PARAMETRIC STUDY OF EXCAVATION WITH SHEET PILE BY PLAXIS

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APPROVAL SHEET

This project report attached here to, entitled "Parametric Studies Of Excavation With Sheet Pile By PLAXIS", prepared and submitted by Hana'aifah bte. A.S. Suhaili in partial fulfilment of the requirement for the degree of Bachelor of Engineering (CIVIL) is hereby accepted.

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Dedicated to my
papa & mama, brothers & Sisters,
Friends & loves one.

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ABSTRACT

This project presents a parametric study about activities of excavation by using Finite Element Method (FEM) that is Plasticity Axisymmetri Program or PLAXIS. The aim of this project was to identify the effect caused by a few factors on excavation activities. In this study, dimension for the excavation happened when data put into the program first. Besides, the data involved parameter such as its amount of struts and stiffness, usage of different height of sheet pile and settlement effect was also being analyzed. Apart from that, the results of comparison can be seen especially on the contour diagram. Meanwhile, the moment and force that has been reacted toward the sheet pile can be figure out together with the values. From the analysis that has been conducted, it was showed that the parameter factors should be look into even though in theory before being applied to practical works.

ABSTRAK

Projek ini adalah kajian parameter yang melibatkan aktiviti pengorekan dengan menggunakan Kaedah unsur Terhingga iaitu Pengaturcaraan Keplastikan Simetri Sepaksi. Kandungan kajian ini adalah untuk mengenalpasti kesan yang berlaku ke atas pengorekan dengan berdasarkan faktor - faktor parameternya. Dalam kajian ini, dimensi bagi pengorekan dapat dilihat dengan memasukkan data - data ke dalam program tersebut terlebih dahulu . Di samping itu, data data berkaitan seperti jumlah tetupang dan kekukuhannya, penggunaan ketinggian cerucuk keping yang berbeza dan kesan mendapannya turut dianalisis. Perbandingan dapat dilihat terutama pada gambarajah kontur yang terhasil setelah siap dianalisis. Selain itu, momen dan daya yang bertindak terhadap cerucuk keping turut dihasilkan beserta nilai-nilainya sekali. Daripada analisis yang dijalankan didapati faktor faktor parameter amatlah perlu ditikberatkan walaupun ia dijalankan secara teori semata sebelum diaplikasikan kepada kerja - kerja praktikal.

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NOTATIONS

$\bar{B}$	=	Width of Exacavation (m or ft).
C	=	Average cohesion of clay.
EA	=	Normal Stiffness.
EI	=	Flexural Stiffness.
H	=	Depth of excavation.
Ka	=	Coefficient of active earth pressure.
Ko	=	Coefficient of lateral pressure.
M	=	A coefficient.
Nc	=	Coefficient depending on the dimensions of the excavation.
P	=	Surface surcharge
S	=	Undrained shear strength.
γ	=	Bulk density of the soil
ϕ	=	Angle of vertical friction of the soil.
δ_{vo}	=	Initial Vertical Stress.
δ_{ho}	=	Initial Horizontal Stress.

CHAPTER ONE

INTRODUCTION

1.1 General

The term excavation and embankment includes a work on earthfill, cut and mixture of cut and fill (Kerisel, 1985). Construction work on site involved a work of excavation and embankment such as foundation, retaining walls, drainage, road etc.

There are few factor that should be considered before and during the construction of excavation such as types of support of excavation, types of soil, groundwater level, settlement and type of fill material used. However, for construction of embankment common factor that should be considered is the stability against shear failure and settlement. The stresses can then be compared to the strength and thus directly used for stability calculation.

Although this project analyze parameter that could influence the work of excavation and embankment a case study of Rotterdam

Tunnel was choosen in this project to study the behaviour of the excavation. This is due to the fact that embankment and excavation involved soil and rock, beside those item have a material with a variation of constitution as in its behaviour under various condition of environment and loads. So, by using PLAXIS were idle tool to solving any problem that facing during excavation.

1.2 Objective

The objective of the project are:

- To use PAXIS to simulate and study the effect of excavation consider with respect of the support with the different height of sheet piles or deep and types of struts (arrangement).

- To use PLAXIS to simulate and also study the movement of excavation soil and the anchor which are used to support the retaining structure during construction. The settlement at the top of the retaining structure and bottom heave are also study.

- To identify which the most suitable design for construction of retaining structure especially when it deal with different height of sheet pile wall.

CHAPTER TWO

LITERATURE REVIEW

2.1 General

Excavation involved a removal of material and consequently causes a change in the state of stress in soil or rock beneath and beside the excavated space (Wolmer Fellenius, 1876). In as much as no material can experience a change in stress without corresponding deformations, excavation is always associated with movements of the adjacent ground surface.

Some soil will stand to considerable depths when cut vertically, although most will not. When vertical slopes slough out to a stable angle, large blocks of material may slide down into the excavation work. Some temporary of slopes were need during the excavation which depends the types of soil .

Practically, there were two method that consider in excavation work;

- Bulk Excavation

The choice of plant for bulk excavation is large determined by the quantity and by the length of haul to the disposal point. Heavy machinery were use and it's also depend the type of soil by using it, for example; Backacter (backhoe), dragline and grab.

- Rock excavation

The use for explosive to break up the rock in advance of mechanical excavation is necessary in all but the weakest rocks such as weathered mudstone , chalk and shales. However the use of explosive involves noise and vibration and the risk of annoyance to the public and possible damage to property.

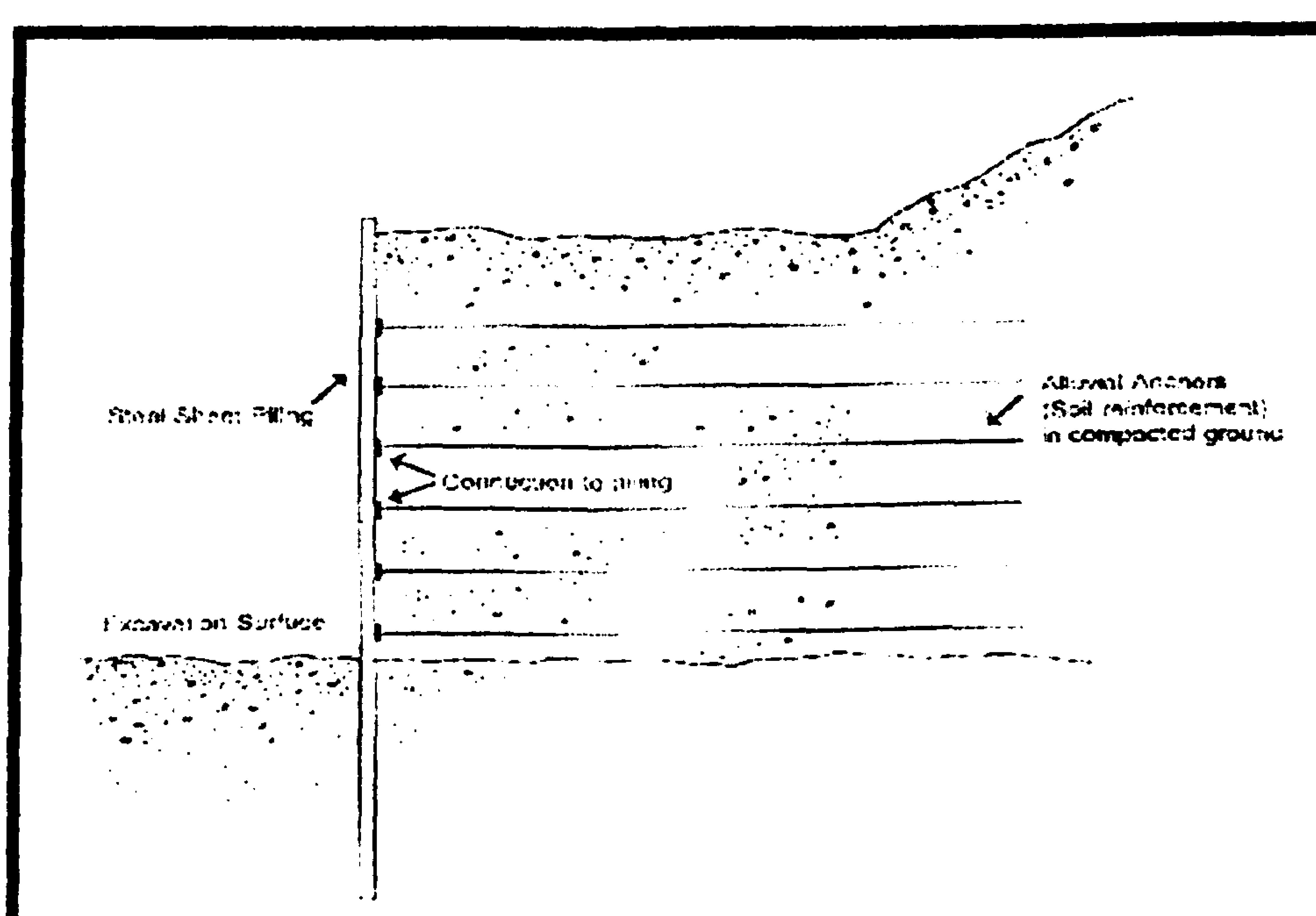

Figure 2.0 Shown about the excavation by using sheet pile to support the wall

2.2 Slope stability

Three main considerations govern the determination of stable slopes for open excavation. The first of these, is the type of soil. The second is the length of time over which the excavation is required to remain open, and the third is the permissible degree of risk of slipping

Gravititional and seepage forces tends to cause instability in natural slopes, in slopes formed by excavation and in slopes of embankment. When a slope is formed by excavation, the decrease in total stress result in changes in pore water pressure in the vicinity of the slope and particular, along a potential failure surface (W.H Ting, 1987).

Many excavation are started with a vertical cut. Some soil will stand to considerable depths when cut vertically although most will not. When vertical slopes slough off to a stable angle, long blocks of material may slide down into the excavation.

The angle at which soil can be expected to stand temporarily during excavation can be calculated. Some rough rule of thumb slope angle are presented at Appendix A and figure 2.1

When the construction area is large , excavation walls maybe sloped in lieu of providing structural support. Selection of a suitable slope involves knowledge of the properties of the soil at the side and application of the principles of soil mechanics.

(W.L Schroeder & T.S Diskenson, 1984).

The direct effect of water in a slope is obvious in connection with seepage, particularly out of slope which causes failure without necessarily being associated with a change in the soil strength. The increase in moisture content can allow immediate reduction in negative pore pressure, swelling on the soil, decrease in inter-granular pressure and loss of cohesive strength (Vail and Beattie, 1985).

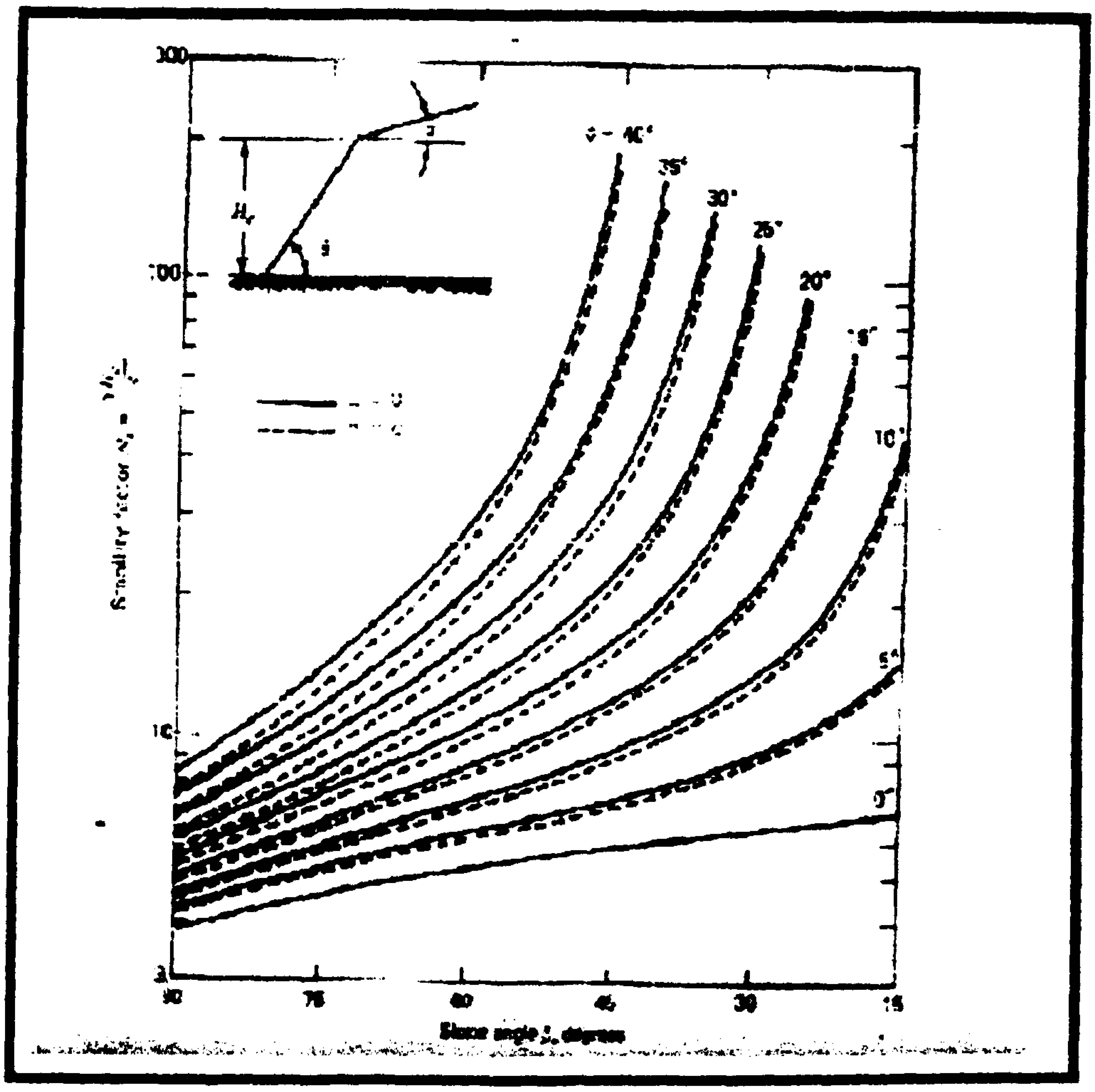

Figure 2.1 Slope angle β, degrees

2.2.1 Slope Failure

Slopes may fail because of the number of mechanisms, depending on the nature of the soil involved and the arrangement of natural earth materials at the site. A number of these mechanisms shown in Fig 2.2. Three types of failure were identified which depend of soil type; Rotational Slump, Translational and Slip.

Slopes failures occurs because forces tending to cause instability exceed those tending to resist it. Generally, the driving forces are represented by a component of soil weight down-slope and the resisting forces are represented by the soil strength acting in the opposite direction.

In any case, the factor of safety (FS) for the slope is expressed as the ratio of resisting moments to the driving forces or moments. When the factor of safety is 1 or less, the slope must fail. When the factor of safety exceeds 1, the slope theoretically stable. In designing cut slopes, the usual factor of safety required in between 1.3.and 1.5.

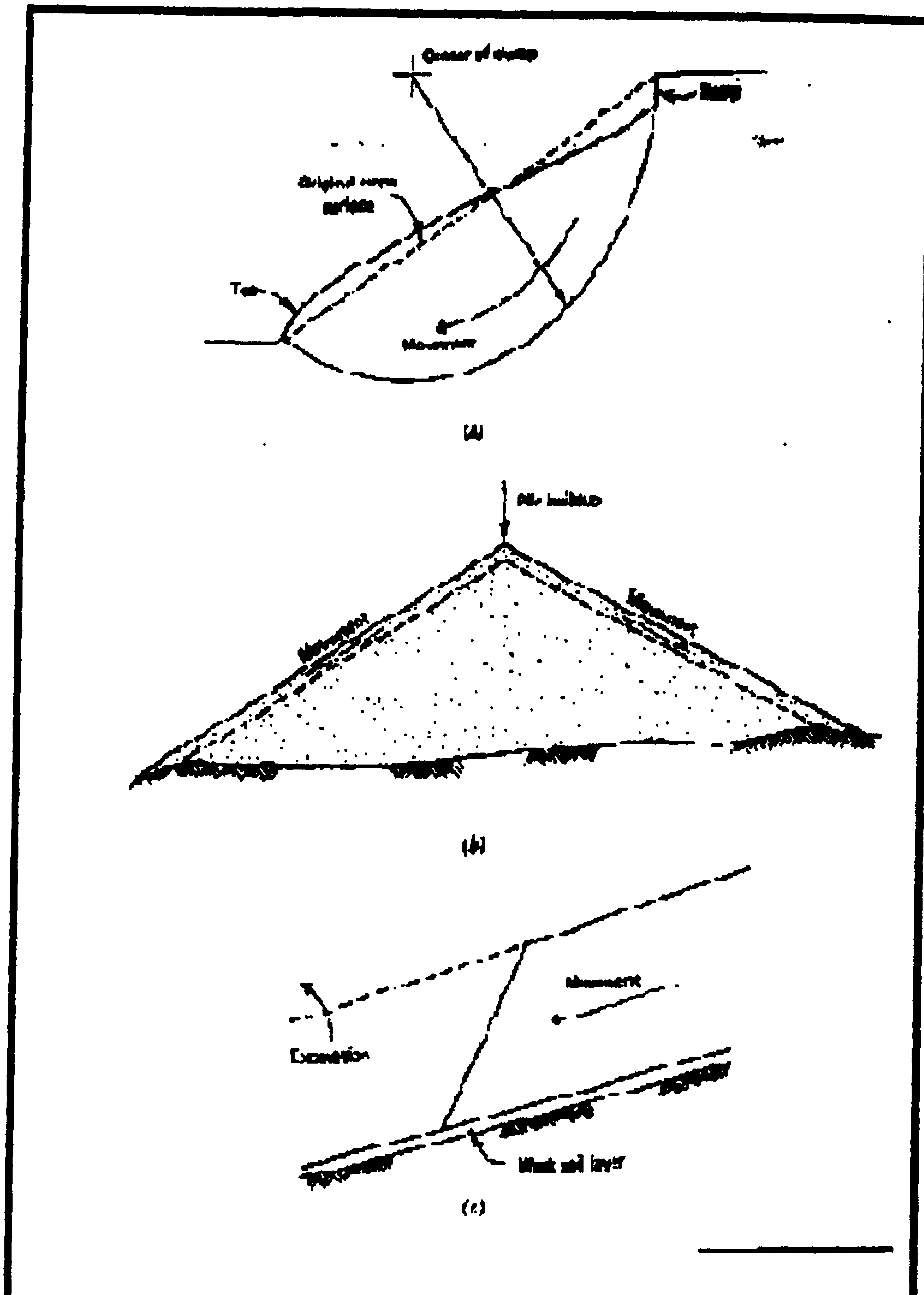

Fig. 2.2 Some slope failure mechanisms (a) Rotatioanal slump in homogeneous clay , (b) Translatioanal slide in cohesionless sand or gravel, (c) Slip along plane of weakness.

2.3 Soil Pressure

Actually, for every excavation work have to considering the soil pressure. Soil is comprised of particles, large and small and it may be necessary to include as "soil" not only solid matter but also air and water.

The soil pressure also known as lateral earth pressure in undisturb soil deposit may considered as proportional to the vertical pressure. Soil behave as linearly elastic porous material which deforms with the change in the effective stress applied (Biot, 1941,1955 &1956).

2.3.1 Rowe (1952)

The author was using the flexibility method for design approach of sheet pile in sand. By assuming the that the anchor and subsoil yield approximately have same amount, such the wall will translate away from the retained soil into the soil below the dredge level. This is the free earth support condition and the equations governing the pressure distribution on gravity walls apply.

Factored soil properties are used on the passive side and taking moments of the active and passive forces about the anchorage point gives an equation for the penetration depth D from which D is determined. Figure 2.3 below shown the moment reduction curves obtained by the author for a sheet - pile wall embedded in sand and retaining sand; α is the ratio of depth of dregde level to the total length H of the piles and ρ is the flexibility number defined by :

$$\rho = \frac{H^4}{EI}$$

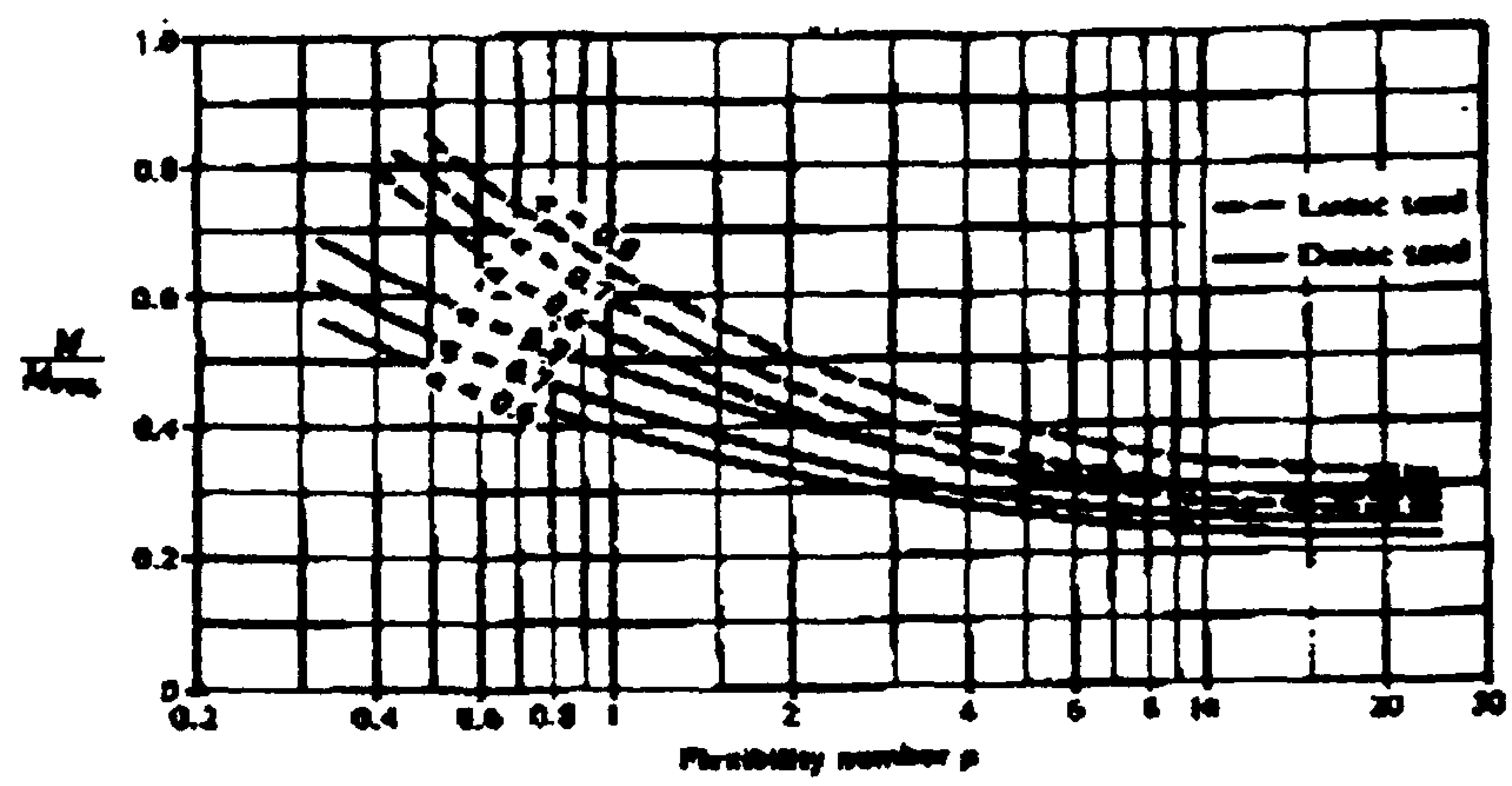

Figure 2.3 Moment reduction curves for sheet -pile walls in sand (After Rome,1952)