-06
0.5184	-0.000239	-0.00107	2.56E-07
0.5616	0.000049	0.00022	1.08E-08
0.6048	0.000324	0.00146	4.73E-07
0.648	0.000591	0.00265	1.57E-06
0.6912	0.000851	0.00382	3.25E-06
0.7344	0.001106	0.00496	5.49E-06
0.7776	0.001358	0.0061	8.28E-06
0.8208	0.001609	0.00722	1.16E-05
0.864	0.001859	0.00835	1.55E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 2.07E-05 m^3

w(b)= 0.005192 m
w(a)= 0.001693 m
delta kh= (w(b)-w(a))/INT
delta kh= 169 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**394**	**kN/m^2**

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Table G68

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

B= 0.0254 m
delta Z= 0.0432 m

	Pi=0.267kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.006231	-0.02332	0.000145
0.0432	-0.005618	-0.02102	0.000118
0.0864	-0.005015	-0.01877	9.41E-05
0.1296	-0.004428	-0.01657	7.34E-05
0.1728	-0.003862	-0.01445	5.58E-05
0.216	-0.003322	-0.01243	4.13E-05
0.2592	-0.002808	-0.01051	2.95E-05
0.3024	-0.002323	-0.00869	2.02E-05
0.3456	-0.001866	-0.00698	1.3E-05
0.3888	-0.001436	-0.00537	7.71E-06
0.432	-0.001031	-0.00386	3.98E-06
0.4752	-0.000649	-0.00243	1.58E-06
0.5184	-0.000287	-0.00107	3.07E-07
0.5616	0.000058	0.00022	1.28E-08
0.6048	0.000389	0.00146	5.68E-07
0.648	0.000709	0.00265	1.88E-06
0.6912	0.001021	0.00382	3.9E-06
0.7344	0.001327	0.00496	6.58E-06
0.7776	0.001629	0.0061	9.94E-06
0.8208	0.00193	0.00722	1.39E-05
0.864	0.002231	0.00835	1.86E-05

by Simpson's rule:

INT= 2.48E-05 m^3

w(b)= 0.006231 m
w(a)= 0.002135 m
delta kh= (w(b)-w(a))/INT
delta kh= 165 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	390	kN/m^2

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Table G69

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.312kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.007269	-0.02332	0.00017
0.0432	-0.006554	-0.02102	0.000138
0.0864	-0.005851	-0.01877	0.00011
0.1296	-0.005166	-0.01657	8.56E-05
0.1728	-0.004506	-0.01445	6.51E-05
0.216	-0.003875	-0.01243	4.82E-05
0.2592	-0.003277	-0.01051	3.44E-05
0.3024	-0.002711	-0.00869	2.36E-05
0.3456	-0.002177	-0.00698	1.52E-05
0.3888	-0.001675	-0.00537	8.99E-06
0.432	-0.001203	-0.00386	4.64E-06
0.4752	-0.000757	-0.00243	1.84E-06
0.5184	-0.000334	-0.00107	3.57E-07
0.5616	0.000068	0.00022	1.5E-08
0.6048	0.000454	0.00146	6.63E-07
0.648	0.000827	0.00265	2.19E-06
0.6912	0.001191	0.00382	4.55E-06
0.7344	0.001548	0.00496	7.68E-06
0.7776	0.001901	0.0061	1.16E-05
0.8208	0.002252	0.00722	1.63E-05
0.864	0.002603	0.00835	2.17E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 2.9E-05 m^3

w(b)= 0.007269 m
w(a)= 0.002642 m
delta kh= (w(b)-w(a))/INT
delta kh= 160 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 385 kN/m^2

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Table G70

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

B= 0.0254 m
delta Z= 0.0432 m

	Pi=0.356kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.008308	-0.02332	0.000194
0.0432	-0.007491	-0.02102	0.000157
0.0864	-0.006687	-0.01877	0.000126
0.1296	-0.005904	-0.01657	9.78E-05
0.1728	-0.005149	-0.01445	7.44E-05
0.216	-0.004429	-0.01243	5.51E-05
0.2592	-0.003745	-0.01051	3.94E-05
0.3024	-0.003098	-0.00869	2.69E-05
0.3456	-0.002488	-0.00698	1.74E-05
0.3888	-0.001915	-0.00537	1.03E-05
0.432	-0.001375	-0.00386	5.31E-06
0.4752	-0.000865	-0.00243	2.1E-06
0.5184	-0.000382	-0.00107	4.09E-07
0.5616	0.000078	0.00022	1.72E-08
0.6048	0.000519	0.00146	7.58E-07
0.648	0.000945	0.00265	2.5E-06
0.6912	0.001361	0.00382	5.2E-06
0.7344	0.001769	0.00496	8.77E-06
0.7776	0.002172	0.0061	1.32E-05
0.8208	0.002574	0.00722	1.86E-05
0.864	0.002975	0.00835	2.48E-05

by Simpson's rule:

INT= 3.31E-05 m^3

w(b)= 0.008308 m
w(a)= 0.003129 m
delta kh= (w(b)-w(a))/INT
delta kh= 156 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	381	kN/m^2

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Table G71

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.401kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.009346	-0.02332	0.000218
0.0432	-0.008428	-0.02102	0.000177
0.0864	-0.007522	-0.01877	0.000141
0.1296	-0.006642	-0.01657	0.00011
0.1728	-0.005793	-0.01445	8.37E-05
0.216	-0.004983	-0.01243	6.19E-05
0.2592	-0.004213	-0.01051	4.43E-05
0.3024	-0.003485	-0.00869	3.03E-05
0.3456	-0.002799	-0.00698	1.95E-05
0.3888	-0.002154	-0.00537	1.16E-05
0.432	-0.001545	-0.00386	5.96E-06
0.4752	-0.000973	-0.00243	2.36E-06
0.5184	-0.000429	-0.00107	4.59E-07
0.5616	0.000088	0.00022	1.94E-08
0.6048	0.000584	0.00146	8.53E-07
0.648	0.001064	0.00265	2.82E-06
0.6912	0.001531	0.00382	5.85E-06
0.7344	0.001989	0.00496	9.87E-06
0.7776	0.002444	0.0061	1.49E-05
0.8208	0.002896	0.00722	2.09E-05
0.864	0.003347	0.00835	2.79E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 3.73E-05 m^3

w(b)= 0.009346 m
w(a)= 0.003624 m
delta kh= (w(b)-w(a))/INT
delta kh= 154 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 379 kN/m^2

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Table G72

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.456kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.010634	-0.02332	0.000248
0.0432	-0.009589	-0.02102	0.000202
0.0864	-0.008559	. -0.01877	0.000161
0.1296	-0.007557	-0.01657	0.000125
0.1728	-0.006591	-0.01445	9.52E-05
0.216	-0.005669	-0.01243	7.05E-05
0.2592	-0.004793	-0.01051	5.04E-05
0.3024	-0.003965	-0.00869	3.45E-05
0.3456	-0.003185	-0.00698	2.22E-05
0.3888	-0.002451	-0.00537	1.32E-05
0.432	-0.001759	-0.00386	6.79E-06
0.4752	-0.001107	-0.00243	2.69E-06
0.5184	-0.000489	-0.00107	5.23E-07
0.5616	0.000099	0.00022	2.18E-08
0.6048	0.000664	0.00146	9.69E-07
0.648	0.00121	0.00265	3.21E-06
0.6912	0.001742	0.00382	6.65E-06
0.7344	0.002264	0.00496	1.12E-05
0.7776	0.002781	0.0061	1.7E-05
0.8208	0.003295	0.00722	2.38E-05
0.864	0.003808	0.00835	3.18E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 4.24E-05 m^3

w(b)= 0.010634 m
w(a)= 0.004326 m
delta kh= (w(b)-w(a))/INT
delta kh= 149 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 374 kN/m^2

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Table G73

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.511kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.011922	-0.02332	0.000278
0.0432	-0.010749	-0.02102	0.000226
0.0864	-0.009595	-0.01877	0.00018
0.1296	-0.008472	-0.01657	0.00014
0.1728	-0.007389	-0.01445	0.000107
0.216	-0.006355	-0.01243	7.9E-05
0.2592	-0.005373	-0.01051	5.65E-05
0.3024	-0.004445	-0.00869	3.86E-05
0.3456	-0.003571	-0.00698	2.49E-05
0.3888	-0.002747	-0.00537	1.48E-05
0.432	-0.001973	-0.00386	7.62E-06
0.4752	-0.001241	-0.00243	3.02E-06
0.5184	-0.000548	-0.00107	5.86E-07
0.5616	0.000112	0.00022	2.46E-08
0.6048	0.000745	0.00146	1.09E-06
0.648	0.001356	0.00265	3.59E-06
0.6912	0.001953	0.00382	7.46E-06
0.7344	0.002538	0.00496	1.26E-05
0.7776	0.003118	0.0061	1.9E-05
0.8208	0.003694	0.00722	2.67E-05
0.864	0.004269	0.00835	3.56E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 4.75E-05 m^3

w(b)= 0.011922 m
w(a)= 0.004989 m
delta kh= (w(b)-w(a))/INT
delta kh= 146 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 371 kN/m^2

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Table G74

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.567kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.013209	-0.02332	0.000308
0.0432	-0.011911	-0.02102	0.00025
0.0864	-0.010632	-0.01877	0.0002
0.1296	-0.009387	-0.01657	0.000156
0.1728	-0.008188	-0.01445	0.000118
0.216	-0.007042	-0.01243	8.75E-05
0.2592	-0.005954	-0.01051	6.26E-05
0.3024	-0.004926	-0.00869	4.28E-05
0.3456	-0.003956	-0.00698	2.76E-05
0.3888	-0.003044	-0.00537	1.63E-05
0.432	-0.002186	-0.00386	8.44E-06
0.4752	-0.001375	-0.00243	3.34E-06
0.5184	-0.000607	-0.00107	6.49E-07
0.5616	0.000124	0.00022	2.73E-08
0.6048	0.000825	0.00146	1.2E-06
0.648	0.001503	0.00265	3.98E-06
0.6912	0.002164	0.00382	8.27E-06
0.7344	0.002813	0.00496	1.4E-05
0.7776	0.003454	0.0061	2.11E-05
0.8208	0.004093	0.00722	2.96E-05
0.864	0.00473	0.00835	3.95E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 5.27E-05 m^3

w(b)= 0.013209 m
w(a)= 0.005734 m
delta kh= (w(b)-w(a))/INT
delta kh= 142 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 367 kN/m^2

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Table G75

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.622kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.014497	-0.02332	0.000338
0.0432	-0.013072	-0.02102	0.000275
0.0864	-0.011668	-0.01877	0.000219
0.1296	-0.010302	-0.01657	0.000171
0.1728	-0.008986	-0.01445	0.00013
0.216	-0.007728	-0.01243	9.61E-05
0.2592	-0.006534	-0.01051	6.87E-05
0.3024	-0.005406	-0.00869	4.7E-05
0.3456	-0.004342	-0.00698	3.03E-05
0.3888	-0.003341	-0.00537	1.79E-05
0.432	-0.002399	-0.00386	9.26E-06
0.4752	-0.001509	-0.00243	3.67E-06
0.5184	-0.000667	-0.00107	7.14E-07
0.5616	0.000136	0.00022	2.99E-08
0.6048	0.000906	0.00146	1.32E-06
0.648	0.001649	0.00265	4.37E-06
0.6912	0.002374	0.00382	9.07E-06
0.7344	0.003087	0.00496	1.53E-05
0.7776	0.003791	0.0061	2.31E-05
0.8208	0.004492	0.00722	3.24E-05
0.864	0.005191	0.00835	4.33E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 5.78E-05 m^3

w(b)= 0.014497 m
w(a)= 0.006467 m
delta kh= (w(b)-w(a))/INT
delta kh= 139 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	364	kN/m^2

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Table G76

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.677kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.015785	-0.02332	0.000368
0.0432	-0.014233	-0.02102	0.000299
0.0864	-0.012705	-0.01877	0.000238
0.1296	-0.011217	-0.01657	0.000186
0.1728	-0.009784	-0.01445	0.000141
0.216	-0.008415	-0.01243	0.000105
0.2592	-0.007115	-0.01051	7.48E-05
0.3024	-0.005886	-0.00869	5.11E-05
0.3456	-0.004728	-0.00698	3.3E-05
0.3888	-0.003638	-0.00537	1.95E-05
0.432	-0.002612	-0.00386	1.01E-05
0.4752	-0.001643	-0.00243	3.99E-06
0.5184	-0.000726	-0.00107	7.77E-07
0.5616	0.000148	0.00022	3.26E-08
0.6048	0.000986	0.00146	1.44E-06
0.648	0.001796	0.00265	4.76E-06
0.6912	0.002586	0.00382	9.88E-06
0.7344	0.003361	0.00496	1.67E-05
0.7776	0.004128	0.0061	2.52E-05
0.8208	0.004891	0.00722	3.53E-05
0.864	0.005652	0.00835	4.72E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 6.29E-05 m^3

w(b)= 0.015785 m
w(a)= 0.007225 m
delta kh= (w(b)-w(a))/INT
delta kh= 136 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	361	kN/m^2

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Table G77

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.732kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.017073	-0.02332	0.000398
0.0432	-0.015394	-0.02102	0.000324
0.0864	-0.013741	-0.01877	0.000258
0.1296	-0.012132	-0.01657	0.000201
0.1728	-0.010582	-0.01445	0.000153
0.216	-0.009101	-0.01243	0.000113
0.2592	-0.007695	-0.01051	8.09E-05
0.3024	-0.006366	-0.00869	5.53E-05
0.3456	-0.005114	-0.00698	3.57E-05
0.3888	-0.003935	-0.00537	2.11E-05
0.432	-0.002825	-0.00386	1.09E-05
0.4752	-0.001777	-0.00243	4.32E-06
0.5184	-0.000785	-0.00107	8.4E-07
0.5616	0.00016	0.00022	3.52E-08
0.6048	0.001067	0.00146	1.56E-06
0.648	0.001943	0.00265	5.15E-06
0.6912	0.002797	0.00382	1.07E-05
0.7344	0.003635	0.00496	1.8E-05
0.7776	0.004464	0.0061	2.72E-05
0.8208	0.005289	0.00722	3.82E-05
0.864	0.006113	0.00835	5.1E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 6.81E-05 m^3

w(b)= 0.017073 m
w(a)= 0.008078 m
delta kh= (w(b)-w(a))/INT
delta kh= 132 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 357 kN/m^2

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Table G78
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Pi=0.821kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.019149	-0.02332	0.000447
0.0432	-0.017267	-0.02102	0.000363
0.0864	-0.015413	-0.01877	0.000289
0.1296	-0.013608	-0.01657	0.000225
0.1728	-0.011869	-0.01445	0.000172
0.216	-0.010209	-0.01243	0.000127
0.2592	-0.008631	-0.01051	9.07E-05
0.3024	-0.00714	-0.00869	6.2E-05
0.3456	-0.005736	-0.00698	4E-05
0.3888	-0.004413	-0.00537	2.37E-05
0.432	-0.003168	-0.00386	1.22E-05
0.4752	-0.001994	-0.00243	4.85E-06
0.5184	-0.000881	-0.00107	9.43E-07
0.5616	0.000179	0.00022	3.94E-08
0.6048	0.001196	0.00146	1.75E-06
0.648	0.002179	0.00265	5.77E-06
0.6912	0.003137	0.00382	1.2E-05
0.7344	0.004077	0.00496	2.02E-05
0.7776	0.005008	0.0061	3.05E-05
0.8208	0.005933	0.00722	4.28E-05
0.864	0.006857	0.00835	5.73E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 7.63E-05 m^3

w(b)= 0.019149 m
w(a)= 0.009658 m
delta kh= (w(b)-w(a))/INT
delta kh= 124 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 349 kN/m^2

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Table G79

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO HORIZONTAL FORCES INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

B= 0.0254 m
delta Z= 0.0432 m

	Pi=0.910kN	P=1.000kN	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.021227	-0.02332	0.000495
0.0432	-0.019139	-0.02102	0.000402
0.0864	-0.017084	-0.01877	0.000321
0.1296	-0.015084	-0.01657	0.00025
0.1728	-0.013157	-0.01445	0.00019
0.216	-0.011316	-0.01243	0.000141
0.2592	-0.009567	-0.01051	0.000101
0.3024	-0.007915	-0.00869	6.88E-05
0.3456	-0.006358	-0.00698	4.44E-05
0.3888	-0.004892	-0.00537	2.63E-05
0.432	-0.003512	-0.00386	1.36E-05
0.4752	-0.002209	-0.00243	5.37E-06
0.5184	-0.000976	-0.00107	1.04E-06
0.5616	0.000199	0.00022	4.38E-08
0.6048	0.001326	0.00146	1.94E-06
0.648	0.002415	0.00265	6.4E-06
0.6912	0.003477	0.00382	1.33E-05
0.7344	0.004519	0.00496	2.24E-05
0.7776	0.005551	0.0061	3.39E-05
0.8208	0.006577	0.00722	4.75E-05
0.864	0.007601	0.00835	6.35E-05

by Simpson's rule:

INT= 8.46E-05 m^3

w(b)= 0.021227 m
w(a)= 0.011641 m
delta kh= (w(b)-w(a))/INT
delta kh= 113 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 338 kN/m^2

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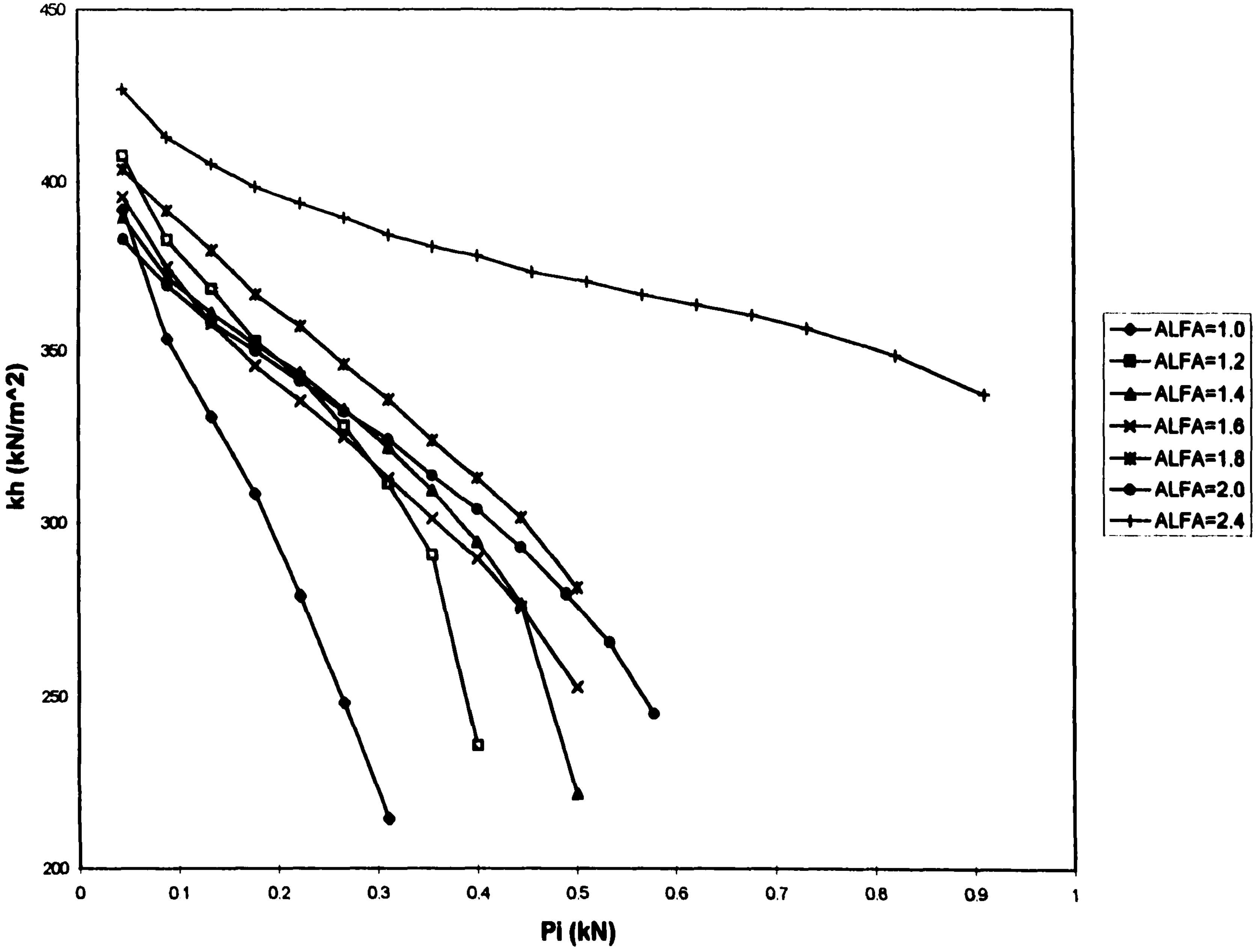

Figure G1. Horizontal Force vs kh for piles Embedded in Clayey Soil Subjected to Horizontal Forces

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APPENDIX H

Numerical Analysis for Piles Embedded in Clayey Soil Subjected to Bending Moments

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Table H1

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Mi=0.011kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.002369	-0.209475	0.000496
0.018	-0.002124	-0.187772	0.000399
0.036	-0.00188	-0.166224	0.000313
0.054	-0.001638	-0.144828	0.000237
0.072	-0.001398	-0.123579	0.000173
0.09	-0.001159	-0.10247	0.000119
0.108	-0.000922	-0.081493	7.51E-05
0.126	-0.000686	-0.060638	4.16E-05
0.144	-0.000451	-0.039895	1.8E-05
0.162	-0.000218	-0.019253	4.2E-06
0.18	0.000015	0.001299	1.95E-08
0.198	0.000246	0.021774	5.36E-06
0.216	0.000477	0.042182	2.01E-05
0.234	0.000707	0.062535	4.42E-05
0.252	0.000937	0.082845	7.76E-05
0.27	0.001166	0.103121	0.00012
0.288	0.001395	0.123372	0.000172
0.306	0.001624	0.143608	0.000233
0.324	0.001853	0.163833	0.000304
0.342	0.002082	0.184054	0.000383
0.36	0.00231	0.204274	0.000472

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 5.77E-05 m^3

w(b)= 0.002369 m
w(a)= 0.001345 m
delta kh= (w(b)-w(a))/INT
delta kh= 18 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 243 kN/m^2

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Table H2

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

B= 0.0254 m
delta Z= 0.018 m

	Mi=0.023kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.004738	-0.209475	0.000992
0.018	-0.004247	-0.187772	0.000797
0.036	-0.003759	-0.166224	0.000625
0.054	-0.003276	-0.144828	0.000474
0.072	-0.002795	-0.123579	0.000345
0.09	-0.002318	-0.10247	0.000238
0.108	-0.001843	-0.081493	0.00015
0.126	-0.001372	-0.060638	8.32E-05
0.144	-0.000902	-0.039895	3.6E-05
0.162	-0.000436	-0.019253	8.39E-06
0.18	0.000029	0.001299	3.77E-08
0.198	0.000493	0.021774	1.07E-05
0.216	0.000954	0.042182	4.02E-05
0.234	0.001415	0.062535	8.85E-05
0.252	0.001874	0.082845	0.000155
0.27	0.002333	0.103121	0.000241
0.288	0.002791	0.123372	0.000344
0.306	0.003248	0.143608	0.000466
0.324	0.003706	0.163833	0.000607
0.342	0.004163	0.184054	0.000766
0.36	0.004621	0.204274	0.000944

by Simpson's rule:

INT= 0.000115 m^3

w(b)= 0.004738 m
w(a)= 0.002261 m
delta kh= (w(b)-w(a))/INT
delta kh= 21 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\text{kh= 246 kN/m^2}}$

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Table H3

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Mi=0.034kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.007107	-0.209475	0.001489
0.018	-0.006371	-0.187772	0.001196
0.036	-0.005639	-0.166224	0.000937
0.054	-0.004914	-0.144828	0.000712
0.072	-0.004193	-0.123579	0.000518
0.09	-0.003477	-0.10247	0.000356
0.108	-0.002765	-0.081493	0.000225
0.126	-0.002057	-0.060638	0.000125
0.144	-0.001354	-0.039895	5.4E-05
0.162	-0.000653	-0.019253	1.26E-05
0.18	0.000044	0.001299	5.72E-08
0.198	0.000739	0.021774	1.61E-05
0.216	0.001431	0.042182	6.04E-05
0.234	0.002122	0.062535	0.000133
0.252	0.00281	0.082845	0.000233
0.27	0.003499	0.103121	0.000361
0.288	0.004186	0.123372	0.000516
0.306	0.004873	0.143608	0.0007
0.324	0.005559	0.163833	0.000911
0.342	0.006245	0.184054	0.001149
0.36	0.006931	0.204274	0.001416

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 0.000173 m^3

w(b)= 0.007107 m
w(a)= 0.003168 m
delta kh= (w(b)-w(a))/INT
delta kh= 23 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 248 kN/m^2

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Table H4

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Mi=0.045kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.009477	-0.209475	0.001985
0.018	-0.008495	-0.187772	0.001595
0.036	-0.007519	-0.166224	0.00125
0.054	-0.006552	-0.144828	0.000949
0.072	-0.005591	-0.123579	0.000691
0.09	-0.004636	-0.10247	0.000475
0.108	-0.003687	-0.081493	0.0003
0.126	-0.002743	-0.060638	0.000166
0.144	-0.001805	-0.039895	7.2E-05
0.162	-0.000871	-0.019253	1.68E-05
0.18	0.000059	0.001299	7.66E-08
0.198	0.000985	0.021774	2.14E-05
0.216	0.001908	0.042182	8.05E-05
0.234	0.002829	0.062535	0.000177
0.252	0.003748	0.082845	0.000311
0.27	0.004665	0.103121	0.000481
0.288	0.005581	0.123372	0.000689
0.306	0.006497	0.143608	0.000933
0.324	0.007412	0.163833	0.001214
0.342	0.008327	0.184054	0.001533
0.36	0.009241	0.204274	0.001888

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 0.000231 m^3

w(b)= 0.009477 m
w(a)= 0.004098 m
delta kh= (w(b)-w(a))/INT
delta kh= 23 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 248 kN/m^2

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Table H5

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Mi=0.057kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.011846	-0.209475	0.002481
0.018	-0.010619	-0.187772	0.001994
0.036	-0.009399	-0.166224	0.001562
0.054	-0.00819	-0.144828	0.001186
0.072	-0.006988	-0.123579	0.000864
0.09	-0.005795	-0.10247	0.000594
0.108	-0.004608	-0.081493	0.000376
0.126	-0.003429	-0.060638	0.000208
0.144	-0.002256	-0.039895	9E-05
0.162	-0.001089	-0.019253	2.1E-05
0.18	0.000073	0.001299	9.48E-08
0.198	0.001231	0.021774	2.68E-05
0.216	0.002385	0.042182	0.000101
0.234	0.003536	0.062535	0.000221
0.252	0.004685	0.082845	0.000388
0.27	0.005831	0.103121	0.000601
0.288	0.006977	0.123372	0.000861
0.306	0.008121	0.143608	0.001166
0.324	0.009265	0.163833	0.001518
0.342	0.010408	0.184054	0.001916
0.36	0.011552	0.204274	0.00236

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 0.000289 m^3

w(b)= 0.011846 m
w(a)= 0.005097 m
delta kh= (w(b)-w(a))/INT
delta kh= 23 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**248**	**kN/m^2**

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Table H6
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Mi=0.068kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.014215	-0.209475	0.002978
0.018	-0.012742	-0.187772	0.002393
0.036	-0.01128	-0.166224	0.001875
0.054	-0.009828	-0.144828	0.001423
0.072	-0.008386	-0.123579	0.001036
0.09	-0.006954	-0.10247	0.000713
0.108	-0.00553	-0.081493	0.000451
0.126	-0.004115	-0.060638	0.00025
0.144	-0.002707	-0.039895	0.000108
0.162	-0.001307	-0.019253	2.52E-05
0.18	0.000088	0.001299	1.14E-07
0.198	0.001477	0.021774	3.22E-05
0.216	0.002862	0.042182	0.000121
0.234	0.004244	0.062535	0.000265
0.252	0.005622	0.082845	0.000466
0.27	0.006998	0.103121	0.000722
0.288	0.008372	0.123372	0.001033
0.306	0.009745	0.143608	0.001399
0.324	0.011118	0.163833	0.001821
0.342	0.012489	0.184054	0.002299
0.36	0.013862	0.204274	0.002832

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 0.000346 m^3

w(b)= 0.014215 m
w(a)= 0.006118 m
delta kh= (w(b)-w(a))/INT
delta kh= 23 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**248**	**kN/m^2**

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Table H7

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Mi=0.079kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.016584	-0.209475	0.003474
0.018	-0.014866	-0.187772	0.002791
0.036	-0.01316	-0.166224	0.002188
0.054	-0.011466	-0.144828	0.001661
0.072	-0.009784	-0.123579	0.001209
0.09	-0.008113	-0.10247	0.000831
0.108	-0.006452	-0.081493	0.000526
0.126	-0.004801	-0.060638	0.000291
0.144	-0.003158	-0.039895	0.000126
0.162	-0.001524	-0.019253	2.93E-05
0.18	0.000103	0.001299	1.34E-07
0.198	0.001724	0.021774	3.75E-05
0.216	0.003339	0.042182	0.000141
0.234	0.004951	0.062535	0.00031
0.252	0.006559	0.082845	0.000543
0.27	0.008164	0.103121	0.000842
0.288	0.009767	0.123372	0.001205
0.306	0.011369	0.143608	0.001633
0.324	0.012971	0.163833	0.002125
0.342	0.014572	0.184054	0.002682
0.36	0.016172	0.204274	0.003304

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 0.000404 m^3

w(b)= 0.016584 m
w(a)= 0.007191 m
delta kh= (w(b)-w(a))/INT
delta kh= 23 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 248 kN/m^2

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Table H8

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Mi=0.091kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.01897	-0.209475	0.003974
0.018	-0.017005	-0.187772	0.003193
0.036	-0.015053	-0.166224	0.002502
0.054	-0.013116	-0.144828	0.0019
0.072	-0.011191	-0.123579	0.001383
0.09	-0.009279	-0.10247	0.000951
0.108	-0.00738	-0.081493	0.000601
0.126	-0.005491	-0.060638	0.000333
0.144	-0.003613	-0.039895	0.000144
0.162	-0.001744	-0.019253	3.36E-05
0.18	0.000118	0.001299	1.53E-07
0.198	0.001972	0.021774	4.29E-05
0.216	0.00382	0.042182	0.000161
0.234	0.005663	0.062535	0.000354
0.252	0.007502	0.082845	0.000622
0.27	0.009339	0.103121	0.000963
0.288	0.011173	0.123372	0.001378
0.306	0.013005	0.143608	0.001868
0.324	0.014837	0.163833	0.002431
0.342	0.016668	0.184054	0.003068
0.36	0.018499	0.204274	0.003779

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 0.000462 m^3

w(b)= 0.01897 m
w(a)= 0.008284 m
delta kh= (w(b)-w(a))/INT
delta kh= 23 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**248**	**kN/m^2**

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Table H9

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Mi=0.102kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.021339	-0.209475	0.00447
0.018	-0.019128	-0.187772	0.003592
0.036	-0.016933	-0.166224	0.002815
0.054	-0.014754	-0.144828	0.002137
0.072	-0.012589	-0.123579	0.001556
0.09	-0.010439	-0.10247	0.00107
0.108	-0.008302	-0.081493	0.000677
0.126	-0.006177	-0.060638	0.000375
0.144	-0.004064	-0.039895	0.000162
0.162	-0.001961	-0.019253	3.78E-05
0.18	0.000132	0.001299	1.71E-07
0.198	0.002218	0.021774	4.83E-05
0.216	0.004297	0.042182	0.000181
0.234	0.00637	0.062535	0.000398
0.252	0.008439	0.082845	0.000699
0.27	0.010505	0.103121	0.001083
0.288	0.012568	0.123372	0.001551
0.306	0.014629	0.143608	0.002101
0.324	0.016689	0.163833	0.002734
0.342	0.018749	0.184054	0.003451
0.36	0.020809	0.204274	0.004251

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 0.00052 m^3

w(b)= 0.021339 m
w(a)= 0.009425 m
delta kh= (w(b)-w(a))/INT
delta kh= 23 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 248 kN/m^2

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Table H10

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Mi=0.116kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.024257	-0.209475	0.005081
0.018	-0.021744	-0.187772	0.004083
0.036	-0.019249	-0.166224	0.0032
0.054	-0.016771	-0.144828	0.002429
0.072	-0.014311	-0.123579	0.001769
0.09	-0.011866	-0.10247	0.001216
0.108	-0.009437	-0.081493	0.000769
0.126	-0.007022	-0.060638	0.000426
0.144	-0.004619	-0.039895	0.000184
0.162	-0.002229	-0.019253	4.29E-05
0.18	0.00015	0.001299	1.95E-07
0.198	0.002521	0.021774	5.49E-05
0.216	0.004885	0.042182	0.000206
0.234	0.007242	0.062535	0.000453
0.252	0.009593	0.082845	0.000795
0.27	0.011941	0.103121	0.001231
0.288	0.014287	0.123372	0.001763
0.306	0.016629	0.143608	0.002388
0.324	0.018972	0.163833	0.003108
0.342	0.021314	0.184054	0.003923
0.36	0.023655	0.204274	0.004832

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 0.000591 m^3

w(b)= 0.024257 m
w(a)= 0.010743 m
delta kh= (w(b)-w(a))/INT
delta kh= 23 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 248 kN/m^2

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Table H11
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Mi=0.130kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.027196	-0.209475	0.005697
0.018	-0.024378	-0.187772	0.004578
0.036	-0.021581	-0.166224	0.003587
0.054	-0.018803	-0.144828	0.002723
0.072	-0.016044	-0.123579	0.001983
0.09	-0.013304	-0.10247	0.001363
0.108	-0.01058	-0.081493	0.000862
0.126	-0.007873	-0.060638	0.000477
0.144	-0.005179	-0.039895	0.000207
0.162	-0.002499	-0.019253	4.81E-05
0.18	0.000169	0.001299	2.2E-07
0.198	0.002827	0.021774	6.16E-05
0.216	0.005476	0.042182	0.000231
0.234	0.008119	0.062535	0.000508
0.252	0.010756	0.082845	0.000891
0.27	0.013388	0.103121	0.001381
0.288	0.016017	0.123372	0.001976
0.306	0.018645	0.143608	0.002678
0.324	0.021271	0.163833	0.003485
0.342	0.023896	0.184054	0.004398
0.36	0.026521	0.204274	0.005418

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 0.000663 m^3

w(b)= 0.027196 m
w(a)= 0.012253 m
delta kh= (w(b)-w(a))/INT
delta kh= 23 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\text{kh= 248 kN/m^2}}$

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Table H12

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Mi=0.144kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.030133	-0.209475	0.006312
0.018	-0.027011	-0.187772	0.005072
0.036	-0.023911	-0.166224	0.003975
0.054	-0.020834	-0.144828	0.003017
0.072	-0.017777	-0.123579	0.002197
0.09	-0.01474	-0.10247	0.00151
0.108	-0.011723	-0.081493	0.000955
0.126	-0.008723	-0.060638	0.000529
0.144	-0.005739	-0.039895	0.000229
0.162	-0.002769	-0.019253	5.33E-05
0.18	0.000187	0.001299	2.43E-07
0.198	0.003132	0.021774	6.82E-05
0.216	0.006068	0.042182	0.000256
0.234	0.008996	0.062535	0.000563
0.252	0.011917	0.082845	0.000987
0.27	0.014834	0.103121	0.00153
0.288	0.017747	0.123372	0.002189
0.306	0.020658	0.143608	0.002967
0.324	0.023567	0.163833	0.003861
0.342	0.026476	0.184054	0.004873
0.36	0.029385	0.204274	0.006003

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 0.000734 m^3

w(b)= 0.030133 m
w(a)= 0.013855 m
delta kh= (w(b)-w(a))/INT
delta kh= 22 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 247 kN/m^2

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Table H13

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.0
LINEAR PART
PILE LENGTH=0.360m

	Mi=0.158kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.033069	-0.209475	0.006927
0.018	-0.029643	-0.187772	0.005566
0.036	-0.026242	-0.166224	0.004362
0.054	-0.022864	-0.144828	0.003311
0.072	-0.019509	-0.123579	0.002411
0.09	-0.016177	-0.10247	0.001658
0.108	-0.012865	-0.081493	0.001048
0.126	-0.009573	-0.060638	0.00058
0.144	-0.006298	-0.039895	0.000251
0.162	-0.003039	-0.019253	5.85E-05
0.18	0.000205	0.001299	2.66E-07
0.198	0.003437	0.021774	7.48E-05
0.216	0.006659	0.042182	0.000281
0.234	0.009872	0.062535	0.000617
0.252	0.013079	0.082845	0.001084
0.27	0.016279	0.103121	0.001679
0.288	0.019477	0.123372	0.002403
0.306	0.022671	0.143608	0.003256
0.324	0.025864	0.163833	0.004237
0.342	0.029057	0.184054	0.005348
0.36	0.032249	0.204274	0.006588

B= 0.0254 m
delta Z= 0.018 m

by Simpson's rule:

INT= 0.000806 m^3

w(b)= 0.033069 m
w(a)= 0.015551 m
delta kh= (w(b)-w(a))/INT
delta kh= 22 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 247 kN/m^2

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Table H14

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Mi=0.011kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.001673	-0.1479	0.000247
0.0216	-0.001493	-0.13203	0.000197
0.0432	-0.001316	-0.11637	0.000153
0.0648	-0.001142	-0.10094	0.000115
0.0864	-0.000969	-0.08572	8.31E-05
0.108	-0.000799	-0.07069	5.65E-05
0.1296	-0.000632	-0.05586	3.53E-05
0.1512	-0.000466	-0.04121	1.92E-05
0.1728	-0.000302	-0.02671	8.07E-06
0.1944	-0.000139	-0.01235	1.72E-06
0.216	0.000021	0.00186	3.91E-08
0.2376	0.000181	0.01597	2.89E-06
0.2592	0.000339	0.02999	1.02E-05
0.2808	0.000497	0.04393	2.18E-05
0.3024	0.000654	0.0578	3.78E-05
0.324	0.00081	0.07163	5.8E-05
0.3456	0.000966	0.08542	8.25E-05
0.3672	0.001122	0.09919	0.000111
0.3888	0.001277	0.11294	0.000144
0.4104	0.001433	0.12669	0.000182
0.432	0.001588	0.14043	0.000223

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 3.34E-05 m^3

w(b)= 0.001673 m
w(a)= 0.000414 m
delta kh= (w(b)-w(a))/INT
delta kh= 38 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\textbf{kh= 263 kN/m^2}}$

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Table H15

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Mi=0.023kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.003346	-0.1479	0.000495
0.0216	-0.002986	-0.13203	0.000394
0.0432	-0.002632	-0.11637	0.000306
0.0648	-0.002283	-0.10094	0.00023
0.0864	-0.001939	-0.08572	0.000166
0.108	-0.001599	-0.07069	0.000113
0.1296	-0.001264	-0.05586	7.06E-05
0.1512	-0.000932	-0.04121	3.84E-05
0.1728	-0.000604	-0.02671	1.61E-05
0.1944	-0.000279	-0.01235	3.45E-06
0.216	0.000042	0.00186	7.81E-08
0.2376	0.000361	0.01597	5.77E-06
0.2592	0.000678	0.02999	2.03E-05
0.2808	0.000994	0.04393	4.37E-05
0.3024	0.001307	0.0578	7.55E-05
0.324	0.00162	0.07163	0.000116
0.3456	0.001932	0.08542	0.000165
0.3672	0.002244	0.09919	0.000223
0.3888	0.002555	0.11294	0.000289
0.4104	0.002866	0.12669	0.000363
0.432	0.003177	0.14043	0.000446

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 6.68E-05 m^3

w(b)= 0.003346 m
w(a)= 0.000807 m
delta kh= (w(b)-w(a))/INT
delta kh= 38 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 263 kN/m^2

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Table H16

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

B= 0.0254 m
delta Z= 0.0216 m

	Mi=0.034kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.005018	-0.1479	0.000742
0.0216	-0.004479	-0.13203	0.000591
0.0432	-0.003948	-0.11637	0.000459
0.0648	-0.003425	-0.10094	0.000346
0.0864	-0.002908	-0.08572	0.000249
0.108	-0.002399	-0.07069	0.00017
0.1296	-0.001895	-0.05586	0.000106
0.1512	-0.001398	-0.04121	5.76E-05
0.1728	-0.000906	-0.02671	2.42E-05
0.1944	-0.000419	-0.01235	5.17E-06
0.216	0.000063	0.00186	1.17E-07
0.2376	0.000542	0.01597	8.66E-06
0.2592	0.001017	0.02999	3.05E-05
0.2808	0.00149	0.04393	6.55E-05
0.3024	0.001961	0.0578	0.000113
0.324	0.00243	0.07163	0.000174
0.3456	0.002898	0.08542	0.000248
0.3672	0.003365	0.09919	0.000334
0.3888	0.003832	0.11294	0.000433
0.4104	0.004299	0.12669	0.000545
0.432	0.004765	0.14043	0.000669

by Simpson's rule:

INT= 0.0001 m^3

w(b)= 0.005018 m
w(a)= 0.001227 m
delta kh= (w(b)-w(a))/INT
delta kh= 38 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	263	kN/m^2

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Table H17

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

B= 0.0254 m
delta Z= 0.0216 m

	Mi=0.045kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.006691	-0.1479	0.00099
0.0216	-0.005973	-0.13203	0.000789
0.0432	-0.005265	-0.11637	0.000613
0.0648	-0.004566	-0.10094	0.000461
0.0864	-0.003878	-0.08572	0.000332
0.108	-0.003198	-0.07069	0.000226
0.1296	-0.002527	-0.05586	0.000141
0.1512	-0.001864	-0.04121	7.68E-05
0.1728	-0.001208	-0.02671	3.23E-05
0.1944	-0.000559	-0.01235	6.9E-06
0.216	0.000084	0.00186	1.56E-07
0.2376	0.000723	0.01597	1.15E-05
0.2592	0.001357	0.02999	4.07E-05
0.2808	0.001987	0.04393	8.73E-05
0.3024	0.002615	0.0578	0.000151
0.324	0.00324	0.07163	0.000232
0.3456	0.003864	0.08542	0.00033
0.3672	0.004487	0.09919	0.000445
0.3888	0.005109	0.11294	0.000577
0.4104	0.005732	0.12669	0.000726
0.432	0.006353	0.14043	0.000892

by Simpson's rule:

INT= 0.000134 m^3

w(b)= 0.006691 m
w(a)= 0.001715 m
delta kh= (w(b)-w(a))/INT
delta kh= 37 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	262	kN/m^2

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Table H18

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Mi=0.057kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.008364	-0.1479	0.001237
0.0216	-0.007466	-0.13203	0.000986
0.0432	-0.006581	-0.11637	0.000766
0.0648	-0.005708	-0.10094	0.000576
0.0864	-0.004847	-0.08572	0.000415
0.108	-0.003998	-0.07069	0.000283
0.1296	-0.003159	-0.05586	0.000176
0.1512	-0.00233	-0.04121	9.6E-05
0.1728	-0.00151	-0.02671	4.03E-05
0.1944	-0.000699	-0.01235	8.63E-06
0.216	0.000105	0.00186	1.95E-07
0.2376	0.000903	0.01597	1.44E-05
0.2592	0.001696	0.02999	5.09E-05
0.2808	0.002484	0.04393	0.000109
0.3024	0.003269	0.0578	0.000189
0.324	0.004051	0.07163	0.00029
0.3456	0.004831	0.08542	0.000413
0.3672	0.005609	0.09919	0.000556
0.3888	0.006387	0.11294	0.000721
0.4104	0.007164	0.12669	0.000908
0.432	0.007942	0.14043	0.001115

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 0.000167 m^3

w(b)= 0.008364 m
w(a)= 0.00223 m
delta kh= (w(b)-w(a))/INT
delta kh= 37 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	262	kN/m^2

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Table H19

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Mi=0.068kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.010037	-0.1479	0.001484
0.0216	-0.008959	-0.13203	0.001183
0.0432	-0.007897	-0.11637	0.000919
0.0648	-0.006849	-0.10094	0.000691
0.0864	-0.005817	-0.08572	0.000499
0.108	-0.004797	-0.07069	0.000339
0.1296	-0.003791	-0.05586	0.000212
0.1512	-0.002796	-0.04121	0.000115
0.1728	-0.001812	-0.02671	4.84E-05
0.1944	-0.000839	-0.01235	1.04E-05
0.216	0.000126	0.00186	2.34E-07
0.2376	0.001084	0.01597	1.73E-05
0.2592	0.002035	0.02999	6.1E-05
0.2808	0.002981	0.04393	0.000131
0.3024	0.003922	0.0578	0.000227
0.324	0.004861	0.07163	0.000348
0.3456	0.005797	0.08542	0.000495
0.3672	0.006731	0.09919	0.000668
0.3888	0.007664	0.11294	0.000866
0.4104	0.008597	0.12669	0.001089
0.432	0.00953	0.14043	0.001338

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 0.0002 m^3

w(b)= 0.010037 m
w(a)= 0.002831 m
delta kh= (w(b)-w(a))/INT
delta kh= 36 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**261**	**kN/m^2**

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Table H20

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Mi=0.079kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.011709	-0.1479	0.001732
0.0216	-0.010452	-0.13203	0.00138
0.0432	-0.009213	-0.11637	0.001072
0.0648	-0.007991	-0.10094	0.000807
0.0864	-0.006786	-0.08572	0.000582
0.108	-0.005597	-0.07069	0.000396
0.1296	-0.004423	-0.05586	0.000247
0.1512	-0.003262	-0.04121	0.000134
0.1728	-0.002115	-0.02671	5.65E-05
0.1944	-0.000978	-0.01235	1.21E-05
0.216	0.000147	0.00186	2.73E-07
0.2376	0.001265	0.01597	2.02E-05
0.2592	0.002374	0.02999	7.12E-05
0.2808	0.003478	0.04393	0.000153
0.3024	0.004576	0.0578	0.000264
0.324	0.005671	0.07163	0.000406
0.3456	0.006763	0.08542	0.000578
0.3672	0.007853	0.09919	0.000779
0.3888	0.008942	0.11294	0.00101
0.4104	0.01003	0.12669	0.001271
0.432	0.011118	0.14043	0.001561

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 0.000234 m^3

w(b)= 0.011709 m
w(a)= 0.003458 m
delta kh= (w(b)-w(a))/INT
delta kh= 35 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	260	kN/m^2

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Table H21

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Mi=0.091kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.013394	-0.1479	0.001981
0.0216	-0.011956	-0.13203	0.001579
0.0432	-0.010539	-0.11637	0.001226
0.0648	-0.009141	-0.10094	0.000923
0.0864	-0.007762	-0.08572	0.000665
0.108	-0.006402	-0.07069	0.000453
0.1296	-0.005059	-0.05586	0.000283
0.1512	-0.003732	-0.04121	0.000154
0.1728	-0.002419	-0.02671	6.46E-05
0.1944	-0.001119	-0.01235	1.38E-05
0.216	0.000169	0.00186	3.14E-07
0.2376	0.001446	0.01597	2.31E-05
0.2592	0.002716	0.02999	8.15E-05
0.2808	0.003978	0.04393	0.000175
0.3024	0.005234	0.0578	0.000303
0.324	0.006487	0.07163	0.000465
0.3456	0.007736	0.08542	0.000661
0.3672	0.008983	0.09919	0.000891
0.3888	0.010228	0.11294	0.001155
0.4104	0.011473	0.12669	0.001454
0.432	0.012718	0.14043	0.001786

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 0.000268 m^3

w(b)= 0.013394 m
w(a)= 0.00422 m
delta kh= (w(b)-w(a))/INT
delta kh= 34 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	259	kN/m^2

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Table H22

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Mi=0.102kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.015067	-0.1479	0.002228
0.0216	-0.013449	-0.13203	0.001776
0.0432	-0.011855	-0.11637	0.00138
0.0648	-0.010283	-0.10094	0.001038
0.0864	-0.008732	-0.08572	0.000749
0.108	-0.007202	-0.07069	0.000509
0.1296	-0.005691	-0.05586	0.000318
0.1512	-0.004198	-0.04121	0.000173
0.1728	-0.002721	-0.02671	7.27E-05
0.1944	-0.001259	-0.01235	1.55E-05
0.216	0.000189	0.00186	3.52E-07
0.2376	0.001627	0.01597	2.6E-05
0.2592	0.003055	0.02999	9.16E-05
0.2808	0.004475	0.04393	0.000197
0.3024	0.005888	0.0578	0.00034
0.324	0.007297	0.07163	0.000523
0.3456	0.008702	0.08542	0.000743
0.3672	0.010104	0.09919	0.001002
0.3888	0.011506	0.11294	0.001299
0.4104	0.012906	0.12669	0.001635
0.432	0.014306	0.14043	0.002009

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 0.000301 m^3

w(b)= 0.015067 m
w(a)= 0.005017 m
delta kh= (w(b)-w(a))/INT
delta kh= 33 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 258 kN/m^2

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Table H23

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Mi=0.116kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.017127	-0.1479	0.002533
0.0216	-0.015288	-0.13203	0.002018
0.0432	-0.013476	-0.11637	0.001568
0.0648	-0.011689	-0.10094	0.00118
0.0864	-0.009926	-0.08572	0.000851
0.108	-0.008186	-0.07069	0.000579
0.1296	-0.006469	-0.05586	0.000361
0.1512	-0.004772	-0.04121	0.000197
0.1728	-0.003093	-0.02671	8.26E-05
0.1944	-0.001431	-0.01235	1.77E-05
0.216	0.000216	0.00186	4.02E-07
0.2376	0.001849	0.01597	2.95E-05
0.2592	0.003473	0.02999	0.000104
0.2808	0.005087	0.04393	0.000223
0.3024	0.006693	0.0578	0.000387
0.324	0.008295	0.07163	0.000594
0.3456	0.009892	0.08542	0.000845
0.3672	0.011486	0.09919	0.001139
0.3888	0.013079	0.11294	0.001477
0.4104	0.014671	0.12669	0.001859
0.432	0.016263	0.14043	0.002284

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 0.000342 m^3

w(b)= 0.017127 m
w(a)= 0.006004 m
delta kh= (w(b)-w(a))/INT
delta kh= 33 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\text{kh= 258 kN/m^2}}$

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Table H24

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Mi=0.130kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.019202	-0.1479	0.00284
0.0216	-0.017141	-0.13203	0.002263
0.0432	-0.015109	-0.11637	0.001758
0.0648	-0.013105	-0.10094	0.001323
0.0864	-0.011128	-0.08572	0.000954
0.108	-0.009178	-0.07069	0.000649
0.1296	-0.007253	-0.05586	0.000405
0.1512	-0.005349	-0.04121	0.00022
0.1728	-0.003468	-0.02671	9.26E-05
0.1944	-0.001605	-0.01235	1.98E-05
0.216	0.000242	0.00186	4.5E-07
0.2376	0.002074	0.01597	3.31E-05
0.2592	0.003894	0.02999	0.000117
0.2808	0.005703	0.04393	0.000251
0.3024	0.007504	0.0578	0.000434
0.324	0.009299	0.07163	0.000666
0.3456	0.01109	0.08542	0.000947
0.3672	0.012877	0.09919	0.001277
0.3888	0.014663	0.11294	0.001656
0.4104	0.016448	0.12669	0.002084
0.432	0.018233	0.14043	0.00256

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 0.000384 m^3

w(b)= 0.019202 m
w(a)= 0.007014 m
delta kh= (w(b)-w(a))/INT
delta kh= 32 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	257	kN/m^2

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Table H25

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Mi=0.144kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.021276	-0.1479	0.003147
0.0216	-0.018992	-0.13203	0.002508
0.0432	-0.01674	-0.11637	0.001948
0.0648	-0.01452	-0.10094	0.001466
0.0864	-0.01233	-0.08572	0.001057
0.108	-0.010169	-0.07069	0.000719
0.1296	-0.008036	-0.05586	0.000449
0.1512	-0.005927	-0.04121	0.000244
0.1728	-0.003842	-0.02671	0.000103
0.1944	-0.001778	-0.01235	2.2E-05
0.216	0.000268	0.00186	4.98E-07
0.2376	0.002298	0.01597	3.67E-05
0.2592	0.004314	0.02999	0.000129
0.2808	0.006319	0.04393	0.000278
0.3024	0.008315	0.0578	0.000481
0.324	0.010304	0.07163	0.000738
0.3456	0.012288	0.08542	0.00105
0.3672	0.014268	0.09919	0.001415
0.3888	0.016247	0.11294	0.001835
0.4104	0.018225	0.12669	0.002309
0.432	0.020202	0.14043	0.002837

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 0.000425 m^3

w(b)= 0.021276 m
w(a)= 0.008163 m
delta kh= (w(b)-w(a))/INT
delta kh= 31 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\textbf{kh= 256 kN/m\^{}2}}$

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Table H26

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

B= 0.0254 m
delta Z= 0.0216 m

	Mi=0.158kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.023349	-0.1479	0.003453
0.0216	-0.020843	-0.13203	0.002752
0.0432	-0.018371	-0.11637	0.002138
0.0648	-0.015935	-0.10094	0.001608
0.0864	-0.013532	-0.08572	0.00116
0.108	-0.011161	-0.07069	0.000789
0.1296	-0.008819	-0.05586	0.000493
0.1512	-0.006505	-0.04121	0.000268
0.1728	-0.004217	-0.02671	0.000113
0.1944	-0.001951	-0.01235	2.41E-05
0.216	0.000294	0.00186	5.47E-07
0.2376	0.002522	0.01597	4.03E-05
0.2592	0.004734	0.02999	0.000142
0.2808	0.006935	0.04393	0.000305
0.3024	0.009125	0.0578	0.000527
0.324	0.011308	0.07163	0.00081
0.3456	0.013485	0.08542	0.001152
0.3672	0.015659	0.09919	0.001553
0.3888	0.01783	0.11294	0.002014
0.4104	0.020001	0.12669	0.002534
0.432	0.022171	0.14043	0.003113

by Simpson's rule:

INT= 0.000466 m^3

w(b)= 0.023349 m
w(a)= 0.009296 m
delta kh= (w(b)-w(a))/INT
delta kh= 30 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 255 kN/m^2

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Table H27

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Mi=0.172kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.025424	-0.1479	0.00376
0.0216	-0.022695	-0.13203	0.002996
0.0432	-0.020004	-0.11637	0.002328
0.0648	-0.017351	-0.10094	0.001751
0.0864	-0.014734	-0.08572	0.001263
0.108	-0.012152	-0.07069	0.000859
0.1296	-0.009603	-0.05586	0.000536
0.1512	-0.007083	-0.04121	0.000292
0.1728	-0.004591	-0.02671	0.000123
0.1944	-0.002124	-0.01235	2.62E-05
0.216	0.00032	0.00186	5.95E-07
0.2376	0.002746	0.01597	4.39E-05
0.2592	0.005155	0.02999	0.000155
0.2808	0.007551	0.04393	0.000332
0.3024	0.009936	0.0578	0.000574
0.324	0.012313	0.07163	0.000882
0.3456	0.014684	0.08542	0.001254
0.3672	0.017051	0.09919	0.001691
0.3888	0.019415	0.11294	0.002193
0.4104	0.021778	0.12669	0.002759
0.432	0.024141	0.14043	0.00339

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 0.000508 m^3

w(b)= 0.025424 m
w(a)= 0.010449 m
delta kh= (w(b)-w(a))/INT
delta kh= 29 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	254	kN/m^2

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Table H28

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Mi=0.186kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.027498	-0.1479	0.004067
0.0216	-0.024546	-0.13203	0.003241
0.0432	-0.021636	-0.11637	0.002518
0.0648	-0.018766	-0.10094	0.001894
0.0864	-0.015936	-0.08572	0.001366
0.108	-0.013143	-0.07069	0.000929
0.1296	-0.010386	-0.05586	0.00058
0.1512	-0.007661	-0.04121	0.000316
0.1728	-0.004966	-0.02671	0.000133
0.1944	-0.002298	-0.01235	2.84E-05
0.216	0.000346	0.00186	6.44E-07
0.2376	0.002969	0.01597	4.74E-05
0.2592	0.005576	0.02999	0.000167
0.2808	0.008167	0.04393	0.000359
0.3024	0.010746	0.0578	0.000621
0.324	0.013317	0.07163	0.000954
0.3456	0.015881	0.08542	0.001357
0.3672	0.018441	0.09919	0.001829
0.3888	0.020998	0.11294	0.002372
0.4104	0.023555	0.12669	0.002984
0.432	0.02611	0.14043	0.003667

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 0.000549 m^3

w(b)= 0.027498 m
w(a)= 0.011784 m
delta kh= (w(b)-w(a))/INT
delta kh= 29 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	254	kN/m^2

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Table H29

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

B= 0.0254 m
delta Z= 0.0216 m

	Mi=0.209kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.030843	-0.1479	0.004562
0.0216	-0.027532	-0.13203	0.003635
0.0432	-0.024268	-0.11637	0.002824
0.0648	-0.021049	-0.10094	0.002125
0.0864	-0.017875	-0.08572	0.001532
0.108	-0.014743	-0.07069	0.001042
0.1296	-0.011649	-0.05586	0.000651
0.1512	-0.008593	-0.04121	0.000354
0.1728	-0.00557	-0.02671	0.000149
0.1944	-0.002577	-0.01235	3.18E-05
0.216	0.000389	0.00186	7.24E-07
0.2376	0.003331	0.01597	5.32E-05
0.2592	0.006254	0.02999	0.000188
0.2808	0.009161	0.04393	0.000402
0.3024	0.012054	0.0578	0.000697
0.324	0.014937	0.07163	0.00107
0.3456	0.017813	0.08542	0.001522
0.3672	0.020685	0.09919	0.002052
0.3888	0.023553	0.11294	0.00266
0.4104	0.02642	0.12669	0.003347
0.432	0.029287	0.14043	0.004113

by Simpson's rule:

INT= 0.000616 m^3

w(b)= 0.030843 m
w(a)= 0.013499 m
delta kh= (w(b)-w(a))/INT
delta kh= 28 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 253 kN/m^2

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Table H30

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.2
LINEAR PART
PILE LENGTH=0.432m

	Mi=0.231kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.034189	-0.1479	0.005057
0.0216	-0.030519	-0.13203	0.004029
0.0432	-0.026901	-0.11637	0.00313
0.0648	-0.023333	-0.10094	0.002355
0.0864	-0.019814	-0.08572	0.001698
0.108	-0.016342	-0.07069	0.001155
0.1296	-0.012913	-0.05586	0.000721
0.1512	-0.009525	-0.04121	0.000393
0.1728	-0.006174	-0.02671	0.000165
0.1944	-0.002857	-0.01235	3.53E-05
0.216	0.000431	0.00186	8.02E-07
0.2376	0.003693	0.01597	5.9E-05
0.2592	0.006932	0.02999	0.000208
0.2808	0.010154	0.04393	0.000446
0.3024	0.013362	0.0578	0.000772
0.324	0.016557	0.07163	0.001186
0.3456	0.019745	0.08542	0.001687
0.3672	0.022928	0.09919	0.002274
0.3888	0.026108	0.11294	0.002949
0.4104	0.029286	0.12669	0.00371
0.432	0.032464	0.14043	0.004559

B= 0.0254 m
delta Z= 0.0216 m

by Simpson's rule:

INT= 0.000683 m^3

w(b)= 0.034189 m
w(a)= 0.015502 m
delta kh= (w(b)-w(a))/INT
delta kh= 27 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 252 kN/m^2

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Table H31

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Mi=0.011kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.001262	-0.11158	0.000141
0.0252	-0.001119	-0.09894	0.000111
0.0504	-0.000979	-0.08662	8.48E-05
0.0756	-0.000844	-0.07459	6.3E-05
0.1008	-0.000711	-0.06284	4.47E-05
0.126	-0.000581	-0.05137	2.98E-05
0.1512	-0.000454	-0.04016	1.82E-05
0.1764	-0.00033	-0.02919	9.63E-06
0.2016	-0.000208	-0.01843	3.83E-06
0.2268	-0.000089	-0.00787	7E-07
0.252	0.000028	0.00252	7.06E-08
0.2772	0.000144	0.01276	1.84E-06
0.3024	0.000259	0.02286	5.92E-06
0.3276	0.000372	0.03287	1.22E-05
0.3528	0.000484	0.04279	2.07E-05
0.378	0.000595	0.05264	3.13E-05
0.4032	0.000706	0.06245	4.41E-05
0.4284	0.000817	0.07222	5.9E-05
0.4536	0.000927	0.08198	7.6E-05
0.4788	0.001037	0.09173	9.51E-05
0.504	0.001148	0.10148	0.000116

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 2.11E-05 m^3

w(b)= 0.001262 m
w(a)= 0.000307 m
delta kh= (w(b)-w(a))/INT
delta kh= 45 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 270 kN/m^2

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Table H32

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

B= 0.0254 m
delta Z= 0.0252 m

	Mi=0.023kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.002524	-0.11158	0.000282
0.0252	-0.002238	-0.09894	0.000221
0.0504	-0.001959	-0.08662	0.00017
0.0756	-0.001687	-0.07459	0.000126
0.1008	-0.001422	-0.06284	8.94E-05
0.126	-0.001162	-0.05137	5.97E-05
0.1512	-0.000908	-0.04016	3.65E-05
0.1764	-0.00066	-0.02919	1.93E-05
0.2016	-0.000417	-0.01843	7.69E-06
0.2268	-0.000178	-0.00787	1.4E-06
0.252	0.000057	0.00252	1.44E-07
0.2772	0.000289	0.01276	3.69E-06
0.3024	0.000517	0.02286	1.18E-05
0.3276	0.000743	0.03287	2.44E-05
0.3528	0.000968	0.04279	4.14E-05
0.378	0.001191	0.05264	6.27E-05
0.4032	0.001413	0.06245	8.82E-05
0.4284	0.001634	0.07222	0.000118
0.4536	0.001854	0.08198	0.000152
0.4788	0.002075	0.09173	0.00019
0.504	0.002295	0.10148	0.000233

by Simpson's rule:

INT= 4.21E-05 m^3

w(b)= 0.002524 m
w(a)= 0.000643 m
delta kh= (w(b)-w(a))/INT
delta kh= 45 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 270 kN/m^2

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Table H33

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Mi=0.034kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.003786	-0.11158	0.000422
0.0252	-0.003357	-0.09894	0.000332
0.0504	-0.002939	-0.08662	0.000255
0.0756	-0.002531	-0.07459	0.000189
0.1008	-0.002132	-0.06284	0.000134
0.126	-0.001743	-0.05137	8.95E-05
0.1512	-0.001363	-0.04016	5.47E-05
0.1764	-0.00099	-0.02919	2.89E-05
0.2016	-0.000625	-0.01843	1.15E-05
0.2268	-0.000267	-0.00787	2.1E-06
0.252	0.000085	0.00252	2.14E-07
0.2772	0.000433	0.01276	5.53E-06
0.3024	0.000776	0.02286	1.77E-05
0.3276	0.001115	0.03287	3.67E-05
0.3528	0.001452	0.04279	6.21E-05
0.378	0.001786	0.05264	9.4E-05
0.4032	0.002119	0.06245	0.000132
0.4284	0.002451	0.07222	0.000177
0.4536	0.002782	0.08198	0.000228
0.4788	0.003112	0.09173	0.000285
0.504	0.003443	0.10148	0.000349

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 6.32E-05 m^3

w(b)= 0.003786 m
w(a)= 0.000958 m
delta kh= (w(b)-w(a))/INT
delta kh= 45 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 270 kN/m^2

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Table H34

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Mi=0.045kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.005048	-0.11158	0.000563
0.0252	-0.004476	-0.09894	0.000443
0.0504	-0.003919	-0.08662	0.000339
0.0756	-0.003374	-0.07459	0.000252
0.1008	-0.002843	-0.06284	0.000179
0.126	-0.002324	-0.05137	0.000119
0.1512	-0.001817	-0.04016	7.3E-05
0.1764	-0.00132	-0.02919	3.85E-05
0.2016	-0.000834	-0.01843	1.54E-05
0.2268	-0.000356	-0.00787	2.8E-06
0.252	0.000114	0.00252	2.87E-07
0.2772	0.000577	0.01276	7.36E-06
0.3024	0.001034	0.02286	2.36E-05
0.3276	0.001487	0.03287	4.89E-05
0.3528	0.001936	0.04279	8.28E-05
0.378	0.002381	0.05264	0.000125
0.4032	0.002825	0.06245	0.000176
0.4284	0.003267	0.07222	0.000236
0.4536	0.003709	0.08198	0.000304
0.4788	0.004149	0.09173	0.000381
0.504	0.004591	0.10148	0.000466

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 8.43E-05 m^3

w(b)= 0.005048 m
w(a)= 0.001359 m
delta kh= (w(b)-w(a))/INT
delta kh= 44 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 269 kN/m^2

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Table H35

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Mi=0.057kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.006309	-0.11158	0.000704
0.0252	-0.005595	-0.09894	0.000554
0.0504	-0.004898	-0.08662	0.000424
0.0756	-0.004218	-0.07459	0.000315
0.1008	-0.003554	-0.06284	0.000223
0.126	-0.002905	-0.05137	0.000149
0.1512	-0.002271	-0.04016	9.12E-05
0.1764	-0.001651	-0.02919	4.82E-05
0.2016	-0.001042	-0.01843	1.92E-05
0.2268	-0.000445	-0.00787	3.5E-06
0.252	0.000142	0.00252	3.58E-07
0.2772	0.000721	0.01276	9.2E-06
0.3024	0.001293	0.02286	2.96E-05
0.3276	0.001858	0.03287	6.11E-05
0.3528	0.002419	0.04279	0.000104
0.378	0.002977	0.05264	0.000157
0.4032	0.003531	0.06245	0.000221
0.4284	0.004084	0.07222	0.000295
0.4536	0.004636	0.08198	0.00038
0.4788	0.005187	0.09173	0.000476
0.504	0.005738	0.10148	0.000582

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 0.000105 m^3

w(b)= 0.006309 m
w(a)= 0.001759 m
delta kh= (w(b)-w(a))/INT
delta kh= 43 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\textbf{kh= 268 kN/m^2}}$

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Table H36

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

B= 0.0254 m
delta Z= 0.0252 m

	Mi=0.068kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.007572	-0.11158	0.000845
0.0252	-0.006714	-0.09894	0.000664
0.0504	-0.005878	-0.08662	0.000509
0.0756	-0.005061	-0.07459	0.000377
0.1008	-0.004265	-0.06284	0.000268
0.126	-0.003486	-0.05137	0.000179
0.1512	-0.002725	-0.04016	0.000109
0.1764	-0.001981	-0.02919	5.78E-05
0.2016	-0.001251	-0.01843	2.31E-05
0.2268	-0.000534	-0.00787	4.2E-06
0.252	0.000171	0.00252	4.31E-07
0.2772	0.000866	0.01276	1.11E-05
0.3024	0.001552	0.02286	3.55E-05
0.3276	0.00223	0.03287	7.33E-05
0.3528	0.002903	0.04279	0.000124
0.378	0.003572	0.05264	0.000188
0.4032	0.004238	0.06245	0.000265
0.4284	0.004901	0.07222	0.000354
0.4536	0.005563	0.08198	0.000456
0.4788	0.006225	0.09173	0.000571
0.504	0.006886	0.10148	0.000699

by Simpson's rule:

INT= 0.000126 m^3

w(b)= 0.007572 m
w(a)= 0.002185 m
delta kh= (w(b)-w(a))/INT
delta kh= 43 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 268 kN/m^2

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Table H37

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

B= 0.0254 m
delta Z= 0.0252 m

	Mi=0.079kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.008834	-0.11158	0.000986
0.0252	-0.007833	-0.09894	0.000775
0.0504	-0.006857	-0.08662	0.000594
0.0756	-0.005905	-0.07459	0.00044
0.1008	-0.004975	-0.06284	0.000313
0.126	-0.004067	-0.05137	0.000209
0.1512	-0.003179	-0.04016	0.000128
0.1764	-0.002311	-0.02919	6.75E-05
0.2016	-0.001459	-0.01843	2.69E-05
0.2268	-0.000623	-0.00787	4.9E-06
0.252	0.000199	0.00252	5.01E-07
0.2772	0.001009	0.01276	1.29E-05
0.3024	0.00181	0.02286	4.14E-05
0.3276	0.002602	0.03287	8.55E-05
0.3528	0.003387	0.04279	0.000145
0.378	0.004167	0.05264	0.000219
0.4032	0.004944	0.06245	0.000309
0.4284	0.005718	0.07222	0.000413
0.4536	0.00649	0.08198	0.000532
0.4788	0.007262	0.09173	0.000666
0.504	0.008034	0.10148	0.000815

by Simpson's rule:

INT= 0.000147 m^3

w(b)= 0.008834 m
w(a)= 0.002611 m
delta kh= (w(b)-w(a))/INT
delta kh= 42 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\text{kh= 267 kN/m^2}}$

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Table H38

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Mi=0.091kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.010104	-0.11158	0.001127
0.0252	-0.00896	-0.09894	0.000887
0.0504	-0.007844	-0.08662	0.000679
0.0756	-0.006755	-0.07459	0.000504
0.1008	-0.005691	-0.06284	0.000358
0.126	-0.004652	-0.05137	0.000239
0.1512	-0.003637	-0.04016	0.000146
0.1764	-0.002643	-0.02919	7.71E-05
0.2016	-0.001669	-0.01843	3.08E-05
0.2268	-0.000713	-0.00787	5.61E-06
0.252	0.000228	0.00252	5.75E-07
0.2772	0.001155	0.01276	1.47E-05
0.3024	0.002071	0.02286	4.73E-05
0.3276	0.002976	0.03287	9.78E-05
0.3528	0.003875	0.04279	0.000166
0.378	0.004767	0.05264	0.000251
0.4032	0.005655	0.06245	0.000353
0.4284	0.006541	0.07222	0.000472
0.4536	0.007424	0.08198	0.000609
0.4788	0.008307	0.09173	0.000762
0.504	0.009189	0.10148	0.000932

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 0.000169 m^3

w(b)= 0.010104 m
w(a)= 0.003113 m
delta kh= (w(b)-w(a))/INT
delta kh= 41 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 266 kN/m^2

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Table H39

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Mi=0.102kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.011366	-0.11158	0.001268
0.0252	-0.010079	-0.09894	0.000997
0.0504	-0.008824	-0.08662	0.000764
0.0756	-0.007598	-0.07459	0.000567
0.1008	-0.006402	-0.06284	0.000402
0.126	-0.005233	-0.05137	0.000269
0.1512	-0.004091	-0.04016	0.000164
0.1764	-0.002973	-0.02919	8.68E-05
0.2016	-0.001877	-0.01843	3.46E-05
0.2268	-0.000802	-0.00787	6.31E-06
0.252	0.000257	0.00252	6.48E-07
0.2772	0.001299	0.01276	1.66E-05
0.3024	0.002329	0.02286	5.32E-05
0.3276	0.003348	0.03287	0.00011
0.3528	0.004359	0.04279	0.000187
0.378	0.005362	0.05264	0.000282
0.4032	0.006361	0.06245	0.000397
0.4284	0.007357	0.07222	0.000531
0.4536	0.008351	0.08198	0.000685
0.4788	0.009345	0.09173	0.000857
0.504	0.010337	0.10148	0.001049

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 0.00019 m^3

w(b)= 0.011366 m
w(a)= 0.003587 m
delta kh= (w(b)-w(a))/INT
delta kh= 41 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 266 kN/m^2

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Table H40

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Mi=0.116kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.012921	-0.11158	0.001442
0.0252	-0.011458	-0.09894	0.001134
0.0504	-0.01003	-0.08662	0.000869
0.0756	-0.0086372	-0.07459	0.000644
0.1008	-0.0072773	-0.06284	0.000457
0.126	-0.0059491	-0.05137	0.000306
0.1512	-0.0046507	-0.04016	0.000187
0.1764	-0.0033798	-0.02919	9.87E-05
0.2016	-0.0021342	-0.01843	3.93E-05
0.2268	-0.000911	-0.00787	7.17E-06
0.252	0.000292	0.00252	7.36E-07
0.2772	0.001477	0.01276	1.88E-05
0.3024	0.002647	0.02286	6.05E-05
0.3276	0.003806	0.03287	0.000125
0.3528	0.004954	0.04279	0.000212
0.378	0.006095	0.05264	0.000321
0.4032	0.007231	0.06245	0.000452
0.4284	0.008363	0.07222	0.000604
0.4536	0.009493	0.08198	0.000778
0.4788	0.010622	0.09173	0.000974
0.504	0.011751	0.10148	0.001192

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 0.000216 m^3

w(b)= 0.012921 m
w(a)= 0.004168 m
delta kh= (w(b)-w(a))/INT
delta kh= 41 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	266	kN/m^2

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Table H41

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4

LINEAR PART

PILE LENGTH=0.504m

	Mi=0.130kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.014486	-0.11158	0.001616
0.0252	-0.012846	-0.09894	0.001271
0.0504	-0.011245	-0.08662	0.000974
0.0756	-0.009684	-0.07459	0.000722
0.1008	-0.008159	-0.06284	0.000513
0.126	-0.006669	-0.05137	0.000343
0.1512	-0.005214	-0.04016	0.000209
0.1764	-0.003789	-0.02919	0.000111
0.2016	-0.002393	-0.01843	4.41E-05
0.2268	-0.001022	-0.00787	8.04E-06
0.252	0.000327	0.00252	8.24E-07
0.2772	0.001656	0.01276	2.11E-05
0.3024	0.002968	0.02286	6.78E-05
0.3276	0.004267	0.03287	0.00014
0.3528	0.005555	0.04279	0.000238
0.378	0.006834	0.05264	0.00036
0.4032	0.008107	0.06245	0.000506
0.4284	0.009377	0.07222	0.000677
0.4536	0.010644	0.08198	0.000873
0.4788	0.011909	0.09173	0.001092
0.504	0.013175	0.10148	0.001337

B= 0.0254 m

delta Z= 0.0252 m

by Simpson's rule:

INT= 0.000242 m^3

w(b)= 0.014486 m

w(a)= 0.004783 m

delta kh= (w(b)-w(a))/INT

delta kh= 40 kN/m^2

kh(initial)= 225 kN/m^2

kh= kh(initial)+delta kh

kh= 265 kN/m^2

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Table H42

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4

LINEAR PART

PILE LENGTH=0.504m

	Mi=0.144kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.01605	-0.11158	0.001791
0.0252	-0.014233	-0.09894	0.001408
0.0504	-0.012459	-0.08662	0.001079
0.0756	-0.010729	-0.07459	0.0008
0.1008	-0.00904	-0.06284	0.000568
0.126	-0.00739	-0.05137	0.00038
0.1512	-0.005777	-0.04016	0.000232
0.1764	-0.004198	-0.02919	0.000123
0.2016	-0.002651	-0.01843	4.89E-05
0.2268	-0.001132	-0.00787	8.91E-06
0.252	0.0003623	0.00252	9.13E-07
0.2772	0.001835	0.01276	2.34E-05
0.3024	0.003289	0.02286	7.52E-05
0.3276	0.004728	0.03287	0.000155
0.3528	0.006155	0.04279	0.000263
0.378	0.007572	0.05264	0.000399
0.4032	0.008983	0.06245	0.000561
0.4284	0.010389	0.07222	0.00075
0.4536	0.011793	0.08198	0.000967
0.4788	0.013195	0.09173	0.00121
0.504	0.014597	0.10148	0.001481

B= 0.0254 m

delta Z= 0.0252 m

by Simpson's rule:

INT= 0.000268 m^3

w(b)= 0.01605 m

w(a)= 0.005404 m

delta kh= (w(b)-w(a))/INT

delta kh= 40 kN/m^2

kh(initial)= 225 kN/m^2

kh= kh(initial)+delta kh

kh= 265 kN/m^2

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Table H43
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Mi=0.158kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.017615	-0.11158	0.001965
0.0252	-0.01562	-0.09894	0.001545
0.0504	-0.013674	-0.08662	0.001184
0.0756	-0.011775	-0.07459	0.000878
0.1008	-0.009921	-0.06284	0.000623
0.126	-0.00811	-0.05137	0.000417
0.1512	-0.00634	-0.04016	0.000255
0.1764	-0.004607	-0.02919	0.000134
0.2016	-0.002909	-0.01843	5.36E-05
0.2268	-0.001242	-0.00787	9.77E-06
0.252	0.000398	0.00252	1E-06
0.2772	0.002013	0.01276	2.57E-05
0.3024	0.003609	0.02286	8.25E-05
0.3276	0.005189	0.03287	0.000171
0.3528	0.006755	0.04279	0.000289
0.378	0.00831	0.05264	0.000437
0.4032	0.009859	0.06245	0.000616
0.4284	0.011402	0.07222	0.000823
0.4536	0.012942	0.08198	0.001061
0.4788	0.014481	0.09173	0.001328
0.504	0.01602	0.10148	0.001626

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 0.000294 m^3

w(b)= 0.017615 m
w(a)= 0.006014 m
delta kh= (w(b)-w(a))/INT
delta kh= 39 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 264 kN/m^2

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Table H44

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Mi=0.172kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.01918	-0.11158	0.00214
0.0252	-0.017009	-0.09894	0.001683
0.0504	-0.014889	-0.08662	0.00129
0.0756	-0.012822	-0.07459	0.000956
0.1008	-0.010803	-0.06284	0.000679
0.126	-0.008831	-0.05137	0.000454
0.1512	-0.006904	-0.04016	0.000277
0.1764	-0.005017	-0.02919	0.000146
0.2016	-0.003168	-0.01843	5.84E-05
0.2268	-0.001353	-0.00787	1.06E-05
0.252	0.000433	0.00252	1.09E-06
0.2772	0.002193	0.01276	2.8E-05
0.3024	0.00393	0.02286	8.98E-05
0.3276	0.005649	0.03287	0.000186
0.3528	0.007355	0.04279	0.000315
0.378	0.009049	0.05264	0.000476
0.4032	0.010735	0.06245	0.00067
0.4284	0.012415	0.07222	0.000897
0.4536	0.014093	0.08198	0.001155
0.4788	0.015768	0.09173	0.001446
0.504	0.017444	0.10148	0.00177

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 0.00032 m^3

w(b)= 0.01918 m
w(a)= 0.006623 m
delta kh= (w(b)-w(a))/INT
delta kh= 39 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 264 kN/m^2

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Table H45

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Mi=0.186kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.020744	-0.11158	0.002315
0.0252	-0.018396	-0.09894	0.00182
0.0504	-0.016104	-0.08662	0.001395
0.0756	-0.013867	-0.07459	0.001034
0.1008	-0.011684	-0.06284	0.000734
0.126	-0.009551	-0.05137	0.000491
0.1512	-0.007467	-0.04016	0.0003
0.1764	-0.005426	-0.02919	0.000158
0.2016	-0.003426	-0.01843	6.31E-05
0.2268	-0.001463	-0.00787	1.15E-05
0.252	0.000468	0.00252	1.18E-06
0.2772	0.002371	0.01276	3.03E-05
0.3024	0.004251	0.02286	9.72E-05
0.3276	0.006111	0.03287	0.000201
0.3528	0.007955	0.04279	0.00034
0.378	0.009787	0.05264	0.000515
0.4032	0.01161	0.06245	0.000725
0.4284	0.013428	0.07222	0.00097
0.4536	0.015242	0.08198	0.00125
0.4788	0.017054	0.09173	0.001564
0.504	0.018867	0.10148	0.001915

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 0.000346 m^3

w(b)= 0.020744 m
w(a)= 0.007252 m
delta kh= (w(b)-w(a))/INT
delta kh= 39 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 264 kN/m^2

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Table H46

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Mi=0.209kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.023268	-0.11158	0.002596
0.0252	-0.020634	-0.09894	0.002042
0.0504	-0.018063	-0.08662	0.001565
0.0756	-0.015554	-0.07459	0.00116
0.1008	-0.013106	-0.06284	0.000824
0.126	-0.010714	-0.05137	0.00055
0.1512	-0.008375	-0.04016	0.000336
0.1764	-0.006087	-0.02919	0.000178
0.2016	-0.003843	-0.01843	7.08E-05
0.2268	-0.001641	-0.00787	1.29E-05
0.252	0.000525	0.00252	1.32E-06
0.2772	0.002659	0.01276	3.39E-05
0.3024	0.004768	0.02286	0.000109
0.3276	0.006854	0.03287	0.000225
0.3528	0.008923	0.04279	0.000382
0.378	0.010977	0.05264	0.000578
0.4032	0.013023	0.06245	0.000813
0.4284	0.015061	0.07222	0.001088
0.4536	0.017096	0.08198	0.001402
0.4788	0.019129	0.09173	0.001755
0.504	0.021162	0.10148	0.002148

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 0.000388 m^3

w(b)= 0.023268 m
w(a)= 0.008238 m
delta kh= (w(b)-w(a))/INT
delta kh= 39 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 264 kN/m^2

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Table H47

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.4
LINEAR PART
PILE LENGTH=0.504m

	Mi=0.231kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.025792	-0.11158	0.002878
0.0252	-0.022872	-0.09894	0.002263
0.0504	-0.020022	-0.08662	0.001734
0.0756	-0.017242	-0.07459	0.001286
0.1008	-0.014527	-0.06284	0.000913
0.126	-0.011876	-0.05137	0.00061
0.1512	-0.009284	-0.04016	0.000373
0.1764	-0.006747	-0.02919	0.000197
0.2016	-0.00426	-0.01843	7.85E-05
0.2268	-0.001819	-0.00787	1.43E-05
0.252	0.000582	0.00252	1.47E-06
0.2772	0.002948	0.01276	3.76E-05
0.3024	0.005285	0.02286	0.000121
0.3276	0.007596	0.03287	0.00025
0.3528	0.00989	0.04279	0.000423
0.378	0.012168	0.05264	0.000641
0.4032	0.014435	0.06245	0.000901
0.4284	0.016695	0.07222	0.001206
0.4536	0.018951	0.08198	0.001554
0.4788	0.021204	0.09173	0.001945
0.504	0.023457	0.10148	0.00238

B= 0.0254 m
delta Z= 0.0252 m

by Simpson's rule:

INT= 0.000431 m^3

w(b)= 0.025792 m
w(a)= 0.009402 m
delta kh= (w(b)-w(a))/INT
delta kh= 38 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 263 kN/m^2

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Table H48

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.011kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.001004	-0.08881	8.92E-05
0.0288	-0.000882	-0.07801	6.88E-05
0.0576	-0.000765	-0.06761	5.17E-05
0.0864	-0.000651	-0.05759	3.75E-05
0.1152	-0.000542	-0.04796	2.6E-05
0.144	-0.000437	-0.03867	1.69E-05
0.1728	-0.000336	-0.02973	9.99E-06
0.2016	-0.000239	-0.02109	5.04E-06
0.2304	-0.000144	-0.01273	1.83E-06
0.2592	-0.000052	-0.00462	2.4E-07
0.288	0.000037	0.00326	1.21E-07
0.3168	0.000124	0.01094	1.36E-06
0.3456	0.000209	0.01846	3.86E-06
0.3744	0.000292	0.02585	7.55E-06
0.4032	0.000375	0.03312	1.24E-05
0.432	0.000456	0.04032	1.84E-05
0.4608	0.000537	0.04745	2.55E-05
0.4896	0.000617	0.05454	3.37E-05
0.5184	0.000697	0.06161	4.29E-05
0.5472	0.000777	0.06867	5.34E-05
0.576	0.000856	0.07573	6.48E-05

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 1.41E-05 m^3

w(b)= 0.001004 m
w(a)= 0.000295 m
delta kh= (w(b)-w(a))/INT
delta kh= 50 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 275 kN/m^2

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Table H49

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

B= 0.0254 m
delta Z= 0.0288 m

	Mi=0.023kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.002009	-0.08881	0.000178
0.0288	-0.001765	-0.07801	0.000138
0.0576	-0.001529	-0.06761	0.000103
0.0864	-0.001303	-0.05759	7.5E-05
0.1152	-0.001085	-0.04796	5.2E-05
0.144	-0.000875	-0.03867	3.38E-05
0.1728	-0.000672	-0.02973	2E-05
0.2016	-0.000477	-0.02109	1.01E-05
0.2304	-0.000288	-0.01273	3.67E-06
0.2592	-0.000105	-0.00462	4.85E-07
0.288	0.000074	0.00326	2.41E-07
0.3168	0.000247	0.01094	2.7E-06
0.3456	0.000418	0.01846	7.72E-06
0.3744	0.000585	0.02585	1.51E-05
0.4032	0.000749	0.03312	2.48E-05
0.432	0.000912	0.04032	3.68E-05
0.4608	0.001073	0.04745	5.09E-05
0.4896	0.001234	0.05454	6.73E-05
0.5184	0.001394	0.06161	8.59E-05
0.5472	0.001553	0.06867	0.000107
0.576	0.001713	0.07573	0.00013

by Simpson's rule:

INT= 2.83E-05 m^3

w(b)= 0.002009 m
w(a)= 0.000612 m
delta kh= (w(b)-w(a))/INT
delta kh= 49 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 274 kN/m^2

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Table H50

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.034kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.003013	-0.08881	0.000268
0.0288	-0.002647	-0.07801	0.000206
0.0576	-0.002294	-0.06761	0.000155
0.0864	-0.001954	-0.05759	0.000113
0.1152	-0.001627	-0.04796	7.8E-05
0.144	-0.001312	-0.03867	5.07E-05
0.1728	-0.001009	-0.02973	3E-05
0.2016	-0.000715	-0.02109	1.51E-05
0.2304	-0.000432	-0.01273	5.5E-06
0.2592	-0.000157	-0.00462	7.25E-07
0.288	0.00011	0.00326	3.59E-07
0.3168	0.000371	0.01094	4.06E-06
0.3456	0.000626	0.01846	1.16E-05
0.3744	0.000877	0.02585	2.27E-05
0.4032	0.001124	0.03312	3.72E-05
0.432	0.001368	0.04032	5.52E-05
0.4608	0.001609	0.04745	7.63E-05
0.4896	0.001851	0.05454	0.000101
0.5184	0.002091	0.06161	0.000129
0.5472	0.00233	0.06867	0.00016
0.576	0.002569	0.07573	0.000195

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 4.24E-05 m^3

w(b)= 0.003013 m
w(a)= 0.000999 m
delta kh= (w(b)-w(a))/INT
delta kh= 47 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 272 kN/m^2

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Table H51

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.045kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.004018	-0.08881	0.000357
0.0288	-0.003529	-0.07801	0.000275
0.0576	-0.003059	-0.06761	0.000207
0.0864	-0.002606	-0.05759	0.00015
0.1152	-0.002169	-0.04796	0.000104
0.144	-0.001749	-0.03867	6.76E-05
0.1728	-0.001345	-0.02973	4E-05
0.2016	-0.000954	-0.02109	2.01E-05
0.2304	-0.000576	-0.01273	7.33E-06
0.2592	-0.000209	-0.00462	9.66E-07
0.288	0.000147	0.00326	4.79E-07
0.3168	0.000495	0.01094	5.42E-06
0.3456	0.000835	0.01846	1.54E-05
0.3744	0.001169	0.02585	3.02E-05
0.4032	0.001498	0.03312	4.96E-05
0.432	0.001824	0.04032	7.35E-05
0.4608	0.002146	0.04745	0.000102
0.4896	0.002467	0.05454	0.000135
0.5184	0.002787	0.06161	0.000172
0.5472	0.003107	0.06867	0.000213
0.576	0.003426	0.07573	0.000259

B= 0.0254 m
delta Z= 0.0288 m

<u>by Simpson's rule:</u>

INT= 5.66E-05 m^3

w(b)= 0.004018 m
w(a)= 0.001383 m
delta kh= (w(b)-w(a))/INT
delta kh= 47 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\text{kh= 272 kN/m^2}}$

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Table H52

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.057kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.005022	-0.08881	0.000446
0.0288	-0.004411	-0.07801	0.000344
0.0576	-0.003823	-0.06761	0.000258
0.0864	-0.003257	-0.05759	0.000188
0.1152	-0.002712	-0.04796	0.00013
0.144	-0.002187	-0.03867	8.46E-05
0.1728	-0.001681	-0.02973	5E-05
0.2016	-0.001192	-0.02109	2.51E-05
0.2304	-0.000719	-0.01273	9.15E-06
0.2592	-0.000262	-0.00462	1.21E-06
0.288	0.000184	0.00326	6E-07
0.3168	0.000619	0.01094	6.77E-06
0.3456	0.001044	0.01846	1.93E-05
0.3744	0.001462	0.02585	3.78E-05
0.4032	0.001873	0.03312	6.2E-05
0.432	0.002279	0.04032	9.19E-05
0.4608	0.002683	0.04745	0.000127
0.4896	0.003084	0.05454	0.000168
0.5184	0.003484	0.06161	0.000215
0.5472	0.003883	0.06867	0.000267
0.576	0.004282	0.07573	0.000324

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 7.07E-05 m^3

w(b)= 0.005022 m
w(a)= 0.00176 m
delta kh= (w(b)-w(a))/INT
delta kh= 46 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	271	kN/m^2

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Table H53

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.068kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.006026	-0.08881	0.000535
0.0288	-0.005294	-0.07801	0.000413
0.0576	-0.004588	-0.06761	0.00031
0.0864	-0.003908	-0.05759	0.000225
0.1152	-0.003254	-0.04796	0.000156
0.144	-0.002624	-0.03867	0.000101
0.1728	-0.002017	-0.02973	6E-05
0.2016	-0.001431	-0.02109	3.02E-05
0.2304	-0.000864	-0.01273	1.1E-05
0.2592	-0.000314	-0.00462	1.45E-06
0.288	0.000221	0.00326	7.2E-07
0.3168	0.000742	0.01094	8.12E-06
0.3456	0.001253	0.01846	2.31E-05
0.3744	0.001754	0.02585	4.53E-05
0.4032	0.002248	0.03312	7.45E-05
0.432	0.002736	0.04032	0.00011
0.4608	0.003219	0.04745	0.000153
0.4896	0.003701	0.05454	0.000202
0.5184	0.004181	0.06161	0.000258
0.5472	0.00466	0.06867	0.00032
0.576	0.005139	0.07573	0.000389

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 8.49E-05 m^3

w(b)= 0.006026 m
w(a)= 0.002155 m
delta kh= (w(b)-w(a))/INT
delta kh= 46 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 271 kN/m^2

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Table H54

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.079kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.007031	-0.08881	0.000624
0.0288	-0.006176	-0.07801	0.000482
0.0576	-0.005353	-0.06761	0.000362
0.0864	-0.004559	-0.05759	0.000263
0.1152	-0.003797	-0.04796	0.000182
0.144	-0.003062	-0.03867	0.000118
0.1728	-0.002353	-0.02973	7E-05
0.2016	-0.001669	-0.02109	3.52E-05
0.2304	-0.001008	-0.01273	1.28E-05
0.2592	-0.000366	-0.00462	1.69E-06
0.288	0.000258	0.00326	8.41E-07
0.3168	0.000866	0.01094	9.47E-06
0.3456	0.001462	0.01846	2.7E-05
0.3744	0.002046	0.02585	5.29E-05
0.4032	0.002622	0.03312	8.68E-05
0.432	0.003192	0.04032	0.000129
0.4608	0.003756	0.04745	0.000178
0.4896	0.004318	0.05454	0.000236
0.5184	0.004878	0.06161	0.000301
0.5472	0.005437	0.06867	0.000373
0.576	0.005995	0.07573	0.000454

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 9.9E-05 m^3

w(b)= 0.007031 m
w(a)= 0.002549 m
delta kh= (w(b)-w(a))/INT
delta kh= 45 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 270 kN/m^2

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Table H55

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.091kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.008042	-0.08881	0.000714
0.0288	-0.007064	-0.07801	0.000551
0.0576	-0.006123	-0.06761	0.000414
0.0864	-0.005216	-0.05759	0.0003
0.1152	-0.004343	-0.04796	0.000208
0.144	-0.003502	-0.03867	0.000135
0.1728	-0.002692	-0.02973	8E-05
0.2016	-0.001909	-0.02109	4.03E-05
0.2304	-0.001153	-0.01273	1.47E-05
0.2592	-0.000419	-0.00462	1.94E-06
0.288	0.000295	0.00326	9.62E-07
0.3168	0.000991	0.01094	1.08E-05
0.3456	0.001672	0.01846	3.09E-05
0.3744	0.002341	0.02585	6.05E-05
0.4032	0.002999	0.03312	9.93E-05
0.432	0.003651	0.04032	0.000147
0.4608	0.004297	0.04745	0.000204
0.4896	0.004939	0.05454	0.000269
0.5184	0.005579	0.06161	0.000344
0.5472	0.006219	0.06867	0.000427
0.576	0.006858	0.07573	0.000519

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 0.000113 m^3

w(b)= 0.008042 m
w(a)= 0.002932 m
delta kh= (w(b)-w(a))/INT
delta kh= 45 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 270 kN/m^2

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Table H56

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.102kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.009047	-0.08881	0.000803
0.0288	-0.007947	-0.07801	0.00062
0.0576	-0.006887	-0.06761	0.000466
0.0864	-0.005867	-0.05759	0.000338
0.1152	-0.004885	-0.04796	0.000234
0.144	-0.003939	-0.03867	0.000152
0.1728	-0.003028	-0.02973	9E-05
0.2016	-0.002148	-0.02109	4.53E-05
0.2304	-0.001297	-0.01273	1.65E-05
0.2592	-0.000471	-0.00462	2.18E-06
0.288	0.000332	0.00326	1.08E-06
0.3168	0.001115	0.01094	1.22E-05
0.3456	0.001881	0.01846	3.47E-05
0.3744	0.002633	0.02585	6.81E-05
0.4032	0.003374	0.03312	0.000112
0.432	0.004107	0.04032	0.000166
0.4608	0.004834	0.04745	0.000229
0.4896	0.005556	0.05454	0.000303
0.5184	0.006277	0.06161	0.000387
0.5472	0.006996	0.06867	0.00048
0.576	0.007714	0.07573	0.000584

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 0.000127 m^3

w(b)= 0.009047 m
w(a)= 0.003317 m
delta kh= (w(b)-w(a))/INT
delta kh= 45 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 270 kN/m^2

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Table H57

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.116kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.010284	-0.08881	0.000913
0.0288	-0.009033	-0.07801	0.000705
0.0576	-0.007829	-0.06761	0.000529
0.0864	-0.006669	-0.05759	0.000384
0.1152	-0.005553	-0.04796	0.000266
0.144	-0.004478	-0.03867	0.000173
0.1728	-0.003442	-0.02973	0.000102
0.2016	-0.002442	-0.02109	5.15E-05
0.2304	-0.001474	-0.01273	1.88E-05
0.2592	-0.000535	-0.00462	2.47E-06
0.288	0.000377	0.00326	1.23E-06
0.3168	0.001267	0.01094	1.39E-05
0.3456	0.002138	0.01846	3.95E-05
0.3744	0.002993	0.02585	7.74E-05
0.4032	0.003836	0.03312	0.000127
0.432	0.004668	0.04032	0.000188
0.4608	0.005495	0.04745	0.000261
0.4896	0.006316	0.05454	0.000344
0.5184	0.007135	0.06161	0.00044
0.5472	0.007952	0.06867	0.000546
0.576	0.008769	0.07573	0.000664

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 0.000145 m^3

w(b)= 0.010284 m
w(a)= 0.003725 m
delta kh= (w(b)-w(a))/INT
delta kh= 45 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	270	kN/m^2

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Table H58

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.130kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.011529	-0.08881	0.001024
0.0288	-0.010128	-0.07801	0.00079
0.0576	-0.008777	-0.06761	0.000593
0.0864	-0.007478	-0.05759	0.000431
0.1152	-0.006226	-0.04796	0.000299
0.144	-0.005021	-0.03867	0.000194
0.1728	-0.003859	-0.02973	0.000115
0.2016	-0.002737	-0.02109	5.77E-05
0.2304	-0.001653	-0.01273	2.1E-05
0.2592	-0.0006004	-0.00462	2.77E-06
0.288	0.000423	0.00326	1.38E-06
0.3168	0.00142	0.01094	1.55E-05
0.3456	0.002397	0.01846	4.42E-05
0.3744	0.003356	0.02585	8.68E-05
0.4032	0.0043	0.03312	0.000142
0.432	0.005234	0.04032	0.000211
0.4608	0.00616	0.04745	0.000292
0.4896	0.007081	0.05454	0.000386
0.5184	0.007999	0.06161	0.000493
0.5472	0.008916	0.06867	0.000612
0.576	0.009832	0.07573	0.000745

B= 0.0254 m
delta Z= 0.0288 m

<u>by Simpson's rule:</u>

INT= 0.000162 m^3

w(b)= 0.011529 m
w(a)= 0.004139 m
delta kh= (w(b)-w(a))/INT
delta kh= 45 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	270	kN/m^2

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Table H59

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.144kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.012775	-0.08881	0.001135
0.0288	-0.011222	-0.07801	0.000875
0.0576	-0.009725	-0.06761	0.000658
0.0864	-0.008285	-0.05759	0.000477
0.1152	-0.006898	-0.04796	0.000331
0.144	-0.005563	-0.03867	0.000215
0.1728	-0.004276	-0.02973	0.000127
0.2016	-0.003033	-0.02109	6.4E-05
0.2304	-0.001831	-0.01273	2.33E-05
0.2592	-0.000665	-0.00462	3.07E-06
0.288	0.000468	0.00326	1.53E-06
0.3168	0.001574	0.01094	1.72E-05
0.3456	0.002656	0.01846	4.9E-05
0.3744	0.003718	0.02585	9.61E-05
0.4032	0.004765	0.03312	0.000158
0.432	0.005799	0.04032	0.000234
0.4608	0.006826	0.04745	0.000324
0.4896	0.007846	0.05454	0.000428
0.5184	0.008863	0.06161	0.000546
0.5472	0.009878	0.06867	0.000678
0.576	0.010894	0.07573	0.000825

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 0.00018 m^3

w(b)= 0.012775 m
w(a)= 0.004567 m
delta kh= (w(b)-w(a))/INT
delta kh= 46 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 271 kN/m^2

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Table H60

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.158kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.014019	-0.08881	0.001245
0.0288	-0.012315	-0.07801	0.000961
0.0576	-0.010673	-0.06761	0.000722
0.0864	-0.009093	-0.05759	0.000524
0.1152	-0.007571	-0.04796	0.000363
0.144	-0.006105	-0.03867	0.000236
0.1728	-0.004693	-0.02973	0.00014
0.2016	-0.003329	-0.02109	7.02E-05
0.2304	-0.002009	-0.01273	2.56E-05
0.2592	-0.00073	-0.00462	3.37E-06
0.288	0.000514	0.00326	1.68E-06
0.3168	0.001727	0.01094	1.89E-05
0.3456	0.002914	0.01846	5.38E-05
0.3744	0.00408	0.02585	0.000105
0.4032	0.005229	0.03312	0.000173
0.432	0.006365	0.04032	0.000257
0.4608	0.007491	0.04745	0.000355
0.4896	0.008611	0.05454	0.00047
0.5184	0.009727	0.06161	0.000599
0.5472	0.010841	0.06867	0.000744
0.576	0.011955	0.07573	0.000905

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 0.000198 m^3

w(b)= 0.014019 m
w(a)= 0.004973 m
delta kh= (w(b)-w(a))/INT
delta kh= 46 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 271 kN/m^2

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Table H61

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

B= 0.0254 m
delta Z= 0.0288 m

	Mi=0.172kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.015266	-0.08881	0.001356
0.0288	-0.013409	-0.07801	0.001046
0.0576	-0.011622	-0.06761	0.000786
0.0864	-0.009901	-0.05759	0.00057
0.1152	-0.008244	-0.04796	0.000395
0.144	-0.006648	-0.03867	0.000257
0.1728	-0.005109	-0.02973	0.000152
0.2016	-0.003625	-0.02109	7.65E-05
0.2304	-0.002188	-0.01273	2.79E-05
0.2592	-0.000795	-0.00462	3.67E-06
0.288	0.000559	0.00326	1.82E-06
0.3168	0.001881	0.01094	2.06E-05
0.3456	0.003173	0.01846	5.86E-05
0.3744	0.004443	0.02585	0.000115
0.4032	0.005694	0.03312	0.000189
0.432	0.00693	0.04032	0.000279
0.4608	0.008156	0.04745	0.000387
0.4896	0.009376	0.05454	0.000511
0.5184	0.010591	0.06161	0.000653
0.5472	0.011805	0.06867	0.000811
0.576	0.013018	0.07573	0.000986

by Simpson's rule:

INT= 0.000215 m^3

w(b)= 0.015266 m
w(a)= 0.005369 m
delta kh= (w(b)-w(a))/INT
delta kh= 46 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 271 kN/m^2

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Table H62

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.186kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.016511	-0.08881	0.001466
0.0288	-0.014503	-0.07801	0.001131
0.0576	-0.012569	-0.06761	0.00085
0.0864	-0.010708	-0.05759	0.000617
0.1152	-0.008916	-0.04796	0.000428
0.144	-0.00719	-0.03867	0.000278
0.1728	-0.005527	-0.02973	0.000164
0.2016	-0.00392	-0.02109	8.27E-05
0.2304	-0.002366	-0.01273	3.01E-05
0.2592	-0.000859	-0.00462	3.97E-06
0.288	0.000605	0.00326	1.97E-06
0.3168	0.002034	0.01094	2.23E-05
0.3456	0.003432	0.01846	6.34E-05
0.3744	0.004805	0.02585	0.000124
0.4032	0.006158	0.03312	0.000204
0.432	0.007495	0.04032	0.000302
0.4608	0.008822	0.04745	0.000419
0.4896	0.010141	0.05454	0.000553
0.5184	0.011455	0.06161	0.000706
0.5472	0.012768	0.06867	0.000877
0.576	0.014079	0.07573	0.001066

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 0.000233 m^3

w(b)= 0.016511 m
w(a)= 0.005772 m
delta kh= (w(b)-w(a))/INT
delta kh= 46 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 271 kN/m^2

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Table H63

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.209kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.018519	-0.08881	0.001645
0.0288	-0.016268	-0.07801	0.001269
0.0576	-0.014099	-0.06761	0.000953
0.0864	-0.012011	-0.05759	0.000692
0.1152	-0.010001	-0.04796	0.00048
0.144	-0.008065	-0.03867	0.000312
0.1728	-0.006199	-0.02973	0.000184
0.2016	-0.004397	-0.02109	9.27E-05
0.2304	-0.002654	-0.01273	3.38E-05
0.2592	-0.000964	-0.00462	4.45E-06
0.288	0.000679	0.00326	2.21E-06
0.3168	0.002282	0.01094	2.5E-05
0.3456	0.003849	0.01846	7.11E-05
0.3744	0.005389	0.02585	0.000139
0.4032	0.006907	0.03312	0.000229
0.432	0.008407	0.04032	0.000339
0.4608	0.009895	0.04745	0.00047
0.4896	0.011374	0.05454	0.00062
0.5184	0.012849	0.06161	0.000792
0.5472	0.014321	0.06867	0.000983
0.576	0.015792	0.07573	0.001196

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 0.000261 m^3

w(b)= 0.018519 m
w(a)= 0.006351 m
delta kh= (w(b)-w(a))/INT
delta kh= 47 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\textbf{kh= 272 kN/m^2}}$

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Table H64

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.231kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.020528	-0.08881	0.001823
0.0288	-0.018033	-0.07801	0.001407
0.0576	-0.015628	-0.06761	0.001057
0.0864	-0.013314	-0.05759	0.000767
0.1152	-0.011086	-0.04796	0.000532
0.144	-0.008939	-0.03867	0.000346
0.1728	-0.006871	-0.02973	0.000204
0.2016	-0.004874	-0.02109	0.000103
0.2304	-0.002942	-0.01273	3.75E-05
0.2592	-0.001069	-0.00462	4.94E-06
0.288	0.000752	0.00326	2.45E-06
0.3168	0.002529	0.01094	2.77E-05
0.3456	0.004267	0.01846	7.88E-05
0.3744	0.005975	0.02585	0.000154
0.4032	0.007656	0.03312	0.000254
0.432	0.009319	0.04032	0.000376
0.4608	0.010968	0.04745	0.00052
0.4896	0.012608	0.05454	0.000688
0.5184	0.014242	0.06161	0.000877
0.5472	0.015874	0.06867	0.00109
0.576	0.017505	0.07573	0.001326

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 0.000289 m^3

w(b)= 0.020528 m
w(a)= 0.006934 m
delta kh= (w(b)-w(a))/INT
delta kh= 47 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 272 kN/m^2

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Table H65

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.254kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.022536	-0.08881	0.002001
0.0288	-0.019796	-0.07801	0.001544
0.0576	-0.017157	-0.06761	0.00116
0.0864	-0.014616	-0.05759	0.000842
0.1152	-0.01217	-0.04796	0.000584
0.144	-0.009814	-0.03867	0.00038
0.1728	-0.007543	-0.02973	0.000224
0.2016	-0.005351	-0.02109	0.000113
0.2304	-0.00323	-0.01273	4.11E-05
0.2592	-0.001174	-0.00462	5.42E-06
0.288	0.000826	0.00326	2.69E-06
0.3168	0.002776	0.01094	3.04E-05
0.3456	0.004685	0.01846	8.65E-05
0.3744	0.006559	0.02585	0.00017
0.4032	0.008405	0.03312	0.000278
0.432	0.010231	0.04032	0.000413
0.4608	0.012041	0.04745	0.000571
0.4896	0.013841	0.05454	0.000755
0.5184	0.015636	0.06161	0.000963
0.5472	0.017427	0.06867	0.001197
0.576	0.019218	0.07573	0.001455

B= 0.0254 m
delta Z= 0.0288 m

<u>by Simpson's rule:</u>

INT= 0.000317 m^3

w(b)= 0.022536 m
w(a)= 0.007535 m
delta kh= (w(b)-w(a))/INT
delta kh= 47 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\textbf{kh= 272 kN/m^2}}$

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Table H66

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.6
LINEAR PART
PILE LENGTH=0.576m

	Mi=0.276kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.024545	-0.08881	0.00218
0.0288	-0.021561	-0.07801	0.001682
0.0576	-0.018686	-0.06761	0.001263
0.0864	-0.015919	-0.05759	0.000917
0.1152	-0.013255	-0.04796	0.000636
0.144	-0.010689	-0.03867	0.000413
0.1728	-0.008216	-0.02973	0.000244
0.2016	-0.005828	-0.02109	0.000123
0.2304	-0.003518	-0.01273	4.48E-05
0.2592	-0.001278	-0.00462	5.9E-06
0.288	0.000899	0.00326	2.93E-06
0.3168	0.003024	0.01094	3.31E-05
0.3456	0.005102	0.01846	9.42E-05
0.3744	0.007144	0.02585	0.000185
0.4032	0.009155	0.03312	0.000303
0.432	0.011143	0.04032	0.000449
0.4608	0.013114	0.04745	0.000622
0.4896	0.015075	0.05454	0.000822
0.5184	0.017029	0.06161	0.001049
0.5472	0.01898	0.06867	0.001303
0.576	0.020931	0.07573	0.001585

B= 0.0254 m
delta Z= 0.0288 m

by Simpson's rule:

INT= 0.000346 m^3

w(b)= 0.024545 m
w(a)= 0.008345 m
delta kh= (w(b)-w(a))/INT
delta kh= 47 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 272 kN/m^2

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Table H67

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.011kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.000837	-0.07398	6.19E-05
0.0324	-0.000726	-0.06418	4.66E-05
0.0648	-0.000621	-0.05487	3.41E-05
0.0972	-0.000521	-0.04605	2.4E-05
0.1296	-0.000426	-0.03771	1.61E-05
0.162	-0.000337	-0.02981	1E-05
0.1944	-0.000252	-0.02233	5.63E-06
0.2268	-0.000172	-0.01524	2.62E-06
0.2592	-0.000096	-0.0085	8.16E-07
0.2916	-0.000024	-0.00208	4.99E-08
0.324	0.000046	0.00406	1.87E-07
0.3564	0.000113	0.00996	1.13E-06
0.3888	0.000177	0.01565	2.77E-06
0.4212	0.000239	0.02118	5.06E-06
0.4536	0.000301	0.02657	8E-06
0.486	0.00036	0.03186	1.15E-05
0.5184	0.000419	0.03708	1.55E-05
0.5508	0.000478	0.04225	2.02E-05
0.5832	0.000536	0.04739	2.54E-05
0.6156	0.000594	0.05252	3.12E-05
0.648	0.000652	0.05764	3.76E-05

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 1E-05 m^3

w(b)= 0.000837 m
w(a)= 0.000339 m
delta kh= (w(b)-w(a))/INT
delta kh= 50 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 275 kN/m^2

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Table H68

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

B= 0.0254 m
dalta Z= 0.0324 m

	Mi=0.023kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.001674	-0.07398	0.000124
0.0324	-0.001452	-0.06418	9.32E-05
0.0648	-0.001241	-0.05487	6.81E-05
0.0972	-0.001042	-0.04605	4.8E-05
0.1296	-0.000853	-0.03771	3.22E-05
0.162	-0.000674	-0.02981	2.01E-05
0.1944	-0.000505	-0.02233	1.13E-05
0.2268	-0.000345	-0.01524	5.26E-06
0.2592	-0.000192	-0.0085	1.63E-06
0.2916	-0.000047	-0.00208	9.78E-08
0.324	0.000092	0.00406	3.74E-07
0.3564	0.000225	0.00996	2.24E-06
0.3888	0.000354	0.01565	5.54E-06
0.4212	0.000479	0.02118	1.01E-05
0.4536	0.000601	0.02657	1.6E-05
0.486	0.000721	0.03186	2.3E-05
0.5184	0.000839	0.03708	3.11E-05
0.5508	0.000956	0.04225	4.04E-05
0.5832	0.001072	0.04739	5.08E-05
0.6156	0.001188	0.05252	6.24E-05
0.648	0.001304	0.05764	7.52E-05

by Simpson's rule:

INT= 2E-05 m^3

w(b)= 0.001674 m
w(a)= 0.000639 m
delta kh= (w(b)-w(a))/INT
delta kh= 52 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 277 kN/m^2

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Table H69
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.034kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.00251	-0.07398	0.000186
0.0324	-0.002178	-0.06418	0.00014
0.0648	-0.001862	-0.05487	0.000102
0.0972	-0.001562	-0.04605	7.19E-05
0.1296	-0.001279	-0.03771	4.82E-05
0.162	-0.001011	-0.02981	3.01E-05
0.1944	-0.000757	-0.02233	1.69E-05
0.2268	-0.000517	-0.01524	7.88E-06
0.2592	-0.000288	-0.0085	2.45E-06
0.2916	-0.000071	-0.00208	1.48E-07
0.324	0.000138	0.00406	5.6E-07
0.3564	0.000338	0.00996	3.37E-06
0.3888	0.000531	0.01565	8.31E-06
0.4212	0.000718	0.02118	1.52E-05
0.4536	0.000902	0.02657	2.4E-05
0.486	0.001081	0.03186	3.44E-05
0.5184	0.001258	0.03708	4.66E-05
0.5508	0.001434	0.04225	6.06E-05
0.5832	0.001608	0.04739	7.62E-05
0.6156	0.001782	0.05252	9.36E-05
0.648	0.001956	0.05764	0.000113

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 3E-05 m^3

w(b)= 0.00251 m
w(a)= 0.000922 m
delta kh= (w(b)-w(a))/INT
delta kh= 53 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 278 kN/m^2

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Table H70

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.045kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.003347	-0.07398	0.000248
0.0324	-0.002903	-0.06418	0.000186
0.0648	-0.002482	-0.05487	0.000136
0.0972	-0.002083	-0.04605	9.59E-05
0.1296	-0.001706	-0.03771	6.43E-05
0.162	-0.001348	-0.02981	4.02E-05
0.1944	-0.00101	-0.02233	2.26E-05
0.2268	-0.000689	-0.01524	1.05E-05
0.2592	-0.000385	-0.0085	3.27E-06
0.2916	-0.000094	-0.00208	1.96E-07
0.324	0.000184	0.00406	7.47E-07
0.3564	0.00045	0.00996	4.48E-06
0.3888	0.000708	0.01565	1.11E-05
0.4212	0.000958	0.02118	2.03E-05
0.4536	0.001202	0.02657	3.19E-05
0.486	0.001442	0.03186	4.59E-05
0.5184	0.001678	0.03708	6.22E-05
0.5508	0.001911	0.04225	8.07E-05
0.5832	0.002144	0.04739	0.000102
0.6156	0.002376	0.05252	0.000125
0.648	0.002607	0.05764	0.00015

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 4E-05 m^3

w(b)= 0.003347 m
w(a)= 0.001246 m
delta kh= (w(b)-w(a))/INT
delta kh= 53 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 278 kN/m^2

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Table H71

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.057kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.004184	-0.07398	0.00031
0.0324	-0.003629	-0.06418	0.000233
0.0648	-0.003103	-0.05487	0.00017
0.0972	-0.002604	-0.04605	0.00012
0.1296	-0.002132	-0.03771	8.04E-05
0.162	-0.001686	-0.02981	5.03E-05
0.1944	-0.001263	-0.02233	2.82E-05
0.2268	-0.000862	-0.01524	1.31E-05
0.2592	-0.000481	-0.0085	4.09E-06
0.2916	-0.000118	-0.00208	2.45E-07
0.324	0.000229	0.00406	9.3E-07
0.3564	0.000563	0.00996	5.61E-06
0.3888	0.000885	0.01565	1.39E-05
0.4212	0.001198	0.02118	2.54E-05
0.4536	0.001503	0.02657	3.99E-05
0.486	0.001802	0.03186	5.74E-05
0.5184	0.002097	0.03708	7.78E-05
0.5508	0.002389	0.04225	0.000101
0.5832	0.002679	0.04739	0.000127
0.6156	0.002969	0.05252	0.000156
0.648	0.003259	0.05764	0.000188

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 5E-05 m^3

w(b)= 0.004184 m
w(a)= 0.001566 m
delta kh= (w(b)-w(a))/INT
delta kh= 52 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	277	kN/m^2

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Table H72

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

B= 0.0254 m
dalta Z= 0.0324 m

	Mi=0.068kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.005021	-0.07398	0.000371
0.0324	-0.004355	-0.06418	0.00028
0.0648	-0.003723	-0.05487	0.000204
0.0972	-0.003125	-0.04605	0.000144
0.1296	-0.002559	-0.03771	9.65E-05
0.162	-0.002023	-0.02981	6.03E-05
0.1944	-0.001515	-0.02233	3.38E-05
0.2268	-0.001034	-0.01524	1.58E-05
0.2592	-0.000577	-0.0085	4.9E-06
0.2916	-0.000141	-0.00208	2.93E-07
0.324	0.000275	0.00406	1.12E-06
0.3564	0.000676	0.00996	6.73E-06
0.3888	0.001062	0.01565	1.66E-05
0.4212	0.001437	0.02118	3.04E-05
0.4536	0.001803	0.02657	4.79E-05
0.486	0.002163	0.03186	6.89E-05
0.5184	0.002516	0.03708	9.33E-05
0.5508	0.002867	0.04225	0.000121
0.5832	0.003216	0.04739	0.000152
0.6156	0.003564	0.05252	0.000187
0.648	0.003911	0.05764	0.000225

by Simpson's rule:

INT= 6E-05 m^3

w(b)= 0.005021 m
w(a)= 0.001876 m
delta kh= (w(b)-w(a))/INT
delta kh= 52 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 277 kN/m^2

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Table H73

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.079kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.005858	-0.07398	0.000433
0.0324	-0.005081	-0.06418	0.000326
0.0648	-0.004344	-0.05487	0.000238
0.0972	-0.003646	-0.04605	0.000168
0.1296	-0.002985	-0.03771	0.000113
0.162	-0.002359	-0.02981	7.03E-05
0.1944	-0.001768	-0.02233	3.95E-05
0.2268	-0.001207	-0.01524	1.84E-05
0.2592	-0.000673	-0.0085	5.72E-06
0.2916	-0.000165	-0.00208	3.43E-07
0.324	0.000321	0.00406	1.3E-06
0.3564	0.000788	0.00996	7.85E-06
0.3888	0.001239	0.01565	1.94E-05
0.4212	0.001677	0.02118	3.55E-05
0.4536	0.002104	0.02657	5.59E-05
0.486	0.002523	0.03186	8.04E-05
0.5184	0.002936	0.03708	0.000109
0.5508	0.003345	0.04225	0.000141
0.5832	0.003752	0.04739	0.000178
0.6156	0.004158	0.05252	0.000218
0.648	0.004563	0.05764	0.000263

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 7E-05 m^3

w(b)= 0.005858 m
w(a)= 0.002185 m
delta kh= (w(b)-w(a))/INT
delta kh= 52 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 277 kN/m^2

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Table H74

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.091kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.0067	-0.07398	0.000496
0.0324	-0.005812	-0.06418	0.000373
0.0648	-0.004969	-0.05487	0.000273
0.0972	-0.00417	-0.04605	0.000192
0.1296	-0.003415	-0.03771	0.000129
0.162	-0.002699	-0.02981	8.05E-05
0.1944	-0.002022	-0.02233	4.52E-05
0.2268	-0.00138	-0.01524	2.1E-05
0.2592	-0.00077	-0.0085	6.55E-06
0.2916	-0.000189	-0.00208	3.93E-07
0.324	0.000368	0.00406	1.49E-06
0.3564	0.000902	0.00996	8.98E-06
0.3888	0.001418	0.01565	2.22E-05
0.4212	0.001918	0.02118	4.06E-05
0.4536	0.002406	0.02657	6.39E-05
0.486	0.002886	0.03186	9.19E-05
0.5184	0.003358	0.03708	0.000125
0.5508	0.003826	0.04225	0.000162
0.5832	0.004292	0.04739	0.000203
0.6156	0.004756	0.05252	0.00025
0.648	0.005119	0.05764	0.000295

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 8E-05 m^3

w(b)= 0.0067 m
w(a)= 0.00249 m
delta kh= (w(b)-w(a))/INT
delta kh= 53 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 278 kN/m^2

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Table H75

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

B= 0.0254 m
dalta Z= 0.0324 m

	Mi=0.102kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.007537	-0.07398	0.000558
0.0324	-0.006538	-0.06418	0.00042
0.0648	-0.005589	-0.05487	0.000307
0.0972	-0.004691	-0.04605	0.000216
0.1296	-0.003841	-0.03771	0.000145
0.162	-0.003036	-0.02981	9.05E-05
0.1944	-0.002275	-0.02233	5.08E-05
0.2268	-0.001552	-0.01524	2.37E-05
0.2592	-0.000866	-0.0085	7.36E-06
0.2916	-0.000212	-0.00208	4.41E-07
0.324	0.000413	0.00406	1.68E-06
0.3564	0.001014	0.00996	1.01E-05
0.3888	0.001594	0.01565	2.49E-05
0.4212	0.002158	0.02118	4.57E-05
0.4536	0.002707	0.02657	7.19E-05
0.486	0.003246	0.03186	0.000103
0.5184	0.003777	0.03708	0.00014
0.5508	0.004304	0.04225	0.000182
0.5832	0.004828	0.04739	0.000229
0.6156	0.005349	0.05252	0.000281
0.648	0.005872	0.05764	0.000338

by Simpson's rule:

INT= 9.01E-05 m^3

w(b)= 0.007537 m
w(a)= 0.002779 m
delta kh= (w(b)-w(a))/INT
delta kh= 53 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 278 kN/m^2

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Table H76

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.116kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.008568	-0.07398	0.000634
0.0324	-0.007432	-0.06418	0.000477
0.0648	-0.006354	-0.05487	0.000349
0.0972	-0.005333	-0.04605	0.000246
0.1296	-0.004366	-0.03771	0.000165
0.162	-0.003452	-0.02981	0.000103
0.1944	-0.002586	-0.02233	5.77E-05
0.2268	-0.001765	-0.01524	2.69E-05
0.2592	-0.000985	-0.0085	8.37E-06
0.2916	-0.000241	-0.00208	5.01E-07
0.324	0.000469	0.00406	1.9E-06
0.3564	0.001153	0.00996	1.15E-05
0.3888	0.001813	0.01565	2.84E-05
0.4212	0.002453	0.02118	5.2E-05
0.4536	0.003077	0.02657	8.18E-05
0.486	0.003689	0.03186	0.000118
0.5184	0.004294	0.03708	0.000159
0.5508	0.004893	0.04225	0.000207
0.5832	0.005488	0.04739	0.00026
0.6156	0.006081	0.05252	0.000319
0.648	0.006675	0.05764	0.000385

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 0.000102 m^3

w(b)= 0.008568 m
w(a)= 0.003064 m
delta kh= (w(b)-w(a))/INT
delta kh= 54 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 279 kN/m^2

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Table H77

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.130kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.009606	-0.07398	0.000711
0.0324	-0.008332	-0.06418	0.000535
0.0648	-0.007123	-0.05487	0.000391
0.0972	-0.005979	-0.04605	0.000275
0.1296	-0.004895	-0.03771	0.000185
0.162	-0.003869	-0.02981	0.000115
0.1944	-0.002899	-0.02233	6.47E-05
0.2268	-0.001979	-0.01524	3.02E-05
0.2592	-0.001104	-0.0085	9.38E-06
0.2916	-0.00027	-0.00208	5.62E-07
0.324	0.000527	0.00406	2.14E-06
0.3564	0.001293	0.00996	1.29E-05
0.3888	0.002032	0.01565	3.18E-05
0.4212	0.002749	0.02118	5.82E-05
0.4536	0.003449	0.02657	9.16E-05
0.486	0.004137	0.03186	0.000132
0.5184	0.004814	0.03708	0.000179
0.5508	0.005485	0.04225	0.000232
0.5832	0.006153	0.04739	0.000292
0.6156	0.006818	0.05252	0.000358
0.648	0.007483	0.05764	0.000431

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 0.000115 m^3

w(b)= 0.009606 m
w(a)= 0.003359 m
delta kh= (w(b)-w(a))/INT
delta kh= 54 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 279 kN/m^2

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Table H78

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.144kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.010643	-0.07398	0.000787
0.0324	-0.009232	-0.06418	0.000593
0.0648	-0.007893	-0.05487	0.000433
0.0972	-0.006624	-0.04605	0.000305
0.1296	-0.005424	-0.03771	0.000205
0.162	-0.004288	-0.02981	0.000128
0.1944	-0.003212	-0.02233	7.17E-05
0.2268	-0.002192	-0.01524	3.34E-05
0.2592	-0.001223	-0.0085	1.04E-05
0.2916	-0.000299	-0.00208	6.22E-07
0.324	0.000584	0.00406	2.37E-06
0.3564	0.001432	0.00996	1.43E-05
0.3888	0.002252	0.01565	3.52E-05
0.4212	0.003047	0.02118	6.45E-05
0.4536	0.003823	0.02657	0.000102
0.486	0.004584	0.03186	0.000146
0.5184	0.005334	0.03708	0.000198
0.5508	0.006078	0.04225	0.000257
0.5832	0.006817	0.04739	0.000323
0.6156	0.007554	0.05252	0.000397
0.648	0.008291	0.05764	0.000478

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 0.000127 m^3

w(b)= 0.010643 m
w(a)= 0.003673 m
delta kh= (w(b)-w(a))/INT
delta kh= 55 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 280 kN/m^2

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Table H79

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.158kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.01168	-0.07398	0.000864
0.0324	-0.010132	-0.06418	0.00065
0.0648	-0.008662	-0.05487	0.000475
0.0972	-0.007269	-0.04605	0.000335
0.1296	-0.005952	-0.03771	0.000224
0.162	-0.004706	-0.02981	0.00014
0.1944	-0.003525	-0.02233	7.87E-05
0.2268	-0.002406	-0.01524	3.67E-05
0.2592	-0.001342	-0.0085	1.14E-05
0.2916	-0.000329	-0.00208	6.84E-07
0.324	0.000641	0.00406	2.6E-06
0.3564	0.001572	0.00996	1.57E-05
0.3888	0.002471	0.01565	3.87E-05
0.4212	0.003344	0.02118	7.08E-05
0.4536	0.004195	0.02657	0.000111
0.486	0.00503	0.03186	0.00016
0.5184	0.005854	0.03708	0.000217
0.5508	0.00667	0.04225	0.000282
0.5832	0.007481	0.04739	0.000355
0.6156	0.008291	0.05252	0.000435
0.648	0.009099	0.05764	0.000524

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 0.00014 m^3

w(b)= 0.01168 m
w(a)= 0.003972 m
delta kh= (w(b)-w(a))/INT
delta kh= 55 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 280 kN/m^2

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Table H80
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.172kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.012718	-0.07398	0.000941
0.0324	-0.011032	-0.06418	0.000708
0.0648	-0.009432	-0.05487	0.000518
0.0972	-0.007916	-0.04605	0.000365
0.1296	-0.006481	-0.03771	0.000244
0.162	-0.005124	-0.02981	0.000153
0.1944	-0.003838	-0.02233	8.57E-05
0.2268	-0.002619	-0.01524	3.99E-05
0.2592	-0.001462	-0.0085	1.24E-05
0.2916	-0.000358	-0.00208	7.45E-07
0.324	0.000698	0.00406	2.83E-06
0.3564	0.001712	0.00996	1.71E-05
0.3888	0.002691	0.01565	4.21E-05
0.4212	0.003641	0.02118	7.71E-05
0.4536	0.004568	0.02657	0.000121
0.486	0.005477	0.03186	0.000174
0.5184	0.006374	0.03708	0.000236
0.5508	0.007263	0.04225	0.000307
0.5832	0.008146	0.04739	0.000386
0.6156	0.009027	0.05252	0.000474
0.648	0.009908	0.05764	0.000571

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 0.000152 m^3

w(b)= 0.012718 m
w(a)= 0.004292 m
delta kh= (w(b)-w(a))/INT
delta kh= 55 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**280**	**kN/m^2**

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Table H81

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.186kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.013756	-0.07398	0.001018
0.0324	-0.011932	-0.06418	0.000766
0.0648	-0.010201	-0.05487	0.00056
0.0972	-0.008562	-0.04605	0.000394
0.1296	-0.00701	-0.03771	0.000264
0.162	-0.005542	-0.02981	0.000165
0.1944	-0.004151	-0.02233	9.27E-05
0.2268	-0.002833	-0.01524	4.32E-05
0.2592	-0.001581	-0.0085	1.34E-05
0.2916	-0.000387	-0.00208	8.05E-07
0.324	0.000754	0.00406	3.06E-06
0.3564	0.001851	0.00996	1.84E-05
0.3888	0.00291	0.01565	4.55E-05
0.4212	0.003938	0.02118	8.34E-05
0.4536	0.00494	0.02657	0.000131
0.486	0.005924	0.03186	0.000189
0.5184	0.006894	0.03708	0.000256
0.5508	0.007855	0.04225	0.000332
0.5832	0.008811	0.04739	0.000418
0.6156	0.009764	0.05252	0.000513
0.648	0.010716	0.05764	0.000618

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 0.000164 m^3

w(b)= 0.013756 m
w(a)= 0.004595 m
delta kh= (w(b)-w(a))/INT
delta kh= 56 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 281 kN/m^2

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Table H82

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.209kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.015429	-0.07398	0.001141
0.0324	-0.013383	-0.06418	0.000859
0.0648	-0.011442	-0.05487	0.000628
0.0972	-0.009603	-0.04605	0.000442
0.1296	-0.007863	-0.03771	0.000297
0.162	-0.006216	-0.02981	0.000185
0.1944	-0.004657	-0.02233	0.000104
0.2268	-0.003178	-0.01524	4.84E-05
0.2592	-0.001773	-0.0085	1.51E-05
0.2916	-0.000434	-0.00208	9.03E-07
0.324	0.000846	0.00406	3.43E-06
0.3564	0.002077	0.00996	2.07E-05
0.3888	0.003264	0.01565	5.11E-05
0.4212	0.004417	0.02118	9.36E-05
0.4536	0.005542	0.02657	0.000147
0.486	0.006645	0.03186	0.000212
0.5184	0.007733	0.03708	0.000287
0.5508	0.008811	0.04225	0.000372
0.5832	0.009882	0.04739	0.000468
0.6156	0.010952	0.05252	0.000575
0.648	0.01202	0.05764	0.000693

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 0.000184 m^3

w(b)= 0.015429 m
w(a)= 0.004912 m
delta kh= (w(b)-w(a))/INT
delta kh= 57 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 282 kN/m^2

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Table H83

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

B= 0.0254 m
dalta Z= 0.0324 m

	Mi=0.231kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.017103	-0.07398	0.001265
0.0324	-0.014835	-0.06418	0.000952
0.0648	-0.012683	-0.05487	0.000696
0.0972	-0.010645	-0.04605	0.00049
0.1296	-0.008716	-0.03771	0.000329
0.162	-0.00689	-0.02981	0.000205
0.1944	-0.005162	-0.02233	0.000115
0.2268	-0.003523	-0.01524	5.37E-05
0.2592	-0.001965	-0.0085	1.67E-05
0.2916	-0.000481	-0.00208	1E-06
0.324	0.000938	0.00406	3.81E-06
0.3564	0.002302	0.00996	2.29E-05
0.3888	0.003618	0.01565	5.66E-05
0.4212	0.004896	0.02118	0.000104
0.4536	0.006143	0.02657	0.000163
0.486	0.007366	0.03186	0.000235
0.5184	0.008572	0.03708	0.000318
0.5508	0.009767	0.04225	0.000413
0.5832	0.010955	0.04739	0.000519
0.6156	0.012139	0.05252	0.000638
0.648	0.013324	0.05764	0.000768

by Simpson's rule:

INT= 0.000204 m^3

w(b)= 0.017103 m
w(a)= 0.005217 m
delta kh= (w(b)-w(a))/INT
delta kh= 58 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 283 kN/m^2

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Table H84

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.254kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.018776	-0.07398	0.001389
0.0324	-0.016286	-0.06418	0.001045
0.0648	-0.013924	-0.05487	0.000764
0.0972	-0.011686	-0.04605	0.000538
0.1296	-0.009568	-0.03771	0.000361
0.162	-0.007564	-0.02981	0.000225
0.1944	-0.005667	-0.02233	0.000127
0.2268	-0.003867	-0.01524	5.89E-05
0.2592	-0.002158	-0.0085	1.83E-05
0.2916	-0.000528	-0.00208	1.1E-06
0.324	0.001029	0.00406	4.18E-06
0.3564	0.002527	0.00996	2.52E-05
0.3888	0.003972	0.01565	6.22E-05
0.4212	0.005375	0.02118	0.000114
0.4536	0.006743	0.02657	0.000179
0.486	0.008086	0.03186	0.000258
0.5184	0.00941	0.03708	0.000349
0.5508	0.010722	0.04225	0.000453
0.5832	0.012026	0.04739	0.00057
0.6156	0.013327	0.05252	0.0007
0.648	0.014627	0.05764	0.000843

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 0.000224 m^3

w(b)= 0.018776 m
w(a)= 0.005543 m
delta kh= (w(b)-w(a))/INT
delta kh= 59 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 284 kN/m^2

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Table H85

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.276kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.020449	-0.07398	0.001513
0.0324	-0.017738	-0.06418	0.001138
0.0648	-0.015165	-0.05487	0.000832
0.0972	-0.012728	-0.04605	0.000586
0.1296	-0.010421	-0.03771	0.000393
0.162	-0.008238	-0.02981	0.000246
0.1944	-0.006172	-0.02233	0.000138
0.2268	-0.004212	-0.01524	6.42E-05
0.2592	-0.00235	-0.0085	2E-05
0.2916	-0.000576	-0.00208	1.2E-06
0.324	0.001122	0.00406	4.56E-06
0.3564	0.002752	0.00996	2.74E-05
0.3888	0.004326	0.01565	6.77E-05
0.4212	0.005854	0.02118	0.000124
0.4536	0.007345	0.02657	0.000195
0.486	0.008807	0.03186	0.000281
0.5184	0.010249	0.03708	0.00038
0.5508	0.011678	0.04225	0.000493
0.5832	0.013098	0.04739	0.000621
0.6156	0.014515	0.05252	0.000762
0.648	0.015931	0.05764	0.000918

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 0.000244 m^3

w(b)= 0.020449 m
w(a)= 0.005862 m
delta kh= (w(b)-w(a))/INT
delta kh= 60 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\textbf{kh= 285 kN/m^2}}$

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Table H86

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=1.8
LINEAR PART
PILE LENGTH=0.648m

	Mi=0.299kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.022123	-0.07398	0.001637
0.0324	-0.019189	-0.06418	0.001232
0.0648	-0.016406	-0.05487	0.0009
0.0972	-0.013769	-0.04605	0.000634
0.1296	-0.011274	-0.03771	0.000425
0.162	-0.008913	-0.02981	0.000266
0.1944	-0.006677	-0.02233	0.000149
0.2268	-0.004557	-0.01524	6.94E-05
0.2592	-0.002542	-0.0085	2.16E-05
0.2916	-0.000623	-0.00208	1.3E-06
0.324	0.001213	0.00406	4.92E-06
0.3564	0.002977	0.00996	2.97E-05
0.3888	0.00468	0.01565	7.32E-05
0.4212	0.006333	0.02118	0.000134
0.4536	0.007946	0.02657	0.000211
0.486	0.009528	0.03186	0.000304
0.5184	0.011088	0.03708	0.000411
0.5508	0.012633	0.04225	0.000534
0.5832	0.01417	0.04739	0.000672
0.6156	0.015703	0.05252	0.000825
0.648	0.017235	0.05764	0.000993

B= 0.0254 m
dalta Z= 0.0324 m

by Simpson's rule:

INT= 0.000264 m^3

w(b)= 0.022123 m
w(a)= 0.00618 m
delta kh= (w(b)-w(a))/INT
delta kh= 60 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 285 kN/m^2

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Table H87

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.011kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.000725	-0.06414	4.65E-05
0.036	-0.000619	-0.05478	3.39E-05
0.072	-0.000521	-0.04603	2.4E-05
0.108	-0.000428	-0.03789	1.62E-05
0.144	-0.000343	-0.03032	1.04E-05
0.18	-0.000264	-0.02331	6.15E-06
0.216	-0.00019	-0.01681	3.19E-06
0.252	-0.000122	-0.01078	1.32E-06
0.288	-0.000059	-0.00518	3.06E-07
0.324	0.0000003	0.00003	9E-12
0.36	0.000056	0.00491	2.75E-07
0.396	0.000107	0.00949	1.02E-06
0.432	0.000156	0.01383	2.16E-06
0.468	0.000203	0.01797	3.65E-06
0.504	0.000248	0.02195	5.44E-06
0.54	0.000292	0.02581	7.54E-06
0.576	0.000335	0.02958	9.91E-06
0.612	0.000377	0.0333	1.26E-05
0.648	0.000418	0.03698	1.55E-05
0.684	0.000459	0.04064	1.87E-05
0.72	0.000501	0.0443	2.22E-05

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 7.38E-06 m^3

w(b)= 0.000725 m
w(a)= 0.000219 m
delta kh= (w(b)-w(a))/INT
delta kh= 69 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 294 kN/m^2

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Table H88

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.023kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.001451	-0.06414	9.31E-05
0.036	-0.001239	-0.05478	6.79E-05
0.072	-0.001041	-0.04603	4.79E-05
0.108	-0.000857	-0.03789	3.25E-05
0.144	-0.000686	-0.03032	2.08E-05
0.18	-0.000527	-0.02331	1.23E-05
0.216	-0.00038	-0.01681	6.39E-06
0.252	-0.000244	-0.01078	2.63E-06
0.288	-0.000117	-0.00518	6.06E-07
0.324	0.0000007	0.00003	2.1E-11
0.36	0.000111	0.00491	5.45E-07
0.396	0.000215	0.00949	2.04E-06
0.432	0.000313	0.01383	4.33E-06
0.468	0.000407	0.01797	7.31E-06
0.504	0.000497	0.02195	1.09E-05
0.54	0.000584	0.02581	1.51E-05
0.576	0.000669	0.02958	1.98E-05
0.612	0.000753	0.0333	2.51E-05
0.648	0.000836	0.03698	3.09E-05
0.684	0.000919	0.04064	3.73E-05
0.72	0.001002	0.0443	4.44E-05

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 1.48E-05 m^3

w(b)= 0.001451 m
w(a)= 0.000444 m
delta kh= (w(b)-w(a))/INT
delta kh= 68 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 293 kN/m^2

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Table H89

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.034kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.002176	-0.06414	0.00014
0.036	-0.001859	-0.05478	0.000102
0.072	-0.001562	-0.04603	7.19E-05
0.108	-0.001285	-0.03789	4.87E-05
0.144	-0.001029	-0.03032	3.12E-05
0.18	-0.000791	-0.02331	1.84E-05
0.216	-0.00057	-0.01681	9.58E-06
0.252	-0.000366	-0.01078	3.95E-06
0.288	-0.000176	-0.00518	9.12E-07
0.324	0.000001	0.00003	3E-11
0.36	0.000167	0.00491	8.2E-07
0.396	0.000322	0.00949	3.06E-06
0.432	0.000469	0.01383	6.49E-06
0.468	0.000609	0.01797	1.09E-05
0.504	0.000745	0.02195	1.64E-05
0.54	0.000876	0.02581	2.26E-05
0.576	0.001004	0.02958	2.97E-05
0.612	0.001129	0.0333	3.76E-05
0.648	0.001255	0.03698	4.64E-05
0.684	0.001379	0.04064	5.6E-05
0.72	0.001503	0.0443	6.66E-05

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 2.21E-05 m^3

w(b)= 0.002176 m
w(a)= 0.00068 m
delta kh= (w(b)-w(a))/INT
delta kh= 68 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 293 kN/m^2

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Table H90

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.045kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.002902	-0.06414	0.000186
0.036	-0.002478	-0.05478	0.000136
0.072	-0.002082	-0.04603	9.58E-05
0.108	-0.001714	-0.03789	6.49E-05
0.144	-0.001371	-0.03032	4.16E-05
0.18	-0.001054	-0.02331	2.46E-05
0.216	-0.00076	-0.01681	1.28E-05
0.252	-0.0004877	-0.01078	5.26E-06
0.288	-0.0002345	-0.00518	1.21E-06
0.324	0.000001	0.00003	3E-11
0.36	0.000222	0.00491	1.09E-06
0.396	0.000429	0.00949	4.07E-06
0.432	0.000626	0.01383	8.66E-06
0.468	0.000813	0.01797	1.46E-05
0.504	0.000993	0.02195	2.18E-05
0.54	0.001168	0.02581	3.01E-05
0.576	0.001338	0.02958	3.96E-05
0.612	0.001506	0.0333	5.01E-05
0.648	0.001673	0.03698	6.19E-05
0.684	0.001839	0.04064	7.47E-05
0.72	0.002004	0.0443	8.88E-05

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 2.95E-05 m^3

w(b)= 0.002902 m
w(a)= 0.000909 m
delta kh= (w(b)-w(a))/INT
delta kh= 67 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\textbf{kh= 292 kN/m^2}}$

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Table H91

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.057kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.003627	-0.06414	0.000233
0.036	-0.003098	-0.05478	0.00017
0.072	-0.002603	. -0.04603	0.00012
0.108	-0.002142	-0.03789	8.12E-05
0.144	-0.001715	-0.03032	5.2E-05
0.18	-0.001318	-0.02331	3.07E-05
0.216	-0.00095	-0.01681	1.6E-05
0.252	-0.000609	-0.01078	6.57E-06
0.288	-0.000293	-0.00518	1.52E-06
0.324	0.000002	0.00003	6E-11
0.36	0.000278	0.00491	1.36E-06
0.396	0.000537	0.00949	5.1E-06
0.432	0.000782	0.01383	1.08E-05
0.468	0.001016	0.01797	1.83E-05
0.504	0.001241	0.02195	2.72E-05
0.54	0.001459	0.02581	3.77E-05
0.576	0.001673	0.02958	4.95E-05
0.612	0.001883	0.0333	6.27E-05
0.648	0.002091	0.03698	7.73E-05
0.684	0.002298	0.04064	9.34E-05
0.72	0.002505	0.0443	0.000111

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 3.69E-05 m^3

w(b)= 0.003627 m
w(a)= 0.001138 m
delta kh= (w(b)-w(a))/INT
delta kh= 67 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 292 kN/m^2

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Table H92

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.068kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.004353	-0.06414	0.000279
0.036	-0.003717	-0.05478	0.000204
0.072	-0.003123	-0.04603	0.000144
0.108	-0.002571	-0.03789	9.74E-05
0.144	-0.002058	-0.03032	6.24E-05
0.18	-0.001582	-0.02331	3.69E-05
0.216	-0.001141	-0.01681	1.92E-05
0.252	-0.000732	-0.01078	7.89E-06
0.288	-0.000352	-0.00518	1.82E-06
0.324	0.000002	0.00003	6E-11
0.36	0.000333	0.00491	1.64E-06
0.396	0.000644	0.00949	6.11E-06
0.432	0.000939	0.01383	1.3E-05
0.468	0.001219	0.01797	2.19E-05
0.504	0.001489	0.02195	3.27E-05
0.54	0.001752	0.02581	4.52E-05
0.576	0.002008	0.02958	5.94E-05
0.612	0.002259	0.0333	7.52E-05
0.648	0.002509	0.03698	9.28E-05
0.684	0.002758	0.04064	0.000112
0.72	0.003006	0.0443	0.000133

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 4.43E-05 m^3

w(b)= 0.004353 m
w(a)= 0.001369 m
delta kh= (w(b)-w(a))/INT
delta kh= 67 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 292 kN/m^2

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Table H93
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.079kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.005078	-0.06414	0.000326
0.036	-0.004337	-0.05478	0.000238
0.072	-0.003644	-0.04603	0.000168
0.108	-0.002999	-0.03789	0.000114
0.144	-0.002401	-0.03032	7.28E-05
0.18	-0.001845	-0.02331	4.3E-05
0.216	-0.001331	-0.01681	2.24E-05
0.252	-0.000854	-0.01078	9.21E-06
0.288	-0.00041	-0.00518	2.12E-06
0.324	0.000002	0.00003	6E-11
0.36	0.000386	0.00491	1.9E-06
0.396	0.000752	0.00949	7.14E-06
0.432	0.001095	0.01383	1.51E-05
0.468	0.001423	0.01797	2.56E-05
0.504	0.001738	0.02195	3.81E-05
0.54	0.002044	0.02581	5.28E-05
0.576	0.002342	0.02958	6.93E-05
0.612	0.002636	0.0333	8.78E-05
0.648	0.002928	0.03698	0.000108
0.684	0.003218	0.04064	0.000131
0.72	0.003507	0.0443	0.000155

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 5.17E-05 m^3

w(b)= 0.005078 m
w(a)= 0.001594 m
delta kh= (w(b)-w(a))/INT
delta kh= 67 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 292 kN/m^2

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Table H94

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.091kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.005809	-0.06414	0.000373
0.036	-0.004961	-0.05478	0.000272
0.072	-0.004168	. -0.04603	0.000192
0.108	-0.003431	-0.03789	0.00013
0.144	-0.002746	-0.03032	8.33E-05
0.18	-0.002111	-0.02331	4.92E-05
0.216	-0.001522	-0.01681	2.56E-05
0.252	-0.000976	-0.01078	1.05E-05
0.288	-0.000469	-0.00518	2.43E-06
0.324	0.000003	0.00003	9E-11
0.36	0.000444	0.00491	2.18E-06
0.396	0.000859	0.00949	8.15E-06
0.432	0.001253	0.01383	1.73E-05
0.468	0.001628	0.01797	2.93E-05
0.504	0.001988	0.02195	4.36E-05
0.54	0.002338	0.02581	6.03E-05
0.576	0.002679	0.02958	7.92E-05
0.612	0.003015	0.0333	0.0001
0.648	0.003348	0.03698	0.000124
0.684	0.00368	0.04064	0.00015
0.72	0.004012	0.0443	0.000178

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 5.91E-05 m^3

w(b)= 0.005809 m
w(a)= 0.001814 m
delta kh= (w(b)-w(a))/INT
delta kh= 68 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 293 kN/m^2

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Table H95
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.102kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.006534	-0.06414	0.000419
0.036	-0.00558	-0.05478	0.000306
0.072	-0.004689	. -0.04603	0.000216
0.108	-0.003859	-0.03789	0.000146
0.144	-0.003089	-0.03032	9.37E-05
0.18	-0.002374	-0.02331	5.53E-05
0.216	-0.001712	-0.01681	2.88E-05
0.252	-0.001098	-0.01078	1.18E-05
0.288	-0.000528	-0.00518	2.74E-06
0.324	0.000003	0.00003	9E-11
0.36	0.000499	0.00491	2.45E-06
0.396	0.000967	0.00949	9.18E-06
0.432	0.001409	0.01383	1.95E-05
0.468	0.001831	0.01797	3.29E-05
0.504	0.002236	0.02195	4.91E-05
0.54	0.002629	0.02581	6.79E-05
0.576	0.003013	0.02958	8.91E-05
0.612	0.003392	0.0333	0.000113
0.648	0.003767	0.03698	0.000139
0.684	0.00414	0.04064	0.000168
0.72	0.004513	0.0443	0.0002

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 6.65E-05 m^3

w(b)= 0.006534 m
w(a)= 0.002051 m
delta kh= (w(b)-w(a))/INT
delta kh= 67 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 292 kN/m^2

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Table H96
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.116kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.007428	-0.06414	0.000476
0.036	-0.006343	-0.05478	0.000347
0.072	-0.00533	-0.04603	0.000245
0.108	-0.004387	-0.03789	0.000166
0.144	-0.003511	-0.03032	0.000106
0.18	-0.002699	-0.02331	6.29E-05
0.216	-0.001946	-0.01681	3.27E-05
0.252	-0.001248	-0.01078	1.35E-05
0.288	-0.0006	-0.00518	3.11E-06
0.324	0.000004	0.00003	1.2E-10
0.36	0.000568	0.00491	2.79E-06
0.396	0.001099	0.00949	1.04E-05
0.432	0.001602	0.01383	2.22E-05
0.468	0.002081	0.01797	3.74E-05
0.504	0.002542	0.02195	5.58E-05
0.54	0.002989	0.02581	7.71E-05
0.576	0.003426	0.02958	0.000101
0.612	0.003856	0.0333	0.000128
0.648	0.004282	0.03698	0.000158
0.684	0.004706	0.04064	0.000191
0.72	0.00513	0.0443	0.000227

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 7.56E-05 m^3

w(b)= 0.007428 m
w(a)= 0.002287 m
delta kh= (w(b)-w(a))/INT
delta kh= 68 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 293 kN/m^2

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Table H97

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.130kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.008328	-0.06414	0.000534
0.036	-0.007112	-0.05478	0.00039
0.072	-0.005976	-0.04603	0.000275
0.108	-0.004919	-0.03789	0.000186
0.144	-0.003937	-0.03032	0.000119
0.18	-0.003026	-0.02331	7.05E-05
0.216	-0.002182	-0.01681	3.67E-05
0.252	-0.001399	-0.01078	1.51E-05
0.288	-0.000673	-0.00518	3.49E-06
0.324	0.000004	0.00003	1.2E-10
0.36	0.000637	0.00491	3.13E-06
0.396	0.001233	0.00949	1.17E-05
0.432	0.001796	0.01383	2.48E-05
0.468	0.002334	0.01797	4.19E-05
0.504	0.00285	0.02195	6.26E-05
0.54	0.003351	0.02581	8.65E-05
0.576	0.003841	0.02958	0.000114
0.612	0.004323	0.0333	0.000144
0.648	0.004801	0.03698	0.000178
0.684	0.005276	0.04064	0.000214
0.72	0.005752	0.0443	0.000255

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 8.47E-05 m^3

w(b)= 0.008328 m
w(a)= 0.002513 m
delta kh= (w(b)-w(a))/INT
delta kh= 69 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 294 kN/m^2

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Table H98

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.144kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.009227	-0.06414	0.000592
0.036	-0.007879	-0.05478	0.000432
0.072	-0.006621	. -0.04603	0.000305
0.108	-0.005449	-0.03789	0.000206
0.144	-0.004362	-0.03032	0.000132
0.18	-0.003353	-0.02331	7.82E-05
0.216	-0.002418	-0.01681	4.06E-05
0.252	-0.001551	-0.01078	1.67E-05
0.288	-0.000746	-0.00518	3.86E-06
0.324	0.000004	0.00003	1.2E-10
0.36	0.000706	0.00491	3.47E-06
0.396	0.001366	0.00949	1.3E-05
0.432	0.00199	0.01383	2.75E-05
0.468	0.002586	0.01797	4.65E-05
0.504	0.003158	0.02195	6.93E-05
0.54	0.003713	0.02581	9.58E-05
0.576	0.004256	0.02958	0.000126
0.612	0.004789	0.0333	0.000159
0.648	0.005319	0.03698	0.000197
0.684	0.005846	0.04064	0.000238
0.72	0.006373	0.0443	0.000282

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 9.39E-05 m^3

w(b)= 0.009227 m
w(a)= 0.002721 m
delta kh= (w(b)-w(a))/INT
delta kh= 69 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 294 kN/m^2

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Table H99

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.159kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.010126	-0.06414	0.000649
0.036	-0.008647	-0.05478	0.000474
0.072	-0.007266	-0.04603	0.000334
0.108	-0.005981	-0.03789	0.000227
0.144	-0.004787	-0.03032	0.000145
0.18	-0.003679	-0.02331	8.58E-05
0.216	-0.002653	-0.01681	4.46E-05
0.252	-0.001702	-0.01078	1.83E-05
0.288	-0.000818	-0.00518	4.24E-06
0.324	0.000005	0.00003	1.5E-10
0.36	0.000775	0.00491	3.81E-06
0.396	0.001498	0.00949	1.42E-05
0.432	0.002184	0.01383	3.02E-05
0.468	0.002838	0.01797	5.1E-05
0.504	0.003466	0.02195	7.61E-05
0.54	0.004075	0.02581	0.000105
0.576	0.00467	0.02958	0.000138
0.612	0.005256	0.0333	0.000175
0.648	0.005838	0.03698	0.000216
0.684	0.006416	0.04064	0.000261
0.72	0.006994	0.0443	0.00031

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 0.000103 m^3

w(b)= 0.010126 m
w(a)= 0.002959 m
delta kh= (w(b)-w(a))/INT
delta kh= 70 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**295**	**kN/m^2**

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Table H100

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

B= 0.0254 m
delta Z= 0.036 m

	Mi=0.172kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.011026	-0.06414	0.000707
0.036	-0.009416	-0.05478	0.000516
0.072	-0.007912	-0.04603	0.000364
0.108	-0.006512	-0.03789	0.000247
0.144	-0.005212	-0.03032	0.000158
0.18	-0.004007	-0.02331	9.34E-05
0.216	-0.002889	-0.01681	4.86E-05
0.252	-0.001853	-0.01078	2E-05
0.288	-0.000891	-0.00518	4.62E-06
0.324	0.000005	0.00003	1.5E-10
0.36	0.000844	0.00491	4.14E-06
0.396	0.001632	0.00949	1.55E-05
0.432	0.002378	0.01383	3.29E-05
0.468	0.003089	0.01797	5.55E-05
0.504	0.003774	0.02195	8.28E-05
0.54	0.004437	0.02581	0.000115
0.576	0.005086	0.02958	0.00015
0.612	0.005724	0.0333	0.000191
0.648	0.006356	0.03698	0.000235
0.684	0.006986	0.04064	0.000284
0.72	0.007615	0.0443	0.000337

by Simpson's rule:

INT= 0.000112 m^3

w(b)= 0.011026 m
w(a)= 0.003196 m
delta kh= (w(b)-w(a))/INT
delta kh= 70 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 295 kN/m^2

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Table H101

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.186kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.011926	-0.06414	0.000765
0.036	-0.010184	-0.05478	0.000558
0.072	-0.008558	-0.04603	0.000394
0.108	-0.007043	-0.03789	0.000267
0.144	-0.005637	-0.03032	0.000171
0.18	-0.004333	-0.02331	0.000101
0.216	-0.003125	-0.01681	5.25E-05
0.252	-0.002004	-0.01078	2.16E-05
0.288	-0.000963	-0.00518	4.99E-06
0.324	0.000006	0.00003	1.8E-10
0.36	0.000912	0.00491	4.48E-06
0.396	0.001765	0.00949	1.67E-05
0.432	0.002572	0.01383	3.56E-05
0.468	0.003342	0.01797	6.01E-05
0.504	0.004082	0.02195	8.96E-05
0.54	0.004799	0.02581	0.000124
0.576	0.0055	0.02958	0.000163
0.612	0.006191	0.0333	0.000206
0.648	0.006875	0.03698	0.000254
0.684	0.007556	0.04064	0.000307
0.72	0.008236	0.0443	0.000365

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 0.000121 m^3

w(b)= 0.011926 m
w(a)= 0.003459 m
delta kh= (w(b)-w(a))/INT
delta kh= 70 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 295 kN/m^2

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Table H102
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.209kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.013377	-0.06414	0.000858
0.036	-0.011423	-0.05478	0.000626
0.072	-0.009599	. -0.04603	0.000442
0.108	-0.0079	-0.03789	0.000299
0.144	-0.006323	-0.03032	0.000192
0.18	-0.004861	-0.02331	0.000113
0.216	-0.003505	-0.01681	5.89E-05
0.252	-0.002248	-0.01078	2.42E-05
0.288	-0.001081	-0.00518	5.6E-06
0.324	0.000006	0.00003	1.8E-10
0.36	0.001023	0.00491	5.02E-06
0.396	0.001979	0.00949	1.88E-05
0.432	0.002885	0.01383	3.99E-05
0.468	0.003748	0.01797	6.74E-05
0.504	0.004578	0.02195	0.0001
0.54	0.005383	0.02581	0.000139
0.576	0.006169	0.02958	0.000182
0.612	0.006944	0.0333	0.000231
0.648	0.007711	0.03698	0.000285
0.684	0.008475	0.04064	0.000344
0.72	0.009238	0.0443	0.000409

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 0.000136 m^3

w(b)= 0.013377 m
w(a)= 0.003687 m
delta kh= (w(b)-w(a))/INT
delta kh= 71 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**296**	**kN/m^2**

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Table H103

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.231kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.014827	-0.06414	0.000951
0.036	-0.012662	-0.05478	0.000694
0.072	-0.010639	. -0.04603	0.00049
0.108	-0.008757	-0.03789	0.000332
0.144	-0.007009	-0.03032	0.000213
0.18	-0.005388	-0.02331	0.000126
0.216	-0.003885	-0.01681	6.53E-05
0.252	-0.002492	-0.01078	2.69E-05
0.288	-0.001198	-0.00518	6.21E-06
0.324	0.000007	0.00003	2.1E-10
0.36	0.001134	0.00491	5.57E-06
0.396	0.002194	0.00949	2.08E-05
0.432	0.003198	0.01383	4.42E-05
0.468	0.004155	0.01797	7.47E-05
0.504	0.005075	0.02195	0.000111
0.54	0.005967	0.02581	0.000154
0.576	0.006839	0.02958	0.000202
0.612	0.007697	0.0333	0.000256
0.648	0.008548	0.03698	0.000316
0.684	0.009395	0.04064	0.000382
0.72	0.010241	0.0443	0.000454

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 0.000151 m^3

w(b)= 0.014827 m
w(a)= 0.003973 m
delta kh= (w(b)-w(a))/INT
delta kh= 72 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 297 kN/m^2

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Table H104

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.254kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.016278	-0.06414	0.001044
0.036	-0.013901	-0.05478	0.000761
0.072	-0.011681	. -0.04603	0.000538
0.108	-0.009614	-0.03789	0.000364
0.144	-0.007695	-0.03032	0.000233
0.18	-0.005915	-0.02331	0.000138
0.216	-0.004265	-0.01681	7.17E-05
0.252	-0.002736	-0.01078	2.95E-05
0.288	-0.001315	-0.00518	6.81E-06
0.324	0.000008	0.00003	2.4E-10
0.36	0.001245	0.00491	6.11E-06
0.396	0.002409	0.00949	2.29E-05
0.432	0.003511	0.01383	4.86E-05
0.468	0.004561	0.01797	8.2E-05
0.504	0.005571	0.02195	0.000122
0.54	0.006551	0.02581	0.000169
0.576	0.007508	0.02958	0.000222
0.612	0.008449	0.0333	0.000281
0.648	0.009384	0.03698	0.000347
0.684	0.010314	0.04064	0.000419
0.72	0.011242	0.0443	0.000498

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 0.000166 m^3

w(b)= 0.016278 m
w(a)= 0.004242 m
delta kh= (w(b)-w(a))/INT
delta kh= 73 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 298 kN/m^2

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Table H105
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.276kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.017729	-0.06414	0.001137
0.036	-0.015139	-0.05478	0.000829
0.072	-0.012722	-0.04603	0.000586
0.108	-0.010471	-0.03789	0.000397
0.144	-0.00838	-0.03032	0.000254
0.18	-0.006442	-0.02331	0.00015
0.216	-0.004645	-0.01681	7.81E-05
0.252	-0.002979	-0.01078	3.21E-05
0.288	-0.001433	-0.00518	7.42E-06
0.324	0.000008	0.00003	2.4E-10
0.36	0.001356	0.00491	6.66E-06
0.396	0.002624	0.00949	2.49E-05
0.432	0.003824	0.01383	5.29E-05
0.468	0.004968	0.01797	8.93E-05
0.504	0.006068	0.02195	0.000133
0.54	0.007134	0.02581	0.000184
0.576	0.008177	0.02958	0.000242
0.612	0.009203	0.0333	0.000306
0.648	0.01022	0.03698	0.000378
0.684	0.011233	0.04064	0.000457
0.72	0.012244	0.0443	0.000542

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 0.00018 m^3

w(b)= 0.017729 m
w(a)= 0.004534 m
delta kh= (w(b)-w(a))/INT
delta kh= 73 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 298 kN/m^2

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Table H106

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.0
LINEAR PART
PILE LENGTH=0.720m

	Mi=0.299kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.019179	-0.06414	0.00123
0.036	-0.016379	-0.05478	0.000897
0.072	-0.013763	. -0.04603	0.000634
0.108	-0.011328	-0.03789	0.000429
0.144	-0.009066	-0.03032	0.000275
0.18	-0.006969	-0.02331	0.000162
0.216	-0.005026	-0.01681	8.45E-05
0.252	-0.003224	-0.01078	3.48E-05
0.288	-0.001549	-0.00518	8.02E-06
0.324	0.000009	0.00003	2.7E-10
0.36	0.001467	0.00491	7.2E-06
0.396	0.002839	0.00949	2.69E-05
0.432	0.004137	0.01383	5.72E-05
0.468	0.005374	0.01797	9.66E-05
0.504	0.006565	0.02195	0.000144
0.54	0.007718	0.02581	0.000199
0.576	0.008846	0.02958	0.000262
0.612	0.009956	0.0333	0.000332
0.648	0.011057	0.03698	0.000409
0.684	0.012152	0.04064	0.000494
0.72	0.013246	0.0443	0.000587

B= 0.0254 m
delta Z= 0.036 m

by Simpson's rule:

INT= 0.000195 m^3

w(b)= 0.019179 m
w(a)= 0.004826 m
delta kh= (w(b)-w(a))/INT
delta kh= 74 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 299 kN/m^2

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Table H107

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.011kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.000602	-0.05319	3.2E-05
0.0432	-0.000495	-0.04372	2.2E-05
0.0864	-0.000398	. -0.03515	1.4E-05
0.1296	-0.00031	-0.02743	8.5E-06
0.1728	-0.000232	-0.02054	4.8E-06
0.216	-0.000163	-0.01443	2.4E-06
0.2592	-0.000102	-0.00904	9.2E-07
0.3024	-0.000049	-0.0043	2.1E-07
0.3456	-0.000002	-0.00015	3.0E-10
0.3888	0.000039	0.00347	1.4E-07
0.432	0.000075	0.00664	5.0E-07
0.4752	0.000107	0.00942	1.0E-06
0.5184	0.000134	0.01187	1.6E-06
0.5616	0.000159	0.01407	2.2E-06
0.6048	0.000182	0.01606	2.9E-06
0.648	0.000202	0.01789	3.6E-06
0.6912	0.000222	0.01962	4.4E-06
0.7344	0.000241	0.02127	5.1E-06
0.7776	0.000259	0.02287	5.9E-06
0.8208	0.000277	0.02446	6.8E-06
0.864	0.000295	0.02604	7.7E-06

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 4.55E-06 m^3

w(b)= 0.000602 m
w(a)= 0.000205 m
delta kh= (w(b)-w(a))/INT
delta kh= 87 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	312	kN/m^2

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Table H108

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.023kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.001203	-0.05319	6.4E-05
0.0432	-0.000989	-0.04372	4.32E-05
0.0864	-0.000795	. -0.03515	2.79E-05
0.1296	-0.00062	-0.02743	1.7E-05
0.1728	-0.000465	-0.02054	9.55E-06
0.216	-0.000326	-0.01443	4.7E-06
0.2592	-0.000204	-0.00904	1.84E-06
0.3024	-0.000097	-0.0043	4.17E-07
0.3456	-0.000003	-0.00015	4.5E-10
0.3888	0.000078	0.00347	2.71E-07
0.432	0.00015	0.00664	9.96E-07
0.4752	0.000213	0.00942	2.01E-06
0.5184	0.000269	0.01187	3.19E-06
0.5616	0.000318	0.01407	4.47E-06
0.6048	0.000363	0.01606	5.83E-06
0.648	0.000405	0.01789	7.25E-06
0.6912	0.000444	0.01962	8.71E-06
0.7344	0.000481	0.02127	1.02E-05
0.7776	0.000517	0.02287	1.18E-05
0.8208	0.000553	0.02446	1.35E-05
0.864	0.000589	0.02604	1.53E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 9.09E-06 m^3

w(b)= 0.001203 m
w(a)= 0.000406 m
delta kh= (w(b)-w(a))/INT
delta kh= 88 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 313 kN/m^2

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Table H109

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.034kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.001805	-0.05319	9.6E-05
0.0432	-0.001484	-0.04372	6.49E-05
0.0864	-0.001193	-0.03515	4.19E-05
0.1296	-0.000931	-0.02743	2.55E-05
0.1728	-0.000697	-0.02054	1.43E-05
0.216	-0.000489	-0.01443	7.06E-06
0.2592	-0.000307	-0.00904	2.78E-06
0.3024	-0.000146	-0.0043	6.28E-07
0.3456	-0.000005	-0.00015	7.5E-10
0.3888	0.000118	0.00347	4.09E-07
0.432	0.000225	0.00664	1.49E-06
0.4752	0.000319	0.00942	3E-06
0.5184	0.000403	0.01187	4.78E-06
0.5616	0.000478	0.01407	6.73E-06
0.6048	0.000545	0.01606	8.75E-06
0.648	0.000607	0.01789	1.09E-05
0.6912	0.000666	0.01962	1.31E-05
0.7344	0.000722	0.02127	1.54E-05
0.7776	0.000776	0.02287	1.77E-05
0.8208	0.000829	0.02446	2.03E-05
0.864	0.000884	0.02604	2.3E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 1.36E-05 m^3

w(b)= 0.001805 m
w(a)= 0.000614 m
delta kh= (w(b)-w(a))/INT
delta kh= 87 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 312 kN/m^2

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Table H110
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.045kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.002407	-0.05319	0.000128
0.0432	-0.001978	-0.04372	8.65E-05
0.0864	-0.00159	-0.03515	5.59E-05
0.1296	-0.001241	-0.02743	3.4E-05
0.1728	-0.000929	-0.02054	1.91E-05
0.216	-0.000653	-0.01443	9.42E-06
0.2592	-0.000409	-0.00904	3.7E-06
0.3024	-0.000195	-0.0043	8.39E-07
0.3456	-0.000007	-0.00015	1.05E-09
0.3888	0.000157	0.00347	5.45E-07
0.432	0.0003	0.00664	1.99E-06
0.4752	0.000426	0.00942	4.01E-06
0.5184	0.000537	0.01187	6.37E-06
0.5616	0.000637	0.01407	8.96E-06
0.6048	0.000727	0.01606	1.17E-05
0.648	0.000809	0.01789	1.45E-05
0.6912	0.000887	0.01962	1.74E-05
0.7344	0.000962	0.02127	2.05E-05
0.7776	0.001035	0.02287	2.37E-05
0.8208	0.001107	0.02446	2.71E-05
0.864	0.001178	0.02604	3.07E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 1.82E-05 m^3

w(b)= 0.002407 m
w(a)= 0.000826 m
delta kh= (w(b)-w(a))/INT
delta kh= 87 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 312 kN/m^2

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Table H111

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.057kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.003008	-0.05319	0.00016
0.0432	-0.002473	-0.04372	0.000108
0.0864	-0.001988	. -0.03515	6.99E-05
0.1296	-0.001551	-0.02743	4.25E-05
0.1728	-0.001162	-0.02054	2.39E-05
0.216	-0.000816	-0.01443	1.18E-05
0.2592	-0.000511	-0.00904	4.62E-06
0.3024	-0.000243	-0.0043	1.04E-06
0.3456	-0.000009	-0.00015	1.35E-09
0.3888	0.000196	0.00347	6.8E-07
0.432	0.000375	0.00664	2.49E-06
0.4752	0.000533	0.00942	5.02E-06
0.5184	0.000672	0.01187	7.98E-06
0.5616	0.000796	0.01407	1.12E-05
0.6048	0.000908	0.01606	1.46E-05
0.648	0.001012	0.01789	1.81E-05
0.6912	0.001109	0.01962	2.18E-05
0.7344	0.001203	0.02127	2.56E-05
0.7776	0.001293	0.02287	2.96E-05
0.8208	0.001383	0.02446	3.38E-05
0.864	0.001473	0.02604	3.84E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 2.27E-05 m^3

w(b)= 0.003008 m
w(a)= 0.001035 m
delta kh= (w(b)-w(a))/INT
delta kh= 87 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 312 kN/m^2

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Table H112

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.068kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.003609	-0.05319	0.000192
0.0432	-0.002967	-0.04372	0.00013
0.0864	-0.002385	. -0.03515	8.38E-05
0.1296	-0.001862	-0.02743	5.11E-05
0.1728	-0.001394	-0.02054	2.86E-05
0.216	-0.000979	-0.01443	1.41E-05
0.2592	-0.000613	-0.00904	5.54E-06
0.3024	-0.000292	-0.0043	1.26E-06
0.3456	-0.00001	-0.00015	1.5E-09
0.3888	0.000235	0.00347	8.15E-07
0.432	0.000451	0.00664	2.99E-06
0.4752	0.000639	0.00942	6.02E-06
0.5184	0.000806	0.01187	9.57E-06
0.5616	0.000955	0.01407	1.34E-05
0.6048	0.001089	0.01606	1.75E-05
0.648	0.001214	0.01789	2.17E-05
0.6912	0.001331	0.01962	2.61E-05
0.7344	0.001443	0.02127	3.07E-05
0.7776	0.001552	0.02287	3.55E-05
0.8208	0.001659	0.02446	4.06E-05
0.864	0.001767	0.02604	4.6E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 2.73E-05 m^3

w(b)= 0.003609 m
w(a)= 0.001255 m
delta kh= (w(b)-w(a))/INT
delta kh= 86 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 311 kN/m^2

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Table H113

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.079kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.004212	-0.05319	0.000224
0.0432	-0.003462	-0.04372	0.000151
0.0864	-0.002783	-0.03515	9.78E-05
0.1296	-0.002172	-0.02743	5.96E-05
0.1728	-0.001626	-0.02054	3.34E-05
0.216	-0.001142	-0.01443	1.65E-05
0.2592	-0.000715	-0.00904	6.46E-06
0.3024	-0.00034	-0.0043	1.46E-06
0.3456	-0.000012	-0.00015	1.8E-09
0.3888	0.000275	0.00347	9.54E-07
0.432	0.000526	0.00664	3.49E-06
0.4752	0.000746	0.00942	7.03E-06
0.5184	0.00094	0.01187	1.12E-05
0.5616	0.001114	0.01407	1.57E-05
0.6048	0.001272	0.01606	2.04E-05
0.648	0.001417	0.01789	2.54E-05
0.6912	0.001553	0.01962	3.05E-05
0.7344	0.001684	0.02127	3.58E-05
0.7776	0.001811	0.02287	4.14E-05
0.8208	0.001936	0.02446	4.74E-05
0.864	0.002062	0.02604	5.37E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 3.18E-05 m^3

w(b)= 0.004212 m
w(a)= 0.001461 m
delta kh= (w(b)-w(a))/INT
delta kh= 86 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 311 kN/m^2

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Table H114

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.091kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.004818	-0.05319	0.000256
0.0432	-0.003959	-0.04372	0.000173
0.0864	-0.003183	. -0.03515	0.000112
0.1296	-0.002484	-0.02743	6.81E-05
0.1728	-0.00186	-0.02054	3.82E-05
0.216	-0.001307	-0.01443	1.89E-05
0.2592	-0.000818	-0.00904	7.39E-06
0.3024	-0.000389	-0.0043	1.67E-06
0.3456	-0.000014	-0.00015	2.1E-09
0.3888	0.000314	0.00347	1.09E-06
0.432	0.000601	0.00664	3.99E-06
0.4752	0.000853	0.00942	8.04E-06
0.5184	0.001076	0.01187	1.28E-05
0.5616	0.001275	0.01407	1.79E-05
0.6048	0.001455	0.01606	2.34E-05
0.648	0.001621	0.01789	2.9E-05
0.6912	0.001776	0.01962	3.48E-05
0.7344	0.001926	0.02127	4.1E-05
0.7776	0.002071	0.02287	4.74E-05
0.8208	0.002215	0.02446	5.42E-05
0.864	0.002358	0.02604	6.14E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 3.64E-05 m^3

w(b)= 0.004818 m
w(a)= 0.001669 m
delta kh= (w(b)-w(a))/INT
delta kh= 86 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**311**	**kN/m^2**

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Table H115

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.102kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.005419	-0.05319	0.000288
0.0432	-0.004454	-0.04372	0.000195
0.0864	-0.00358	. -0.03515	0.000126
0.1296	-0.002794	-0.02743	7.66E-05
0.1728	-0.002093	-0.02054	4.3E-05
0.216	-0.001469	-0.01443	2.12E-05
0.2592	-0.000921	-0.00904	8.33E-06
0.3024	-0.000438	-0.0043	1.88E-06
0.3456	-0.000016	-0.00015	2.4E-09
0.3888	0.000353	0.00347	1.22E-06
0.432	0.000676	0.00664	4.49E-06
0.4752	0.000959	0.00942	9.03E-06
0.5184	0.00121	0.01187	1.44E-05
0.5616	0.001434	0.01407	2.02E-05
0.6048	0.001636	0.01606	2.63E-05
0.648	0.001823	0.01789	3.26E-05
0.6912	0.001998	0.01962	3.92E-05
0.7344	0.002166	0.02127	4.61E-05
0.7776	0.002329	0.02287	5.33E-05
0.8208	0.002492	0.02446	6.1E-05
0.864	0.002653	0.02604	6.91E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 4.1E-05 m^3

w(b)= 0.005419 m
w(a)= 0.001881 m
delta kh= (w(b)-w(a))/INT
delta kh= 86 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\textbf{kh= 311 kN/m}^2}$

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Table H116

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.116kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.00616	-0.05319	0.000328
0.0432	-0.005064	-0.04372	0.000221
0.0864	-0.004069	-0.03515	0.000143
0.1296	-0.003177	-0.02743	8.71E-05
0.1728	-0.002379	-0.02054	4.89E-05
0.216	-0.001671	-0.01443	2.41E-05
0.2592	-0.001046	-0.00904	9.46E-06
0.3024	-0.000498	-0.0043	2.14E-06
0.3456	-0.000018	-0.00015	2.7E-09
0.3888	0.000402	0.00347	1.39E-06
0.432	0.000769	0.00664	5.11E-06
0.4752	0.001091	0.00942	1.03E-05
0.5184	0.001376	0.01187	1.63E-05
0.5616	0.001629	0.01407	2.29E-05
0.6048	0.00186	0.01606	2.99E-05
0.648	0.002072	0.01789	3.71E-05
0.6912	0.002272	0.01962	4.46E-05
0.7344	0.002463	0.02127	5.24E-05
0.7776	0.002648	0.02287	6.06E-05
0.8208	0.002832	0.02446	6.93E-05
0.864	0.003015	0.02604	7.85E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 4.66E-05 m^3

w(b)= 0.00616 m
w(a)= 0.002078 m
delta kh= (w(b)-w(a))/INT
delta kh= 88 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 313 kN/m^2

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Table H117

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.130kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.006907	-0.05319	0.000367
0.0432	-0.005677	-0.04372	0.000248
0.0864	-0.004563	-0.03515	0.00016
0.1296	-0.003561	-0.02743	9.77E-05
0.1728	-0.002667	-0.02054	5.48E-05
0.216	-0.001873	-0.01443	2.7E-05
0.2592	-0.001173	-0.00904	1.06E-05
0.3024	-0.000558	-0.0043	2.4E-06
0.3456	-0.00002	-0.00015	3E-09
0.3888	0.00045	0.00347	1.56E-06
0.432	0.000862	0.00664	5.72E-06
0.4752	0.001223	0.00942	1.15E-05
0.5184	0.001542	0.01187	1.83E-05
0.5616	0.001827	0.01407	2.57E-05
0.6048	0.002085	0.01606	3.35E-05
0.648	0.002323	0.01789	4.16E-05
0.6912	0.002547	0.01962	5E-05
0.7344	0.002761	0.02127	5.87E-05
0.7776	0.002969	0.02287	6.79E-05
0.8208	0.003175	0.02446	7.77E-05
0.864	0.003381	0.02604	8.8E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 5.22E-05 m^3

w(b)= 0.006907 m
w(a)= 0.002304 m
delta kh= (w(b)-w(a))/INT
delta kh= 88 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh=	**313**	**kN/m^2**

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Table H118

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.144kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.007652	-0.05319	0.000407
0.0432	-0.00629	-0.04372	0.000275
0.0864	-0.005056	. -0.03515	0.000178
0.1296	-0.003946	-0.02743	0.000108
0.1728	-0.002955	-0.02054	6.07E-05
0.216	-0.002076	-0.01443	3E-05
0.2592	-0.001299	-0.00904	1.17E-05
0.3024	-0.000619	-0.0043	2.66E-06
0.3456	-0.000022	-0.00015	3.3E-09
0.3888	0.000499	0.00347	1.73E-06
0.432	0.000955	0.00664	6.34E-06
0.4752	0.001355	0.00942	1.28E-05
0.5184	0.001709	0.01187	2.03E-05
0.5616	0.002025	0.01407	2.85E-05
0.6048	0.002311	0.01606	3.71E-05
0.648	0.002574	0.01789	4.6E-05
0.6912	0.002822	0.01962	5.54E-05
0.7344	0.003059	0.02127	6.51E-05
0.7776	0.00329	0.02287	7.52E-05
0.8208	0.003518	0.02446	8.61E-05
0.864	0.003746	0.02604	9.75E-05

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 5.79E-05 m^3

w(b)= 0.007652 m
w(a)= 0.002475 m
delta kh= (w(b)-w(a))/INT
delta kh= 89 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\textbf{kh= 314 kN/m^2}}$

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Table H119

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.158kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.008398	-0.05319	0.000447
0.0432	-0.006903	-0.04372	0.000302
0.0864	-0.005549	. -0.03515	0.000195
0.1296	-0.004331	-0.02743	0.000119
0.1728	-0.003243	-0.02054	6.66E-05
0.216	-0.002278	-0.01443	3.29E-05
0.2592	-0.001427	-0.00904	1.29E-05
0.3024	-0.000679	-0.0043	2.92E-06
0.3456	-0.000024	-0.00015	3.6E-09
0.3888	0.000548	0.00347	1.9E-06
0.432	0.001048	0.00664	6.96E-06
0.4752	0.001487	0.00942	1.4E-05
0.5184	0.001875	0.01187	2.23E-05
0.5616	0.002222	0.01407	3.13E-05
0.6048	0.002536	0.01606	4.07E-05
0.648	0.002825	0.01789	5.05E-05
0.6912	0.003097	0.01962	6.08E-05
0.7344	0.003357	0.02127	7.14E-05
0.7776	0.003611	0.02287	8.26E-05
0.8208	0.003861	0.02446	9.44E-05
0.864	0.004111	0.02604	0.000107

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 6.35E-05 m^3

w(b)= 0.008398 m
w(a)= 0.002687 m
delta kh= (w(b)-w(a))/INT
delta kh= 90 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 315 kN/m^2

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Table H120

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.172kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.009144	-0.05319	0.000486
0.0432	-0.007516	-0.04372	0.000329
0.0864	-0.006042	. -0.03515	0.000212
0.1296	-0.004715	-0.02743	0.000129
0.1728	-0.003531	-0.02054	7.25E-05
0.216	-0.00248	-0.01443	3.58E-05
0.2592	-0.001553	-0.00904	1.4E-05
0.3024	-0.000739	-0.0043	3.18E-06
0.3456	-0.000026	-0.00015	3.9E-09
0.3888	0.000596	0.00347	2.07E-06
0.432	0.001141	0.00664	7.58E-06
0.4752	0.001619	0.00942	1.53E-05
0.5184	0.002042	0.01187	2.42E-05
0.5616	0.002419	0.01407	3.4E-05
0.6048	0.002761	0.01606	4.43E-05
0.648	0.003076	0.01789	5.5E-05
0.6912	0.003372	0.01962	6.62E-05
0.7344	0.003655	0.02127	7.77E-05
0.7776	0.003932	0.02287	8.99E-05
0.8208	0.004204	0.02446	0.000103
0.864	0.004476	0.02604	0.000117

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 6.91E-05 m^3

w(b)= 0.009144 m
w(a)= 0.002911 m
delta kh= (w(b)-w(a))/INT
delta kh= 90 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 315 kN/m^2

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Table H121

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.186kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.00989	-0.05319	0.000526
0.0432	-0.008129	-0.04372	0.000355
0.0864	-0.006534	-0.03515	0.00023
0.1296	-0.0051	-0.02743	0.00014
0.1728	-0.003819	-0.02054	7.84E-05
0.216	-0.002683	-0.01443	3.87E-05
0.2592	-0.00168	-0.00904	1.52E-05
0.3024	-0.000799	-0.0043	3.44E-06
0.3456	-0.000029	-0.00015	4.35E-09
0.3888	0.000645	0.00347	2.24E-06
0.432	0.001234	0.00664	8.19E-06
0.4752	0.001752	0.00942	1.65E-05
0.5184	0.002209	0.01187	2.62E-05
0.5616	0.002617	0.01407	3.68E-05
0.6048	0.002986	0.01606	4.8E-05
0.648	0.003327	0.01789	5.95E-05
0.6912	0.003647	0.01962	7.16E-05
0.7344	0.003954	0.02127	8.41E-05
0.7776	0.004252	0.02287	9.72E-05
0.8208	0.004547	0.02446	0.000111
0.864	0.004841	0.02604	0.000126

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 7.48E-05 m^3

w(b)= 0.00989 m
w(a)= 0.003136 m
delta kh= (w(b)-w(a))/INT
delta kh= 90 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

$\boxed{\textbf{kh= 315 kN/m^2}}$

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Table H122

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.209kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.011094	-0.05319	0.00059
0.0432	-0.009119	-0.04372	0.000399
0.0864	-0.007329	-0.03515	0.000258
0.1296	-0.005721	-0.02743	0.000157
0.1728	-0.004284	-0.02054	8.8E-05
0.216	-0.003009	-0.01443	4.34E-05
0.2592	-0.001885	-0.00904	1.7E-05
0.3024	-0.000897	-0.0043	3.86E-06
0.3456	-0.0000321	-0.00015	4.82E-09
0.3888	0.000724	0.00347	2.51E-06
0.432	0.001385	0.00664	9.2E-06
0.4752	0.001965	0.00942	1.85E-05
0.5184	0.002477	0.01187	2.94E-05
0.5616	0.002935	0.01407	4.13E-05
0.6048	0.003349	0.01606	5.38E-05
0.648	0.003732	0.01789	6.68E-05
0.6912	0.004091	0.01962	8.03E-05
0.7344	0.004435	0.02127	9.43E-05
0.7776	0.004769	0.02287	0.000109
0.8208	0.005101	0.02446	0.000125
0.864	0.00543	0.02604	0.000141

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 8.39E-05 m^3

w(b)= 0.011094 m
w(a)= 0.003334 m
delta kh= (w(b)-w(a))/INT
delta kh= 93 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 318 kN/m^2

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Table H123

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.231kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.012297	-0.05319	0.000654
0.0432	-0.010108	-0.04372	0.000442
0.0864	-0.008124	-0.03515	0.000286
0.1296	-0.006341	-0.02743	0.000174
0.1728	-0.004749	-0.02054	9.75E-05
0.216	-0.003336	-0.01443	4.81E-05
0.2592	-0.002089	-0.00904	1.89E-05
0.3024	-0.000994	-0.0043	4.27E-06
0.3456	-0.000036	-0.00015	5.4E-09
0.3888	0.000802	0.00347	2.78E-06
0.432	0.001535	0.00664	1.02E-05
0.4752	0.002178	0.00942	2.05E-05
0.5184	0.002746	0.01187	3.26E-05
0.5616	0.003253	0.01407	4.58E-05
0.6048	0.003713	0.01606	5.96E-05
0.648	0.004137	0.01789	7.4E-05
0.6912	0.004535	0.01962	8.9E-05
0.7344	0.004916	0.02127	0.000105
0.7776	0.005287	0.02287	0.000121
0.8208	0.005654	0.02446	0.000138
0.864	0.006019	0.02604	0.000157

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 9.3E-05 m^3

w(b)= 0.012297 m
w(a)= 0.003618 m
delta kh= (w(b)-w(a))/INT
delta kh= 93 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 318 kN/m^2

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Table H124

NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.254kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.013499	-0.05319	0.000718
0.0432	-0.011096	-0.04372	0.000485
0.0864	-0.008919	-0.03515	0.000314
0.1296	-0.006961	-0.02743	0.000191
0.1728	-0.005214	-0.02054	0.000107
0.216	-0.003662	-0.01443	5.28E-05
0.2592	-0.002293	-0.00904	2.07E-05
0.3024	-0.001091	-0.0043	4.69E-06
0.3456	-0.000039	-0.00015	5.85E-09
0.3888	0.000881	0.00347	3.06E-06
0.432	0.001685	0.00664	1.12E-05
0.4752	0.002391	0.00942	2.25E-05
0.5184	0.003014	0.01187	3.58E-05
0.5616	0.003572	0.01407	5.03E-05
0.6048	0.004076	0.01606	6.55E-05
0.648	0.004541	0.01789	8.12E-05
0.6912	0.004978	0.01962	9.77E-05
0.7344	0.005396	0.02127	0.000115
0.7776	0.005804	0.02287	0.000133
0.8208	0.006207	0.02446	0.000152
0.864	0.006608	0.02604	0.000172

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 0.000102 m^3

w(b)= 0.013499 m
w(a)= 0.003869 m
delta kh= (w(b)-w(a))/INT
delta kh= 94 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 319 kN/m^2

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Table H125
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

B= 0.0254 m
delta Z= 0.0432 m

	Mi=0.276kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.014703	-0.05319	0.000782
0.0432	-0.012086	-0.04372	0.000528
0.0864	-0.009714	-0.03515	0.000341
0.1296	-0.007582	-0.02743	0.000208
0.1728	-0.005678	-0.02054	0.000117
0.216	-0.003988	-0.01443	5.75E-05
0.2592	-0.002498	-0.00904	2.26E-05
0.3024	-0.001189	-0.0043	5.11E-06
0.3456	-0.000043	-0.00015	6.45E-09
0.3888	0.000959	0.00347	3.33E-06
0.432	0.001835	0.00664	1.22E-05
0.4752	0.002604	0.00942	2.45E-05
0.5184	0.003283	0.01187	3.9E-05
0.5616	0.003889	0.01407	5.47E-05
0.6048	0.004439	0.01606	7.13E-05
0.648	0.004946	0.01789	8.85E-05
0.6912	0.005422	0.01962	0.000106
0.7344	0.005877	0.02127	0.000125
0.7776	0.006322	0.02287	0.000145
0.8208	0.00676	0.02446	0.000165
0.864	0.007197	0.02604	0.000187

by Simpson's rule:

INT= 0.000111 m^3

w(b)= 0.014703 m
w(a)= 0.004173 m
delta kh= (w(b)-w(a))/INT
delta kh= 95 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 320 kN/m^2

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Table H126
NUMERICAL ANALYSIS OF LATERALLY LOADED PILES EMBEDDED IN CLAYEY SOIL SUBJECTED TO BENDING MOMENTS INCREASING LINEARLY

ALFA=2.4
LINEAR PART
PILE LENGTH=0.864m

	Mi=0.299kNm	M=1.000kNm	
z (m)	w (m)	w(ad) (m)	(w)(w(ad))
0	-0.015906	-0.05319	0.000846
0.0432	-0.013075	-0.04372	0.000572
0.0864	-0.010509	-0.03515	0.000369
0.1296	-0.0082	-0.02743	0.000225
0.1728	-0.006142	-0.02054	0.000126
0.216	-0.004315	-0.01443	6.23E-05
0.2592	-0.002702	-0.00904	2.44E-05
0.3024	-0.001286	-0.0043	5.53E-06
0.3456	-0.000046	-0.00015	6.9E-09
0.3888	0.001037	0.00347	3.6E-06
0.432	0.001985	0.00664	1.32E-05
0.4752	0.002817	0.00942	2.65E-05
0.5184	0.003552	0.01187	4.22E-05
0.5616	0.004208	0.01407	5.92E-05
0.6048	0.004803	0.01606	7.71E-05
0.648	0.005351	0.01789	9.57E-05
0.6912	0.005866	0.01962	0.000115
0.7344	0.006359	0.02127	0.000135
0.7776	0.006839	0.02287	0.000156
0.8208	0.007313	0.02446	0.000179
0.864	0.007786	0.02604	0.000203

B= 0.0254 m
delta Z= 0.0432 m

by Simpson's rule:

INT= 0.00012 m^3

w(b)= 0.015906 m
w(a)= 0.004446 m
delta kh= (w(b)-w(a))/INT
delta kh= 95 kN/m^2

kh(initial)= 225 kN/m^2
kh= kh(initial)+delta kh

kh= 320 kN/m^2

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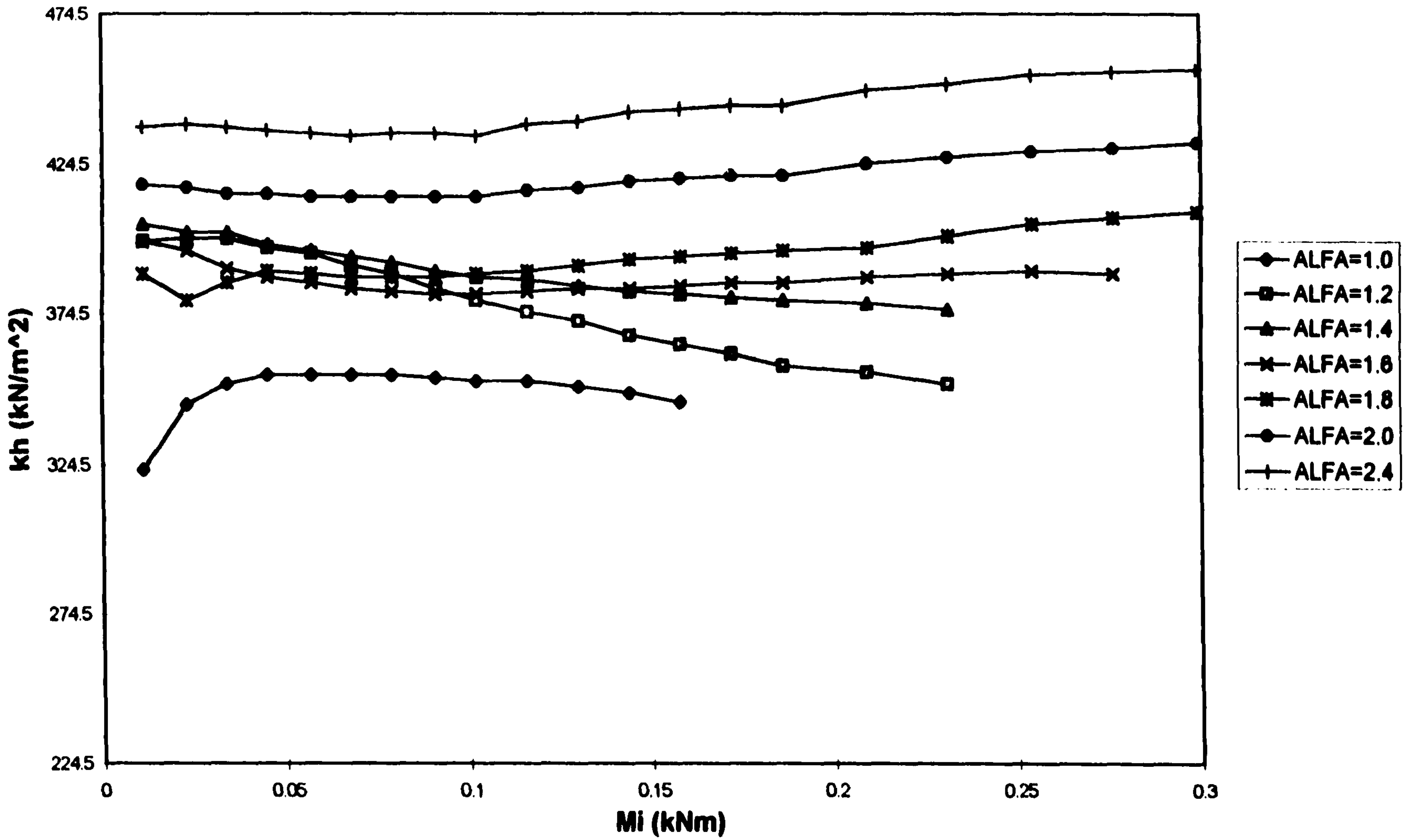

Figure H1. Bending Moment vs kh for Piles Embedded in Clayey Soil Subjected to Bending Moments

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