

PERPUSTAKAAN FTSP UII	
HADIAH/BELI	
TGL. TERIMA :	7 September 2005
NO. JUDUL :	0216 SC
NO. INV. :	520001656001
NO. INDUK :	

TUGAS AKHIR

ANALISIS PERUBAHAN *SLIP SURFACE* PADA LERENG AKIBAT PENGARUH ELEVASI MUKA AIR TANAH, KEMIRINGAN, DAN POSISI BEBAN



disusun oleh:

Angga Sukmatirta K. 99 511 009

Agung Triyana 99 511 194

JURUSAN TEKNIK SIPIL
FAKULTAS TEKNIK SIPIL DAN PERENCANAAN
UNIVERSITAS ISLAM INDONESIA
JOGJAKARTA
2005

HALAMAN PENGESAHAN

TUGAS AKHIR

ANALISIS PERUBAHAN *SLIP SURFACE* PADA LERENG

AKIBAT PENGARUH ELEVASI MUKA AIR TANAH,

KEMIRINGAN DAN POSISI BEBAN

Nama : Angga Sukmatirta K.

No. Mhs : 99 511 009

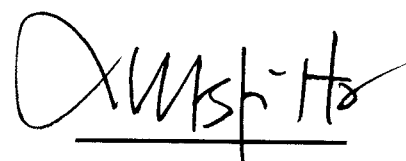
Nama : Agung Triyana

No. Mhs : 99 511 194

Telah diperiksa dan disetujui oleh:

Dr. Ir. H. Luthfi Hasan, MS

Dosen Pembimbing


Tanggal: 17/10/2005

KATA PENGANTAR

Assalamualaikum Wr. Wb

Puji syukur penyusun panjatkan kehadiran Allah SWT yang telah melimpahkan rahmat dan hidayah-Nya kepada kita semua sehingga telah dapat diselesaikan Tugas Akhir ini dengan sebaik-baiknya, shalawat serta salam dihaturkan kepada Nabi besar Muhammad (Rasulullah) saw beserta keluarga, sahabat, serta umatnya yang selalu setia hingga akhir zaman.

Tugas Akhir dengan judul “ **Analisis Perubahan Slip Surface pada Lereng Akibat Pengaruh Elevasi Muka Air Tanah, Kemiringan, dan Posisi Beban.** “ diajukan sebagai salah satu syarat untuk memperoleh gelar Strata satu (S1) Teknik Sipil pada Jurusan Teknik Sipil, Fakultas Teknik Sipil dan Perencanaan, Universitas Islam Indonesia, Yogyakarta.

Penyusun menyadari bahwa dalam penulisan Tugas Akhir ini tidak lepas atas saran dan pemikiran dari berbagai pihak yang sangat membantu dalam penyelesaian Tugas Akhir ini, maka pada kesempatan ini dengan penuh rasa hormat dan kerendahan hati, penyusun mengucapkan terima kasih kepada pihak-pihak yang telah membantu :

1. DR. Ir. H. Luthfi Hasan, MS selaku dosen pembimbing dan penguji yang telah membimbing penyusun dalam menyelesaikan Tugas Akhir ini, sekaligus sebagai Rektor Universitas Islam Indonesia, Yogyakarta.
2. Ir. H. Ibnu Sudarmadji, MS selaku dosen tamu yang telah membantu menguji penyusun dalam Tugas Akhir ini.

3. Ir. H. Bambang Sulistiono, MSCE selaku dosen tamu yang telah membantu menguji penyusun dalam Tugas Akhir ini.
4. Prof. Ir. H. Widodo, MSCE, Ph.D selaku Dekan Fakultas Teknik Sipil dan Perencanaan, Universitas Islam Indonesia, Yogyakarta.
5. Ir. H. Munadhir, MS selaku Ketua Jurusan Teknik Sipil, Universitas Islam Indonesia, Yogyakarta.
6. Seluruh Dosen Jurusan Teknik Sipil, Universitas Islam Indonesia, Yogyakarta.
7. Seluruh Karyawan Jurusan Teknik Sipil, Universitas Islam Indonesia, Yogyakarta.
8. Kedua Orang tua dan Saudara-saudara kami yang telah memberikan bimbingan, do'a dan dukungan sehingga terselesaikannya Tugas Akhir ini.
9. Sobat senasib dan seperjuangan Teknik Sipil '99 UII, semoga hubungan persahabatannya tetap baik, abadi hingga akhir jaman.
10. Teman-teman di kos pusat maupun cabang yang selalu menjadi sahabat dan saudara selama menempuh kuliah di UII.
11. Segenap jama'ah masjid As-Sadiqin yang telah memberikan do'a dan dukungan kepada penyusun.

Dalam penyusunan Tugas Akhir ini masih jauh dari kesempurnaan untuk itu diharapkan kritik dan saran yang sifatnya membangun guna perbaikan dan pengembangan selanjutnya.

Akhir kata penyusun mengucapkan terima kasih atas bantuan yang telah diberikan semoga bermanfaat dan memberikan tambahan ilmu pengetahuan bagi kita semua.

Wassalamualaikum Wr. Wb.

Yogyakarta, April 2005

Penyusun



INTISARI

Penelitian ini dilakukan terhadap maraknya peristiwa tanah longsor yang terjadi baik di dalam maupun di luar negeri yang banyak sekali memakan korban jiwa dan harta benda. Bencana alam tanah longsor sering kali timbul karena ulah dari manusia itu sendiri yang kurang mempedulikan keseimbangan alam. Penggundulan hutan di sekitar lereng, membuat bangunan perumahan, perkebunan, jalan dan lain-lain di puncak lereng ataupun yang memotong kemiringan lereng adalah sebagian dari ulah manusia yang kurang mempedulikan keseimbangan alam. Hal tersebut menjadi faktor-faktor penyebab munculnya lereng-lereng yang rawan terhadap longsor.

Kondisi lereng semacam itu sangat memungkinkan untuk terjadi longsor, apalagi dipicu dengan turunnya hujan, maka tidak heran apabila kita mendengar banyak sekali peristiwa tanah longsor ketika datangnya musim hujan. Bahaya tanah longsor merupakan salah satu ancaman yang patut diwaspadai oleh setiap orang mengingat banyaknya korban baik jiwa maupun harta benda yang ditimbulkannya.

Oleh karena itu, perlu diteliti pengaruh faktor elevasi muka air tanah pada lereng, sudut kemiringan lereng dan posisi beban yang bekerja di puncak suatu lereng. Dengan penelitian ini diharapkan dapat memberikan pengetahuan dan pemahaman terhadap perilaku lereng, khususnya perilaku lereng yang dipicu oleh turunnya hujan dan penggunaan lahan di sekitar lereng, sehingga bencana tanah longsor dapat dihindari. Penelitian dilakukan dengan membuat suatu pemodelan lereng dengan geometri dan properties tanah tertentu, kemudian dikenakan tiga variabel yang dianggap sangat berpengaruh terhadap stabilitas lereng, yaitu elevasi muka air tanah, kemiringan lereng, dan beban. Variabel-variabel tersebut dikenakan secara bergantian pada model lereng sehingga diperoleh pengaruhnya terhadap stabilitas lereng.

Dari penelitian ini dapat diketahui bahwa angka keamanan akan menurun jika lereng semakin jenuh akibat naiknya elevasi muka air tanah oleh turunnya hujan. Angka keamanan akan turun jika sudut kemiringan lereng semakin besar (curam) dan posisi beban pada puncak lereng pun akan mempengaruhi angka keamanan lereng. Semakin tinggi angka keamanan suatu lereng, maka lereng semakin aman dari longsor. Sebaliknya semakin kecil angka keamanan, maka lereng semakin tidak stabil dan cenderung akan terjadi longsor. Dari penelitian yang dilakukan, akibat naiknya elevasi muka air tanah pada lereng, angka keamanan akan turun sekitar 19 % - 42 %. Akibat pengaruh kemiringan lereng, angka keamanan turun sekitar 4 % - 11 %, sedangkan akibat perubahan posisi beban, angka keamanan akan turun sekitar 0 % - 3 %.

DAFTAR ISI

Halaman Judul	i
Halaman Pengesahan	ii
Halaman Persembahan	iii
Kata Pengantar	iv
Intisari	vii
Daftar Isi	viii
Daftar Tabel	xi
Daftar Gambar	xii
Daftar Grafik	xiv
Daftar Lampiran	xv
BAB I PENDAHULUAN	
1.1 Latar Belakang	1
1.2 Rumusan Masalah	3
1.3 Tujuan Penelitian	3
1.4 Manfaat Penelitian	4
1.5 Batasan Penelitian	4
BAB II TINJAUAN PUSTAKA	6
BAB III DASAR TEORI	
3.1 Air Tanah	20
3.1.1 Tekanan Kapiler	21
3.1.2 Permeabilitas	22

3.2 Tegangan Efektif.....	22
3.3 Kuat Geser Tanah.....	24
3.4 Tegangan yang Diakibatkan oleh Beban Terpusat.....	26
3.5 Angka Keamanan (<i>Safety Factor</i>).....	28
3.6 Metode Stabilitas Lereng	30
3.6.1 Metode Irisan	31
3.6.2 Metode Irisan Bishop yang Disederhanakan.....	34
BAB IV METODE PENELITIAN	
4.1 Tinjauan Umum	38
4.2 Pemodelan Lereng.....	39
4.3 Teknik Penelitian	39
BAB V HASIL PENELITIAN	
5.1 Tinjauan Umum	43
5.2 <i>Slip Surface</i> pada Lereng Akibat Pengaruh Kemiringan	43
5.3 <i>Slip Surface</i> pada Lereng Akibat Pengaruh Elevasi Muka Air Tanah	46
5.4 <i>Slip Surface</i> pada Lereng Akibat Pengaruh Posisi Beban	48
BAB VI ANALISIS HASIL PENELITIAN	
6.1 Tinjauan Umum	50
6.2 Analisis Angka Keamanan terhadap Pengaruh Elevasi Muka Air Tanah	50
6.2.1 Analisis Pengaruh Elevasi Muka Air Tanah terhadap Tegangan Normal.....	52

6.2.2 Analisis Perubahan <i>Slip Surface</i> Akibat naiknya Elevasi	
Muka Air Tanah	57
6.2.3 Analisis Tipe-Tipe Keruntuhan Akibat Naiknya Elevasi	
Muka Air Tanah	60
6.3 Analisis Angka Keamanan terhadap Pengaruh Kemiringan	
Lereng	62
6.3.1 Analisis Tipe-tipe Keruntuhan Akibat Bertambahnya	
Kemiringan Lereng	68
6.4 Analisis Angka Keamanan terhadap Pengaruh Posisi Beban	69
6.4.1 Analisis Tegangan -tegangan yang Diakibatkan	
oleh Beban Terpusat.....	71
6.4.2 Analisis Perubahan <i>Slip Surface</i> Akibat Pengaruh	
Posisi Beban	72
6.4.3 Analisis Tipe Keruntuhan Akibat Posisi Beban	
pada Lereng.....	74
BAB VII KESIMPULAN DAN SARAN	
6.1 Kesimpulan	76
6.2 Saran.....	77
DAFTAR PUSTAKA	79
LAMPIRAN	

DAFTAR TABEL

1.1	Beberapa jenis bencana dan kejadiannya di Indonesia	1
2.1	Tingkat laju longsoran.....	14
5.1	Hubungan <i>safety factor</i> dengan kemiringan lereng	45
5.2	Hubungan <i>safety factor</i> dengan elevasi muka air	47
5.3	Hubungan <i>safety factor</i> dengan posisi beban.....	49
6.1	Pengaruh naiknya elevasi muka air tanah terhadap <i>safety factor</i>	51
6.2	Perhitungan model lereng pada gambar 6.1a	53
6.3	Perhitungan model lereng pada gambar 6.1b.....	54
6.4	Pengaruh elevasi muka air tanah terhadap panjang <i>slip surface</i>	58
6.5	Pengaruh elevasi muka air tanah terhadap <i>resisting moment</i> dan <i>driving moment</i>	60
6.6	Pengaruh sudut kemiringan lereng terhadap <i>safety factor</i>	62
6.7	Besarnya <i>resisting force</i> dan <i>driving force</i> pada dasar suatu <i>slice</i>	65
6.8	Pengaruh kemiringan terhadap panjang <i>slip surface</i>	67
6.9	Pengaruh kemiringan lereng terhadap <i>resisting moment</i> dan <i>driving moment</i>	67
6.10	Pengaruh posisi beban terhadap <i>safety factor</i>	70
6.11	Penambahan tegangan arah horizontal dan vertikal yang diakibatkan oleh beban terpusat.....	72
6.12	Pengaruh posisi beban terhadap panjang dan kemiringan <i>slip surface</i>	74

DAFTAR GAMBAR

2.1	Tipe-tipe keruntuhan lereng	7
2.2	Ilustrasi beberapa penyebab keruntuhan lereng	11
3.1	Tegangan-tegangan dalam tanah yang disebabkan oleh beban terpusat	27
3.2	Analisis stabilitas dengan metode irisan biasa	33
3.3	Analisis stabilitas dengan metode irisan biasa untuk lereng pada tanah berlapis	34
3.4	Metode irisan menurut Bishop yang sudah disederhanakan	34
4.1	Geometri lereng yang akan dianalisis	39
4.2	Bagan alir penelitian	41
4.3	Bagan alir geo-slope	42
5.1	Geometri lereng dengan variabel kemiringan	43
5.2	Pengaruh perubahan kemiringan pada lereng	45
5.3	Geometri lereng dengan variabel muka air tanah	46
5.4	Perubahan panjang <i>slip surface</i> akibat perubahan elevasi muka air tanah ..	47
5.5	Geometri lereng dengan variabel beban	48
5.6	Perubahan panjang <i>slip surface</i> akibat perubahan posisi beban pada puncak lereng	49
6.1	Kenaikan elevasi muka air tanah pada lereng	52
6.2	Perubahan panjang <i>slip surface</i> akibat perubahan elevasi muka air tanah ..	58
6.3	Analisis stabilitas lereng dengan metode irisan	63
6.4	Gaya-gaya yang bekerja pada dasar sebuah <i>slice</i>	64

6.5	Pengaruh perubahan kemiringan pada lereng	66
6.6	Pengaruh beban garis pada suatu titik di bawah muka tanah.....	71
6.7	Perubahan <i>slip surface</i> akibat perubahan posisi beban pada lereng.....	73



DAFTAR GRAFIK

6.1	Hubungan antara <i>safety factor</i> dan elevasi muka air tanah.....	51
6.2	Besarnya <i>shear resistance</i> yang terjadi pada tiap <i>slice</i>	61
6.3	Hubungan antar <i>safety factor</i> dan sudut kemiringan lereng.....	63
6.4	Besarnya <i>shear resistance</i> yang terjadi pada tiap <i>slice</i>	69
6.5	Hubungan antara posisi beban dan <i>safety factor</i>	70
6.6	Besarnya <i>shear resistance</i> yang terjadi pada tiap <i>slice</i>	75



DAFTAR LAMPIRAN

Lampiran I	Out-put variabel elevasi muka air tanah.....	i
Lampiran II	Out-put variabel kemiringan lereng	ii
Lampiran II	Out-put posisi beban	iii



BAB I

PENDAHULUAN

1.1 Latar Belakang

Tanah longsor merupakan salah satu bencana alam yang sangat berbahaya di banyak wilayah di seluruh dunia. Di Amerika Serikat diperkirakan 25-50 orang meninggal dan kerugian mencapai 1 milyar dollar Amerika setiap tahunnya (*The National Landslide Information Center, developed by the U.S. Geological Survey*). Di Indonesia, sejak tahun 1998-2003 tercatat telah terjadi 245 kejadian bencana tanah longsor yang telah menelan 645 korban jiwa dengan kerugian mencapai 13,928 milyar rupiah (sumber: Bakornas Penanggulangan Bencana). Selengkapnya jenis dan jumlah kejadian bencana di Indonesia berikut korban dan kerugiannya dapat dilihat pada Tabel 1.1 di bawah ini.

Tabel 1.1 Beberapa jenis bencana dan kejadiannya di Indonesia

Jenis	Jumlah Kejadian	Korban Jiwa	Kerugian (milyar rupiah)
Longsor	245	645	13.928
Gempa bumi	38	306	100.000
Gunung berapi	16	2	n.a
Angin topan	46	3	4.015

Sumber: Badan Koordinasi Nasional Penanggulangan Bencana (2003)

Selama kurun waktu 2003-2004 dari data yang dikeluarkan oleh Departemen Pemukiman dan Prasarana Wilayah, tercatat telah terjadi 174

bencana tanah longsor dengan total korban jiwa mencapai 334 orang di seluruh Indonesia.

Mengingat besarnya frekuensi kejadian tanah longsor dan besarnya korban jiwa yang ditimbulkan maka bencana tanah longsor ini harus mendapat perhatian yang cukup serius. Dalam kasus bencana tanah longsor ini sering kali bukan hanya karena faktor alamiah, namun lebih banyak karena campur tangan manusia. Secara teknis faktor penyebab terjadinya tanah longsor antara lain: morfologi permukaan bumi, penggunaan lahan, struktur geologi, curah hujan, kegempaan dan semuanya itu saling mempengaruhi satu sama lain, sedangkan faktor-faktor pemicu tanah longsor itu sendiri adalah perubahan penggunaan lahan, dari hutan menjadi non-hutan, baik untuk lahan pertanian, perkebunan, pemukiman, maupun lainnya tanpa memperhatikan efek negatifnya. Hal ini tampak dengan banyaknya lahan pertanian dan pemukiman di atas lereng ataupun di bawah lereng yang memotong kelandaian lereng sehingga lereng bertambah curam/terjal. Seiring dengan datangnya musim penghujan, permukaan air tanah akan naik dan berat unit tanah akan bertambah ditambah lagi dengan kondisi tanah yang labil maka akan sangat memungkinkan untuk terjadinya tanah longsor. Perubahan penggunaan lahan dari hutan menjadi non-hutan bisa dilihat pada pertambahan lahan terbuka di Jateng, yaitu 179 Ha pada tahun 1996 menjadi 2.809,5 Ha pada tahun 1999, sehingga 10 kabupaten di Jateng digolongkan daerah rawan tanah longsor, daerah tersebut antara lain: Kebumen, Banyumas, Banjarnegara, Purworejo, Wonosobo, Magelang, Semarang, Kudus, Temanggung, dan Cilacap.

Bencana tanah longsor tampaknya sudah menjadi hal yang biasa terjadi setiap datangnya musim penghujan, kendati membawa dampak terhadap kerusakan alam, kerusakan struktur dan infrastruktur bahkan jatuhnya korban jiwa, hal ini dikarenakan sekitar 70% dari lokasi tanah longsor adalah daerah yang berpenghuni, khususnya di Pulau Jawa yang penduduknya relatif padat. Oleh karena itu perlu dilakukan pencegahan untuk menghindari terjadinya bencana tanah longsor, khususnya di daerah-daerah yang padat penduduknya.

1.2 Rumusan Masalah

Dari penjelasan latar belakang di atas dapat dirumuskan masalah sebagai berikut:

1. Banyaknya peristiwa bencana tanah longsor seiring dengan datangnya musim hujan.
2. Peristiwa bencana tanah longsor sering kali disebabkan oleh naiknya elevasi muka air tanah, berkurangnya kemiringan lereng, dan beban yang bekerja pada lereng.

1.3 Tujuan Penelitian

Adapun tujuan yang ingin dicapai adalah sebagai berikut ini.

1. Mengetahui pengaruh elevasi muka air tanah, kemiringan lereng, dan pembebanan terhadap perubahan *slip surface* dan *safety factor*.

2. Menganalisis perubahan *slip surface* dan *safety factor* pada lereng, akibat perubahan elevasi muka air tanah, kemiringan lereng, dan pembebanan.

1.4 Manfaat Penelitian

Dari hasil penelitian yang diperoleh, diharapkan dapat memberikan manfaat berikut ini.

1. Memberikan pemahaman tentang perilaku bidang longsor pada lereng.
2. Menambah pengetahuan tentang faktor-faktor yang dapat mendukung dan mengurangi stabilitas suatu lereng.
3. Memberikan wawasan baru dalam perencanaan stabilitas suatu lereng dilihat dari faktor elevasi muka air tanah, kemiringan, dan pembebanan.
4. Merangsang melakukan penelitian berikutnya tentang stabilitas lereng ditinjau dari faktor internal ataupun eksternal bagi mahasiswa Teknik Sipil di Indonesia, khususnya bidang Geoteknik.

1.5 Batasan Penelitian

Mengingat banyaknya faktor penyebab yang mempengaruhi stabilitas lereng di atas, maka diperlukan batasan penelitian sebagai berikut:

1. Analisis stabilitas lereng menggunakan variabel bebas (*independent*);

- a. Untuk perubahan elevasi muka air tanah, maka pembebanan dan kemiringan konstan.
- b. Untuk perubahan beban pada lereng, maka elevasi muka air tanah dan kemiringan konstan.
- c. Untuk perubahan kemiringan, maka elevasi muka air tanah dan pembebanan konstan.
- d. Variabel independent yang bersifat konstant terdiri atas:
 1. geometri lereng
 2. kohesi tanah (c)
 3. sudut gesek dalam (ϕ)
 4. berat unit tanah (γ)
2. Variabel tergantung (dependent) adalah bidang longsor (*slip surface*) dan angka keamanan (*safety factor*).
3. Kelongsoran yang ditinjau adalah *rotational slide*.
4. Kelongsoran lereng terjadi di sepanjang permukaan bidang longsor tertentu dan dianggap sebagai masalah bidang dua dimensi.
5. Tahanan geser dari massa tanah pada setiap titik sepanjang bidang longsor tidak tergantung dari orientasi permukaan longsor atau dengan kata lain kuat geser tanah dianggap *isotropic*.
6. Beban gempa tidak diperhitungkan.
7. Analisis menggunakan *software* Geo-Slope versi 5 dari Geo-Slope International Ltd.

BAB II

TINJAUAN PUSTAKA

Suatu permukaan tanah yang miring dengan sudut tertentu terhadap bidang horizontal dinamakan lereng (Braja M. Das). Abramson (1985) membedakan lereng menjadi lereng alam (*natural slope*) dan lereng buatan (*engineered slope*).

1. Lereng alam (*natural slope*)

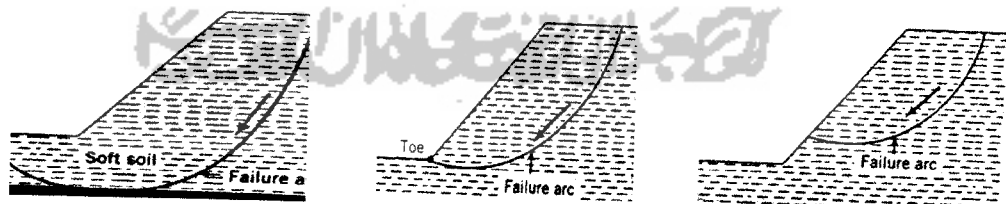
Lereng alam terbentuk karena proses alam. Lereng-lereng alam yang telah ada selama bertahun-tahun dapat tiba-tiba runtuh dikarenakan adanya perubahan topografi, gempa, aliran air tanah, hilangnya kuat geser, perubahan tegangan, dan cuaca. Biasanya keruntuhan-keruntuhan tersebut tidak dipahami secara baik karena sedikitnya studi yang dilakukan pada lereng-lereng alam itu. Mengetahui adanya bidang runtuh lama pada lereng alam dapat memudahkan untuk memahami dan memprediksi perilaku lereng tersebut. Selain sering kali disebabkan oleh aktivitas tektonik dan longsoran tanah sebelumnya, bidang runtuh juga dapat disebabkan oleh pengaruh sungai glacial dan fenomena glacial seperti pengembangan/pemuaian tanah lempung yang tidak seragam. Solusi dalam stabilitas lereng yang berkaitan dengan lereng alam (*natural slope*) telah dikenal luas dari waktu-waktu. Material yang paling berpengaruh pada analisis stabilitas lereng yaitu tanah lempung (*clay*) dan *shale* yang terikat secara kimia yang secara berangsur-angsur dapat terlepas karena

pengaruh cuaca. Cuaca dapat menyebabkan banyak energi yang dilepaskan pada ikatan tersebut (Bjerrum, 1966).

2. Lereng buatan (*engineered slope*)

Lereng ini dibuat dari tanah asli dengan memotong tanah tersebut untuk pembuatan jalan atau saluran air untuk irigasi. Lereng buatan dapat di bedakan menjadi tiga kategori: galian (*embankments*), pemotongan lereng(*cut slope*), dan dinding penahan tanah(*retaining wall*).

Muni Budhu (1979), menjelaskan bahwa kelongsoran tanah bergantung pada tipe tanah, susunan tanah, air tanah, rembesan dan geometri lereng. Berikut ini adalah tipe-tipe keruntuhan lereng yang sering terjadi. Tipe pertama disebut *base failure*, keruntuhan ini terjadi jika tanah dibawah tinggi (level) ujung kaki dari lereng tidak mampu memikul berat dari bahan yang terletak di atasnya, maka keruntuhan terjadi di sepanjang suatu permukaan yang terletak di bawah ujung kaki lereng (gambar 2.1a). Tipe yang kedua adalah *toe failure* dimana *slip surface* tepat memotong kaki lereng (gambar 2.1b). Tipe ketiga adalah *slope failure* dimana *slip surface* memotong kemiringan lereng (gambar 2.1c).



Gambar 2.1 Tipe-tipe keruntuhan lereng
(Muni Budhu, 1979)

Keruntuhan lereng alam dan lereng buatan biasanya disebabkan oleh aktifitas meningkatnya tegangan geser tanah (*shear stress*), atau menurunnya kuat geser tanah (*shear strength*).

The Highway Research Board (1978) secara rinci mengemukakan beberapa hal penyebab meningkatnya tegangan geser tanah (*shear stress*) pada lereng, yaitu:

1. Berkurangnya *bearing capacity*, yang disebabkan oleh:
 - a. Erosi, baik yang disebabkan oleh aliran air sungai, hujan maupun perbedaan suhu yang sangat drastis. Air dan angin secara terus menerus mengikis lereng alam dan buatan. Erosi mengubah geometri lereng (gambar 2.2a), yang akhirnya dapat mengakibatkan longsor.
 - b. Pergerakan alami dari lereng akibat pergeseran bidang longsor maupun akibat penurunan (*settlements*).
 - c. Aktivitas manusia, antara lain:
 - c.1 Penggalian dasar lereng yang dapat mempertajam kemiringan lereng
 - c.2 Penggeseran/pengrusakan terhadap struktur penahan tanah yang ada.
 - c.3 Penurunan seketika tinggi muka air pada lereng.
2. Penambahan beban pada lereng.

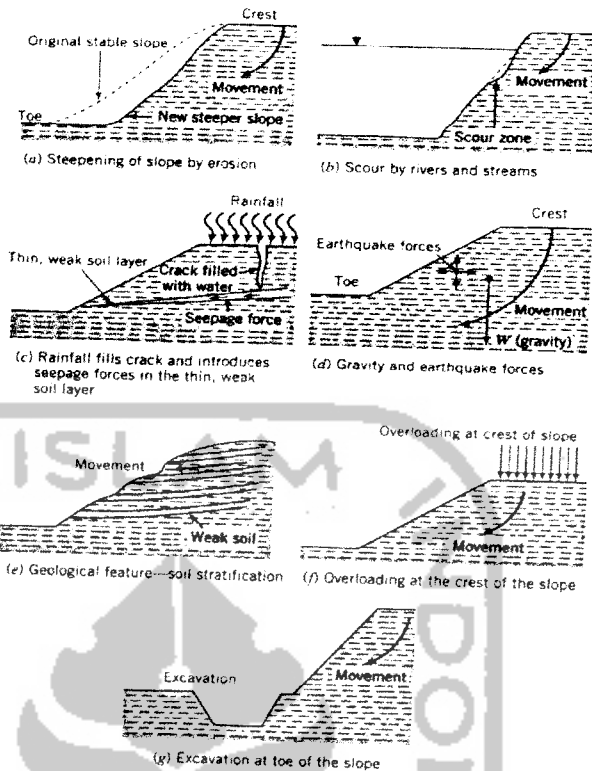
Beban yang bekerja pada puncak lereng memperbesar gaya gravitasi dan dapat menyebabkan kelongsoran (gambar 2.2f), sedangkan beban yang diletakkan pada kaki lereng, yang disebut berm, akan meningkatkan stabilitas lereng. Berm sering digunakan untuk mengatasi masalah stabilitas lereng. Bertambahnya beban pada lereng dapat disebabkan beberapa hal;

- a. Kondisi alam, seperti:
 - a.1 Peningkatan berat volume tanah akibat pengaruh air hujan.
 - a.2 Akumulasi sedimen di atas lereng
- b. Aktivitas manusia, seperti:
 - b.1 Pengurugan tanah di atas lereng
 - b.2 Pengembangan gedung, jalan dan sejenisnya di sekitar lereng.
3. Pengaruh terjadinya gempa atau sumber getaran yang lain. Gempa bumi memicu gaya dinamik (gambar 2.2d) khususnya gaya geser dinamik yang mengurangi kuat geser (*shear strength*) dan kekakuan tanah (*soil stiffness*). Tekanan air pori dalam tanah jenuh air dapat meningkat sampai suatu nilai yang sama dengan tegangan rata-rata total dan menyebabkan tanah tersebut mempunyai perilaku seperti cairan kental, yang disebut likuifaksi (*liquefaction*). Bangunan-bangunan yang didirikan pada tanah tersebut akan roboh.
4. Pemindahan material di sekeliling dasar, yang disebabkan oleh:
 - a. Aliran sungai maupun gelombang laut.
 - b. Terjadinya peristiwa *piping*.
 - c. Aktivitas manusia seperti penggalian dan penambangan.
 - d. Hilangnya kuat geser tanah di sekeliling dasar lereng.
5. Meningkatnya tekanan tanah lateral, yang disebabkan oleh:
 - a. Retakan-retakan tanah.
 - b. Beban yang bekerja di sekitar muka lereng.
 - c. Mengembangnya tanah lempung.

Beberapa hal yang dapat menyebabkan menurunnya kuat geser tanah (*shear strength*) pada lereng adalah:

1. Faktor-faktor alami dari material penyusun lereng:
 - a. Komposisi material
 - b. Struktur material
 - c. Struktur sekunder material
 - d. Lapisan tanah
2. Perubahan yang disebabkan proses physiochemical dan cuaca:
 - a. Proses basah dan kering pada tanah
 - b. Hydration
 - c. Terkikisnya lapisan sediment tanah
3. Efek dari tekanan air pori
4. Perubahan pada struktur tanah
 - a. Pelepasan tegangan
 - b. Degradasi stuktural

Beberapa penyebab kelongsoran lereng diilustrasikan pada gambar 2.2.



Gambar 2.2 Ilustrasi beberapa penyebab keruntuhan lereng
(Muni Budhu, 1979)

Peristiwa tanah longsor atau dikenal sebagai gerakan massa tanah, batuan atau kombinasinya, sering terjadi pada lereng-lereng alam atau buatan, dan sebenarnya merupakan fenomena alam, yaitu alam mencari keseimbangan baru akibat adanya gangguan atau faktor yang mempengaruhinya dan menyebabkan terjadinya pengurangan kuat geser serta peningkatan tegangan geser tanah (Suryolelono, 1995).

Kontribusi pengurangan kuat geser tanah pada lereng alam yang mengalami longsor disebabkan oleh faktor yang dapat berasal dari alam itu sendiri, erat kaitannya dengan kondisi geologi antara lain jenis tanah, tekstur (komposisi) tanah pembentuk lereng sangat berpengaruh terhadap terjadinya

longsoran, misalnya sensitivitas sifat-sifat tanah lempung, adanya lapisan tanah *shale*, *loess*, pasir lepas, dan bahan organik. Bentuk butiran tanah (bulat, ataupun tajam) berpengaruh terhadap friksi yang terjadi dalam tanah, pelapisan tanah, pengaruh gempa, geomorfologi (kemiringan daerah), iklim, terutama hujan dengan intensitas tinggi atau sedang, dengan durasi yang lama di awal musim hujan, atau menjelang akhir musim hujan, menimbulkan perubahan parameter tanah yang berkaitan dengan pengurangan kuat gesernya.

Kontribusi peningkatan tegangan geser disebabkan oleh banyak faktor antara lain fenomena variasi gaya intergranuler yang diakibatkan oleh kadar air dalam tanah/batuan yang menimbulkan tegangan air pori, serta tekanan hidrostatik dalam tanah meningkat. Variasi pembentuk batuan dan tekstur tanah, retakan-retakan yang terisi butiran halus, diskontinuitas, pelapukan dan hancurnya batuan yang menyebabkan lereng terpotong-potong, atau tersusunnya kembali butiran-butiran halus (Suryolelono, 1995).

Faktor lain yang berpengaruh adalah bertambah berat beban pada lereng dapat berasal dari alam itu sendiri, antara lain air hujan yang berinfiltrasi ke dalam tanah di bagian lereng yang terbuka (tanpa penutup vegetasi) menyebabkan kandungan air dalam tanah meningkat, tanah menjadi jenuh, sehingga berat volume tanah bertambah dan beban pada lereng semakin berat. Pekerjaan timbunan di bagian lereng tanpa memperhitungkan beban lereng dapat menyebabkan lereng menjadi rawan longsor. Pengaruh hujan dapat terjadi di bagian lereng yang terbuka akibat aktivitas makhluk hidup terutama berkaitan dengan budaya masyarakat saat ini dalam memanfaatkan alam berkaitan dengan

pemanfaatan lahan (tata guna lahan), kurang memperhatikan pola-pola yang sudah ditetapkan oleh pemerintah. Penebangan hutan yang seharusnya tidak diperbolehkan tetap saja dilakukan, sehingga lahan-lahan pada kondisi lereng dengan geomorfologi yang sangat miring, menjadi terbuka dan lereng menjadi rawan longsor. Kebiasaan masyarakat dalam mengembangkan pertanian/perkebunan tidak memperhatikan kemiringan lereng, pembukaan lahan-lahan baru di lereng-lereng bukit menyebabkan permukaan lereng terbuka tanpa pengaturan sistem tata air (drainase) yang seharusnya, maka bentuk-bentuk terassering pada lereng perlu dilakukan untuk mengerem laju erosi. Bertambahnya penduduk menyebabkan perkembangan perumahan ke arah daerah perbukitan (lereng-lereng bukit) yang tidak sesuai dengan peruntukan lahan (tata guna lahan), menimbulkan beban pada lereng (*surchage*) semakin bertambah berat. Erosi di bagian kaki lereng akibat aliran sungai, atau gelombang air laut mengakibatkan lemahnya bagian kaki lereng, terjadinya kembang susut material pembentuk lereng, dan lain-lain menyebabkan terjadinya peningkatan tegangan geser. Pengaruh gempa juga menyebabkan kondisi lereng yang sebelumnya cukup stabil menjadi labil. Kondisi ini dapat terjadi, akibat guncangan pada lapisan tanah di bumi, sehingga struktur tanah menjadi berubah (Suryolelono, 1995).

Pada jenis-jenis tanah berbutir kasar dalam kondisi kering akan menyebabkan butiran-butiran ini merapat, namun untuk jenis tanah yang sama dalam kondisi jenuh dan terjebak dalam lapisan tanah lempung yang membentuk lensa-lensa pasir, apabila terjadi gempa akan mengalami peristiwa *liquefaction*. Akibat pengaruh gempa tegangan pori (u) dalam lapisan tanah pasir (lensa-lensa

pasir) ini meningkat, mengakibatkan tegangan efektif tanah (σ') menurun dan bahkan mencapai nilai terendah. Hal ini berarti tanah kehilangan kuat dukungnya, berakibat tanah pembentuk lereng di atas lapisan ini runtuh, dan terjadi tanah longsor. Selain itu, apabila lapisan tanah lempung terletak di atas lapisan batuan keras (*bed rock*), akibat pengaruh gempa pada ke dua massa yang berbeda (tanah dan batuan) mempunyai percepatan yang berbeda, sehingga bidang kontak ke dua lapisan ini menjadi bagian yang lemah. Munculnya sumber-sumber air di bagian kaki lereng akibat terjadi rembesan air menimbulkan terjadinya peristiwa piping. Pada kondisi ini tanah di bagian kaki lereng kehilangan kuat dukungnya dan bahkan mendekati harga sama dengan nol, sehingga perlawanan terhadap gaya yang melongsorkan menurun, dan lereng menjadi rawan longsor, demikian pula pada lereng buatan yang dapat berupa lereng galian, lereng bendungan, lereng timbunan sampah (Chowdhury, 1978).

Mengetahui tipe-tipe kelongsoran berdasarkan tingkat laju gerakan lereng sangat penting. Tingkat laju gerakan lereng berkisar kurang dari 6 inch sampai lebih dari 5 feet per detik tiap tahun (Cruden and Varnes, 1992). Tingkat laju pergerakan lereng dapat dilihat pada Tabel 2.1 di bawah ini.

Tabel 2.1 Tingkat laju longsor

Class	Description	Velocity (mm/sec)
7	Extremely rapid	5×10^3
6	Very rapid	50
5	Rapid	0,5
4	Moderate	5×10^{-3}
3	Slow	50×10^{-6}
2	Very slow	$0,5 \times 10^{-6}$
1	Extremely slow	$< 0,5 \times 10^{-6}$

Sumber: Cruden and Varnes (1992)

Gerakan lereng tidak stabil merupakan gerakan yang dibedakan sebagai gerakan guguran (*falling*), runtuhan (*toppling*), longsoran (*sliding*), penyebaran (*spreading*), aliran (*flowing*), dan gerakan kompleks yang merupakan kombinasi dari berbagai gerakan tersebut (Varnes, 1978 dalam Giani, 1992). Semua bentuk gerakan ini sangat ditentukan oleh formasi geologi yaitu lapisan batuan, lapukan batuan dan tanah. Longsoran yang terjadi akan membentuk suatu pola baik di permukaan lereng maupun bentuk bidang gelincirnya. Pola longsoran di bagian permukaan lereng akan membentuk pola tapal kuda, bidang longsor sejajar arah kaki lereng (Suryolelono, 1995), sedang bentuk bidang longsor dapat merupakan satu atau lebih permukaan bidang longsor dengan bentuk silindris (tampang lingkaran) atau datar (tampang garis).

Dalam bidang geoteknik, untuk menyatakan lereng aman terhadap terjadinya longsoran, dilakukan analisis dengan pendekatan model matematik dua dimensi untuk berbagai bentuk bidang longsor datar, lengkung (lingkaran), atau kombinasi keduanya. Dalam analisis ini umumnya dicari besarnya angka aman (*safety factor*) yang merupakan fungsi tegangan geser (τ). Pendekatan yang digunakan dalam metode ini adalah keseimbangan batas, dan bentuk bidang longsor dalam dua dimensi, namun lereng tanah perlu dipertimbangkan sebagai suatu sistem tidak jenuh air sampai dengan jenuh air. Letak muka air tanah (*phreatic water surface*) di daerah perbukitan umumnya dalam atau dangkal, sehingga kondisi tanah pada waktu-waktu tertentu menjadi kering (musim kemarau) dan jenuh di musim hujan. Di awal musim hujan, kondisi tanah sebagian pori tanah terisi air atau dalam kondisi tidak jenuh air. Selain itu, jenis

tanah merupakan parameter yang harus dipertimbangkan pula, berhubungan dengan sifat fisis dan mekanis tanah akibat pengaruh air.

Analisis mekanisme tanah longsor yang selama ini digunakan, umumnya untuk lereng jenuh dengan memperhitungkan tegangan air pori positif, namun pada kondisi tanah belum cukup jenuh air (*unsaturated*), tegangan air pori dapat bernilai negatif menimbulkan terjadinya gaya sedot (*soil suction* atau *matrix suction*) dan berpengaruh terhadap kuat geser tanah (*shear strength*). Oleh karena itu, dalam melakukan tinjauan analisis mekanisme tanah longsor, harus dipertimbangkan kondisi lereng yang merupakan suatu sistem menyeluruh dari kondisi tanah tidak jenuh air sampai dengan jenuh air.

Abramson, dkk. (1996), menyatakan ada dua parameter bebas yang berpengaruh terhadap tegangan dalam tanah dengan kondisi tidak jenuh air (ruang pori tanah sebagian terisi udara dan sebagian air), yaitu tegangan netto dan *matrix suction*. Pada kondisi tanah jenuh air, maka seluruh ruang pori tanah terisi air, tegangan air pori akan sama dengan tegangan udara pori sehingga *matrix suction* diabaikan ($= 0$). Oleh karena itu, parameter tegangan dalam tanah menjadi tegangan efektif. Tampak pengaruh air terutama air hujan yang berinfiltrasi ke dalam tanah, menimbulkan perubahan pada kedua parameter ini dan memberikan pengaruh terhadap tegangan geser serta volume tanah yang merubah sifat-sifat tanah.

Keruntuhan lereng dapat terjadi karena berkurang atau menurunnya kemampuan kuat geser tanah (*shear strength*) secara perlahan-lahan maupun mendadak atau perubahan kondisi geometri lereng akibat galian misalnya,

sehingga lereng menjadi curam. Parameter penting yang dibutuhkan dalam analisis stabilitas lereng adalah berat unit tanah, kohesi, sudut gesek dalam, geometri lereng, tegangan air pori atau gaya rembesan, dan beban serta kondisi lingkungan sekitar lereng. Konsep stabilitas lereng menggunakan metode analisis dalam memprediksi kestabilan lereng tanah untuk dua dimensi telah banyak dikembangkan oleh ahli-ahli geoteknik. Umumnya untuk menyatakan lereng dalam kondisi stabil dinyatakan dengan angka aman (*safety factor*) yang merupakan rasio antara momen yang melawan terjadinya longsor dan momen yang melongsorkan.

Perkembangan metode batas keseimbangan yang didasarkan pada keseimbangan plastis terhadap bidang-bidang runtuh cobaan di mulai di Swedia pada tahun 1916, disusul dengan runtuhnya sejumlah dinding dermaga pada pelabuhan Gothenburg. Setelah beberapa tahun kemudian analisis lingkaran gesekan digunakan dengan sukses dalam memprediksi stabilitas lereng, dan metode irisan diperkenalkan (Fellenius, 1936). Konsep tekanan air pori dan metode analisis tagangan efektif telah diperkenalkan juga oleh Terzaghi (1936). Pengukuran kekuatan tanah yang diperbaiki dihasilkan dari teknik pengambilan sampel yang lebih baik, perkembangan pengujian geser triaksial, dan pengukuran tekanan pori.

Konsep stabilitas lereng adalah menggunakan metode keseimbangan batas (*limit equilibrium*) dengan lereng yang diperkirakan akan runtuh dibagi-bagi menjadi beberapa pias. Metode tersebut antara lain : *Ordinary Method of Slice* (OMS) dikembangkan oleh Fellenius (1927, 1936). Dalam analisisnya Fellenius

mengabaikan keseimbangan gaya di kedua sisi pias dan massa tanah yang diperkirakan akan runtuh sebagai satu kesatuan. Metode ini merupakan metode dengan prosedur paling sederhana serta sebagai dasar semua metode selanjutnya. Bishop *simplified* (1955) meniadakan semua gaya geser antar-pias, namun keseimbangan gaya horisontal diperhitungkan secara keseluruhan. Janbu (1957, 1973) dengan anggapan seperti metode Bishop *simplified* namun tidak meninjau keseimbangan momen. Lowe dan Karafiath (1960) menganggap gaya-gaya antar-pias membentuk sudut sebesar rerata sudut alas dan atas pias.

Corps of Engineers (1982) beranggapan bahwa kemiringan gaya-gaya antar-pias sama dengan kemiringan lereng atau sama dengan rerata sudut kemiringan ujung-ujung permukaan bidang runtuh. Spencer (1967, 1973) dalam Winterkorn dan Fang, 1975, beranggapan besarnya gaya-gaya antar pias adalah sama, namun tidak diketahui arahnya. Sarma (1973), dan Morgenstern & Price (1965) dalam Winterkorn dan Fang (1975), menggunakan fungsi distribusi gaya antar-pias. Fredlund (1977) cenderung meninjau kondisi lereng sebagai suatu lapisan tanah yang tidak jenuh air (*unsaturated*), sedang metode lainnya dengan anggapan tanah dalam kondisi jenuh air (*saturated*) atau kondisi kering. Dua metode yaitu Fellenius dan Bishop hanya dapat digunakan apabila bentuk bidang gelincir berbentuk tampang lingkaran, sedangkan bentuk bidang gelincir yang tidak berbentuk lingkaran menggunakan metode Janbu, *Corps of Engineers*, Lowe dan Karafiath. Analisis stabilitas lereng untuk lereng tidak jenuh air menggunakan metode Fredlund, namun untuk mengetahui metode mana yang paling cocok, digunakan metode GLE (*General Limit Equilibrium*) yang berdasarkan pada

keseimbangan gaya dan keseimbangan momen. Cara analisis ini baru dapat dilakukan, apabila sudah didapatkan parameter-parameter tanah dari hasil uji geoteknik di lapangan maupun di laboratorium. Dalam melakukan uji lapangan perlu dilakukan secara teliti untuk mendapatkan data yang akurat, dan mewakili seluruh daerah yang diuji. Berbagai uji lapangan dapat digunakan untuk mendapatkan letak bidang gelincir antara lain dengan alat uji penetrasi statis (Suryolelono, 1996) atau dinamis, dan selanjutnya diambil sampelnya untuk uji laboratorium guna mendapatkan parameter tanah.



BAB III

DASAR TEORI

3.1 Air Tanah

Air tanah didefinisikan sebagai air yang terdapat di bawah permukaan bumi, salah satu sumber utamanya adalah air hujan yang meresap ke bawah lewat ruang pori diantara butiran tanah. Air sangat berpengaruh pada sifat-sifat teknis tanah, khususnya tanah berbutir halus. Air merupakan faktor yang sangat penting dalam masalah-masalah teknis yang berhubungan dengan tanah seperti: penurunan, stabilitas pondasi, stabilitas lereng, dan lain-lain. (Christady, 2002)

Abramson (1985), mengemukakan air mempengaruhi stabilitas lereng dengan cara:

1. meningkatkan tekanan pori tanah, yang mengubah kondisi tegangan dalam tanah.
2. mengubah kepadatan dari struktur material pembentuk lereng.
3. menyebabkan terjadinya erosi di permukaan tanah dan di dalam tanah.
4. mengubah unsur-unsur mineral dan material pembentuk lereng.
5. menyebabkan menurunnya kekuatan geser tanah. Tanah yang telah jenuh air, friksinya akan turun dan akan menyebabkan rusaknya kapilaritas dan kohesi tanah.

Pengaruh hujan sangat penting dalam stabilitas suatu lereng, karena air hujan yang turun dan jatuh ke permukaan tanah akan menyebabkan perubahan

kondisi dalam tanah seperti yang telah dijelaskan di atas, sehingga suatu kelongsoran sebagian besar selalu dipicu oleh hujan.

Air tanah berasal dari banyak sumber, tapi yang utama berasal dari air hujan. Sebagian air hujan itu meresap ke dasar tanah, sedang sebagian lagi mengalir di permukaan sebagai aliran permukaan (*run-off*). Air tanah yang berada pada zona jenuh mengalir ke arah sungai, danau, laut, dimana air tersebut dapat menguap dan kembali lagi ke bumi sebagai air hujan. Luasnya area resapan air hujan yang mengurangi stabilitas lereng bergantung pada sejumlah faktor, seperti posisi asli air tanah, intensitas dan lamanya hujan turun, daerah tangkapan air hujan, geologi, derajat kejenuhan, dan topografi, Abramson (1985).

3.1.1 Tekanan Kapiler

Tekanan kapiler dapat timbul karena adanya tarikan lapisan tipis di permukaan air. Kejadian ini disebabkan oleh adanya pertemuan antara dua jenis material yang berbeda sifatnya. Pada prinsipnya, tarikan permukaan disebabkan perbedaan gaya tarik antara molekul-molekul pada bidang singgung pertemuan dua material yang berbeda sifatnya.

Akibat tekanan kapiler, air tanah tertarik keatas melebihi permukaan air tanah. Pori pori tanah sebenarnya bukan sistem pipa kapiler tapi teori kapiler dapat diterapkan untuk mempelajari perilaku air tanah pada zona kapiler. Air dalam pipa kapiler dapat dianggap bertekanan negatif, yaitu mempunyai tekanan dibawah tekanan atmosfer. Pengaruh tekanan kapiler pada tanah adalah menambah

tegangan efektif. Jika tekanan kapiler membesar maka tegangan kontak diantara partikel juga membesar. Akibatnya kuat geser tanah bertambah (Christady, 2002).

3.1.2 Permeabilitas

Permeabilitas didefinisikan sebagai sifat bahan berpori yang memungkinkan aliran rembesan dari cairan yang berupa air atau minyak mengalir lewat rongga pori. Pori-pori tanah saling berhubungan antara satu dengan lainnya, sehingga air dapat mengalir dari titik dengan energi tinggi ketitik dengan energi rendah. Untuk tanah, permeabilitas didefinisikan sebagai sifat tanah yang mengalirkan air melalui rongga pori tanah.

Di dalam tanah, sifat aliran mungkin laminar atau turbulen. Tahanan terhadap aliran bergantung pada jenis tanah, ukuran butiran, bentuk butiran, rapat massa, dan bentuk geometri rongga pori. Tanah yang mempunyai kemampuan meloloskan air disebut tanah yang *permeable* sedangkan tanah disebut kedap air atau *impermeable* bila tanah tersebut mempunyai kemampuan meloloskan air yang sangat kecil (Christady, 2002).

3.2 Tegangan Efektif

Bila tanah mengalami tekanan yang diakibatkan oleh beban, maka angka pori tanah akan berkurang. Selain itu, tekanan akibat beban juga dapat mengakibatkan perubahan-perubahan sifat mekanik tanah yang lain seperti menambah tahanan geser tanah. Jika tanah berada di dalam air, tanah dipengaruhi oleh gaya angkat ke atas sebagai akibat tekanan tanah hidrostatik. Berat tanah

yang terendam ini, disebut berat tanah efektif, sedangkan tegangan yang terjadi akibat berat tanah efektif di dalam tanah disebut tegangan efektif. Tegangan efektif merupakan tegangan yang mempengaruhi kuat geser dan perubahan volume atau penurunan tanah (Christady, 2002).

Segumpal tanah terdiri dari butiran padat dan ruang pori yang dapat berisi air ataupun udara. Bila tanah jenuh sempurna, ruang pori terisi penuh dengan air. Besar bidang kontak antarbutiran bergantung bentuk dan susunan butiran. Tegangan yang terjadi pada bidang kontak antarbutiran akan dipengaruhi oleh tekanan air pori. Untuk hitungan tegangan yang terjadi dalam tanah, dalam prakteknya butiran tanah dan air dianggap tidak mudah mampat, sebaliknya udara mudah sekali mampat (kompresibel). Sifat mudah mampat tanah bergantung pada susunan butiran padat. Dalam tanah yang jenuh, karena air dianggap tidak mudah mampat, pengurangan volume hanya terjadi kalau sejumlah air meninggalkan ruang pori. Untuk tanah kering atau jenuh sebagian, pengurangan volume biasanya akibat dari berkurangnya udara yang terdesak keluar dari ruang pori yang dapat mengakibatkan perubahan susunan butiran. Volume tanah secara keseluruhan dapat berubah akibat adanya perubahan susunan yang lama ke susunan yang baru. Perubahan dapat terjadi dengan cara menggeser atau menggelinding. Dengan demikian terjadi pula perubahan gaya-gaya yang bekerja di antara butiran (Christady, 2002).

Tegangan geser hanya dapat ditahan oleh butiran-butiran tanah, yaitu oleh gaya-gaya yang berkembang pada bidang singgung antarbutiran.

Terzaghi (1923), memberikan prinsip tegangan efektif yang bekerja pada segumpal tanah. Prinsip tegangan efektif hanya berlaku pada tanah yang jenuh sempurna, yaitu:

1. Tegangan normal total (σ) pada suatu bidang di dalam massa tanah, yaitu tegangan akibat berat tanah total termasuk air dalam ruang pori per satuan luas yang arahnya tegak lurus.
2. Tekanan pori (u), disebut juga dengan tekanan netral yang bekerja ke segala arah sama besar, yaitu tekanan air yang mengisi rongga di antara butiran padat.
3. Tegangan normal efektif (σ') pada suatu bidang di dalam massa tanah, yaitu tegangan yang dihasilkan dari beban berat butiran.

Hubungan dari ketiganya adalah:

$$\sigma = \sigma' + u \quad (3.1)$$

3.3 Kuat Geser Tanah

Kekuatan geser suatu tanah merupakan perlawanan internal tanah tersebut per satuan luas terhadap keruntuhan atau pergeseran sepanjang bidang geser dalam tanah yang dimaksud. Parameter kuat geser tanah diperlukan untuk analisis-analisis kapasitas daya dukung tanah, stabilitas lereng, dan gaya dorong pada dinding penahan tanah. Menurut teori Mohr (1910), kondisi keruntuhan suatu bahan terjadi akibat adanya kombinasi keadaan kritis dari tegangan normal dan tegangan geser pada bidang runtuhnya, dinyatakan oleh persamaan:

$$\tau = f(\sigma) \quad (3.2)$$

dengan τ adalah tegangan geser pada saat terjadinya keruntuhan atau kegagalan (*failure*), dan σ adalah tegangan normal pada saat kondisi tersebut.

Kuat geser tanah adalah gaya perlawanan yang dilakukan oleh butir-butir tanah terhadap desakan atau tarikan. Dengan dasar pengertian ini, bila tanah mengalami pembebanan akan ditahan oleh:

1. Kohesi tanah yang bergantung pada jenis tanah dan kepadatannya, tetapi tidak bergantung pada tegangan normal yang bekerja pada bidang geser.
2. Gesekan antara butir-butir tanah yang besarnya berbanding lurus dengan tegangan normal pada bidang gesernya.

Coulomb (1776) mendefinisikan $f(\sigma)$ sebagai:

$$\tau = c + \sigma \operatorname{tg} \varphi \quad (3.3)$$

dengan:

τ = kuat geser tanah (kN/m^2)

c = kohesi tanah (kN/m^2)

φ = sudut gesek dalam tanah (derajat)

σ = tegangan normal pada bidang runtuh (kN/m^2)

Persamaan 3.3 ini disebut kriteria keruntuhan Mohr-Coulomb. Tegangan-tegangan efektif yang terjadi di dalam tanah sangat dipengaruhi oleh tekanan air pori. Terzaghi (1925) mengubah persamaan Coulomb dalam bentuk tegangan efektif sebagai berikut:

$$\tau = c' + (\sigma - u) \operatorname{tg} \varphi' \quad (3.4)$$

$$\tau = c' + \sigma' \operatorname{tg} \varphi'$$

dengan:

$c' =$ kohesi tanah efektif (kN/m^2)

$\sigma' =$ tegangan normal efektif (kN/m^2)

$u =$ tekanan air pori (kN/m^2)

$\phi' =$ sudut gesek dalam tanah efektif (derajat)

Persamaan 3.4 menghasilkan data untuk nilai c' dan ϕ' yang relatif lebih tepat.

3.4 Tegangan yang Diakibatkan oleh Beban Terpusat

Boussinesq (1883) telah memecahkan masalah yang berhubungan dengan penentuan tegangan-tegangan pada sembarang titik pada sebuah medium yang homogen, elastis, dan isotropis di mana medium tersebut adalah berupa ruang yang luas tak terhingga dan pada permukaannya bekerja sebuah beban terpusat (beban titik). Menurut gambar 6.6, rumus Boussinesq untuk tegangan normal pada titik A yang diakibatkan oleh beban terpusat P adalah:

$$\Delta P_x = \frac{P}{2\pi} \left\{ \frac{3x^2z}{L^3} - (1-2\mu) \left[\frac{x^2-y^2}{Lr^2(L+z)} + \frac{y^2z}{L^3r^2} \right] \right\} \quad (3.5)$$

$$\Delta P_y = \frac{P}{2\pi} \left\{ \frac{3y^2z}{L^3} - (1-2\mu) \left[\frac{y^2-x^2}{Lr^2(L+z)} + \frac{x^2z}{L^3r^2} \right] \right\} \quad (3.6)$$

dan

$$\Delta p_z = \frac{3P}{2\pi} \frac{z^3}{L^5} = \frac{3P}{2\pi} \frac{z^3}{(r^2 + z^2)^{\frac{5}{2}}} \quad (3.7)$$

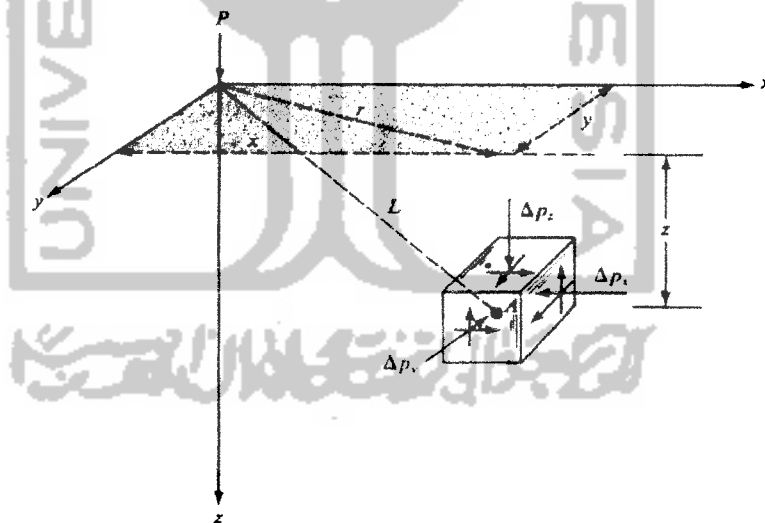
dengan:

$$r = \sqrt{x^2 + y^2}$$

$$L = \sqrt{x^2 + y^2 + z^2} = \sqrt{r^2 + z^2}$$

μ = angka poisson

Harus diingat bahwa persamaan-persamaan (3.5) dan (3.6), yang merupakan tegangan-tegangan normal dalam arah horizontal, adalah tergantung pada angka Poisson mediumnya. Angka Poisson menunjukkan rasio antara regangan lateral terhadap regangan vertical, yang merupakan suatu konstanta untuk material-material yang berada dalam batas-batas proporsional. Tegangan arah vertical, Δp_z , seperti pada persamaan (3.7) tidak tergantung pada angka Poisson. Hubungan untuk Δp_z di atas kemudian dapat dituliskan lagi dalam bentuk sebagai berikut.



Gambar 3.1 Tegangan-tegangan dalam tanah yang disebabkan oleh beban terpusat (Boussinesq, 1883)

$$\Delta p_z = \frac{P}{z^2} \left\{ \frac{3}{2\pi} \frac{1}{[(r/z)^2 + 1]^{\frac{5}{2}}} \right\} = \frac{P}{z^2} I_1 \quad (3.8)$$

$$\text{dimana } I_1 = \frac{3}{2\pi} \frac{1}{[(r/z)^2 + 1]^{\frac{5}{2}}}$$

3.5 Angka Keamanan (*Safety Factor*)

Das (1985), mendefinisikan angka keamanan sebagai perbandingan antara kekuatan geser rata-rata tanah dengan tegangan geser rata-rata tanah yang bekerja sepanjang bidang longsor .

$$Fs = \frac{\tau_f}{\tau_d} \quad (3.9)$$

dengan : Fs = angka keamanan

τ_f = kekuatan geser rata-rata tanah

τ_d = tegangan geser rata-rata yang bekerja sepanjang bidang longsor

Kekuatan geser tanah terdiri dari dua komponen, yaitu kohesi dan geseran, dan dapat kita tuliskan sebagai berikut:

$$\tau_f = c + \sigma \tan \phi \quad (3.10)$$

dengan:

c = kohesi

ϕ = sudut geser tanah

σ = tegangan normal rata-rata pada permukaan bidang longsor

dengan cara yang sama kita dapat menuliskan:

$$\tau_d = c_d + \sigma \tan \phi_d \quad (3.11)$$

dengan c_d adalah kohesi dan ϕ_d sudut geser yang bekerja sepanjang bidang longsor. Dengan memasukkan persamaan (3.6) dan (3.7) kedalam persamaan (3.5) kita dapatkan:

$$F_s = \frac{c + \sigma \tan \phi}{c_d + \sigma \tan \phi_d} \quad (3.12)$$

Sekarang kita dapat memperkenalkan aspek-aspek lain dari angka keamanan tadi, yaitu angka keamanan terhadap kohesi F_c , dan angka keamanan terhadap sudut geser, F_ϕ . Dengan demikian, F_c dan F_ϕ dapat kita definisikan:

$$F_c = \frac{c}{c_d} \quad (3.13)$$

dan

$$F_\phi = \frac{\tan \phi}{\tan \phi_d} \quad (3.14)$$

Jika persamaan (3.8), (3.9), dan (3.10) dibandingkan, adalah wajar bila F_c menjadi sama dengan F_ϕ , harga tersebut memberikan angka keamanan terhadap kekuatan tanah atau bila

$$\frac{c}{c_d} = \frac{\tan \phi}{\tan \phi_d} \quad (3.15)$$

Kita dapat menuliskan:

$$F_s = F_c = F_\phi \quad (3.16)$$

$F_s = 1$, maka lereng dalam keadaan akan longsor. Umumnya, harga 1,5 untuk angka keamanan terhadap kekuatan geser dapat diterima untuk merencanakan stabilitas lereng.

3.6 Metode Stabilitas Lereng

Analisis stabilitas lereng didasarkan pada konsep keseimbangan batas plastis (*limit plastis equilibrium*). Analisis stabilitas lereng ini digunakan untuk menentukan faktor aman dari bidang longsor yang potensial. Peristiwa kelongsoran diakibatkan oleh pergelinciran bagian tanah yang labil (*active zone*) terhadap bagian tanah yang stabil (*passive zone*), ini terjadi pada bidang longsor (*failure surface*) atau dengan kata lain kelongsoran disebabkan oleh gaya yang mendorong keruntuhan tanah (*sliding force*) lebih besar dari gaya yang menahannya (*resisting force*), sehingga peninjauan kelongsoran dilakukan pada dua komponen tersebut, yaitu apakah terjadinya longsor karena meningkatnya *sliding force* atau berkurangnya *resisting force* atau karena keduanya.

Peningkatan *sliding force* antara lain disebabkan oleh hujan yang tak kunjung reda yang menyebabkan kandungan air pada lereng meningkat, pori-pori tanah terisi air sehingga terjadi kenaikan berat unit tanah. Timbulnya *piping* (pipa-pipa dalam tanah oleh gerusan aliran air), akibat aliran air dalam tanah juga akan mempercepat *sliding force*.

Berkurangnya *resisting force* antara lain disebabkan sudut gesek tanah berkurang atau kohesi pada tanah berkurang. *Resisting force* secara alami terbentuk karena lekatan antar-partikel tanah (kohesi) dan tingkat kepadatan tanah, sedangkan tegangan air pori yang cukup tinggi akibat pembasahan menyebabkan turunnya kuat geser tanah (*shear strength*) yang berakibat kurangnya *resisting force*.

Dalam beberapa aplikasi, tujuan utama analisis stabilitas lereng adalah untuk memperoleh desain konstruksi-konstruksi tanah yang aman dan ekonomis (Abramson, 1985). Beberapa tujuan analisis stabilitas lereng adalah:

1. Memahami pembangunan dan pembentukan lereng alam dan lereng buatan.
2. Menganalisis stabilitas lereng untuk kondisi jangka pendek (biasanya selama kegiatan konstruksi) juga kondisi jangka panjang.
3. Untuk mengetahui kemungkinan keruntuhan lereng alam maupun buatan.
4. Menganalisis keruntuhan dan memahami mekanisme keruntuhannya serta pengaruhnya pada lingkungan sekitar.
5. Melakukan desain ulang terhadap lereng yang telah runtuh, termasuk merencanakan dan mendesain lereng dalam upaya tindakan pencegahan.
6. Mempelajari efek beban akibat gempa pada lereng dan tanggul.

3.6.1 Metode Irisan (*Method of Slice*)

Analisis stabilitas dengan menggunakan metode irisan, dapat dijelaskan dengan menggunakan Gambar 3.3a, dengan AC merupakan lengkungan lingkaran sebagai permukaan bidang longsor percobaan. Tanah yang berada di atas bidang longsor percobaan di bagi ke dalam beberapa *slice* tegak. Lebar tiap-tiap *slice* tidak harus sama. Perhatikan satu satuan tebal tegak lurus *slice* melintang talud seperti pada gambar; gaya-gaya yang bekerja pada *slice* tertentu (*slice no n*) ditunjukkan dalam gambar 3.3b. W_n adalah berat *slice*. Gaya gaya N_r dan T_r adalah komponen tegak dan sejajar dari reaksi R . P_n dan P_{n+1} adalah gaya normal yang bekerja pada sisi-sisi *slice*. Demikian juga gaya geser yang bekerja pada sisi

slice adalah T_n dan T_{n+1} . Untuk memudahkan, tegangan air pori dianggap sama dengan nol. Gaya P_n , P_{n+1} , T_n , dan T_{n+1} adalah sulit di tentukan. Tetapi kita dapat membuat asumsi perkiraan bahwa resultan P_n dan T_n adalah sama besar dengan resultan P_{n+1} dan T_{n+1} dan juga garis-garis kerjanya segaris

Untuk pengamatan keseimbangan

$$N_r = W_n \cos \alpha_n$$

Gaya geser perlawanan dapat dinyatakan sebagai berikut:

$$T_r = \tau_d (\Delta L_n) = \frac{\tau_f (\Delta L_n)}{F_s} = \frac{1}{F_s} [c + \sigma \tan \phi] \Delta L_n \quad (3.17)$$

Tegangan normal σ dalam persamaan di atas adalah sama dengan :

$$\frac{N_r}{\Delta L_n} = \frac{W_n \cos \alpha_n}{\Delta L_n}$$

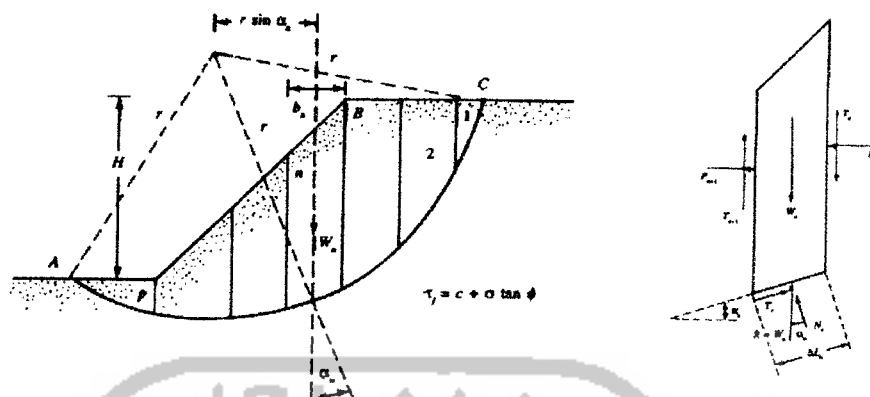
Untuk keseimbangan blok ABC, momen gaya dorong terhadap titik O adalah sama dengan momen gaya perlawanan terhadap titik O, atau

$$\sum_{n=1}^{n=p} W_n r \sin \alpha_n = \sum_{n=1}^{n=p} \frac{1}{F_s} \left[c + \frac{W_n \cos \alpha_n}{\Delta L_n} \tan \phi \right] (\Delta L_n) (r)$$

atau

$$F_s = \frac{\sum_{n=1}^{n=p} (c \Delta L_n + W_n \cos \alpha_n \cdot \tan \phi)}{\sum_{n=1}^{n=p} W_n \sin \alpha_n} \quad (3.18)$$

catatan: ΔL_n dalam persamaan (3.14) diperkirakan sama dengan $\frac{(b_n)}{\cos \alpha_n}$ dengan b_n = lebar potongan nomor n.



Gambar 3.2 Analisis stabilitas dengan metode irisan biasa. (a) permukaan bidang yang dicoba. (b) gaya yang bekerja pada slice nomor n (Das, 1985).

Perhatikan bahwa harga α_n bisa negatif atau positif. harga α_n adalah positif bila talud bidang longsor yang merupakan sisi bawah dari slice, berada pada kwadran yang sama dengan talud muka tanah yang merupakan sisi atas dari slice. Untuk mendapatkan angka keamanan yang minimum yaitu angka keamanan lingkaran kritis beberapa percobaan dibuat dengan cara mengubah letak pusat lingkaran yang dicoba. Metode ini umumnya dikenal sebagai “Metode irisan yang sederhana (*ordinary method of slices*)”.

Untuk mudahnya, suatu talud dalam tanah yang homogen ditunjukkan dalam gambar 3.3a. Akan tetapi, metode irisan dapat dikembangkan untuk talud dalam tanah berlapis seperti ditunjukkan dalam gambar 3.4. Prosedur umum dari analisis stabilitas adalah sama. Tetapi, ada beberapa hal yang perlu diingat. Selama menggunakan persamaan 3-2 untuk menghitung angka keamanan, harga-harga ϕ dan c tidak akan sama untuk semua potongan. Sebagai contoh, untuk potongan no.3 (gambar 3.4) kita harus menggunakan sudut geser $\phi = \phi_3$ dan kohesi $c = c_3$; dan serupa untuk potongan no.2, $\phi = \phi_2$ dan $c = c_2$.

Gambar 3.5b menunjukkan poligon gaya untuk keseimbangan dari *slice* nomor n .
Jumlahkan gaya dalam arah vertikal.

$$W_n + \Delta T = N_r \cos \alpha_n + \left[\frac{N_r \tan \phi}{F_s} + \frac{c \Delta L_s}{F_s} \right] \sin \alpha_n$$

atau

$$N_r = \frac{W_n + \Delta T - \frac{c \Delta L_n}{F_s} \sin \alpha_n}{\cos \alpha_n + \frac{\tan \phi \sin \alpha_n}{F_s}} \quad (3.20)$$

Untuk keseimbangan blok ABC (gambar 3.3a) ambil momen terhadap O

$$\sum_{n=1}^{n=p} W_n r \sin \alpha_n = \sum_{n=1}^{n=p} T_r r \quad (3.21)$$

dengan

$$\begin{aligned} T_r &= \frac{1}{F_s} (c + \sigma \tan \phi) \Delta L_n \\ &= \frac{1}{F_s} (c \Delta L_n + N_r \tan \phi) \end{aligned} \quad (3.22)$$

Dengan memasukkan persamaan (3.20) dan (3.22) ke dalam persamaan (3.21),
didapatkan

$$F_s = \frac{\sum_{n=1}^{n=p} (c b_n + W_n \tan \phi + \Delta T \tan \phi)}{\sum_{n=1}^{n=p} W_n \sin \alpha_n} \frac{1}{m_{\alpha(n)}} \quad (3.23)$$

dengan

$$m_{\alpha(n)} = \cos \alpha_n + \frac{\tan \phi \sin \alpha_n}{F_s} \quad (3.24)$$

untuk penyederhanaan, bila kita mengumpamakan $\Delta T = 0$ maka persamaan (3.23) berubah menjadi:

$$F_s = \frac{\sum_{n=1}^{n=p} (cb_n + W_n \tan \phi) \frac{1}{m_{\alpha(n)}}}{\sum_{n=1}^{n=p} W_n \sin \alpha_n} \quad (3.25)$$

Seperti pada metode irisan sederhana, beberapa bidang longsor harus diselidiki untuk mendapatkan bidang longsor yang paling kritis yang akan memberikan angka keamanan minimum.

Metode Bishop yang disederhanakan ini mungkin merupakan metode yang paling banyak digunakan bila kita menerapkannya dengan program komputer, maka metode ini akan memberikan hasil yang memuaskan dalam banyak masalah.

Terdapat sejumlah variasi-variasi program komputer dari metode stabilisasi lereng Bishop yang disederhanakan. Semua metode tersebut didasarkan pada keseimbangan batas plastis atau keadaan kritis dengan memakai gaya-gaya atau momen-momen. Metode ini harus dapat memenuhi keseimbangan gaya dan momen, tetapi ini tidaklah mungkin kecuali dengan membuat beberapa asumsi untuk mengurangi jumlah bilangan-bilangan yang tidak diketahui, sehingga beberapa asumsi dari distribusi gaya atau titik kerja dari elemen gaya tadi harus dibuat. Oleh karena gaya-gaya pada bagian dalam suatu massa tanah yang hampir runtuh adalah merupakan keadaan yang sangat spekulatif. Terlihat bahwa analisis stabilitas lereng tidak sangat peka terhadap asumsi-asumsi yang dibuat hanya mendapat perbedaan-perbedaan 5-10% pada faktor keamanan.

Dalam analisis stabilitas lereng ini ada 2 hal yang perlu dicatat, yaitu:

1. Studi-studi perbandingan yang menyeluruh telah menunjukkan perbedaan SF yang kecil dari metode Bishop dibandingkan dengan metode lainnya. Dalam studi-studi ini, metode Bishop-lah yang paling umum digunakan.
2. Perbaikan dalam analisis stabilitas lereng akan diperoleh dari pemakaian nilai-nilai parameter kekuatan tanah yang lebih baik dan sesuai. Parameter-parameter tanah yang benar merupakan suatu hal yang penting dalam membuat suatu analisis lereng yang dapat dipertanggungjawabkan.



BAB IV

METODE PENELITIAN

4.1 Tinjauan Umum

Pada penelitian ini akan dicari pengaruh elevasi muka air tanah, kemiringan lereng, dan pembebanan terhadap stabilitas lereng yang diperkirakan menjadi faktor pemicu terjadinya bencana tanah longsor yang sering kali terjadi. Analisis dilakukan menggunakan software Geo-Slope, yaitu suatu program aplikasi geoteknik khususnya yang membahas tentang stabilitas lereng. Adapun input data yang diperlukan dalam program tersebut meliputi beberapa variabel spesifikasi kondisi tanah pada lereng yang diamati, seperti geometri lereng, berat unit tanah, sudut gesek dalam, kohesi, elevasi muka air tanah, sedangkan metode yang dipakai adalah Metode Bishop. Dari analisis tersebut, diharapkan dapat ditentukan kondisi mana yang menghasilkan faktor keamanan (*safety factor*) yang paling baik, sehingga pada perencanaan kekuatan stabilitas lereng dapat dijadikan sebagai bahan acuan untuk kondisi tanah dan nilai pembebanan tertentu. Adapun program kerja penelitian sesuai dengan bagan alir pada gambar 4.2.

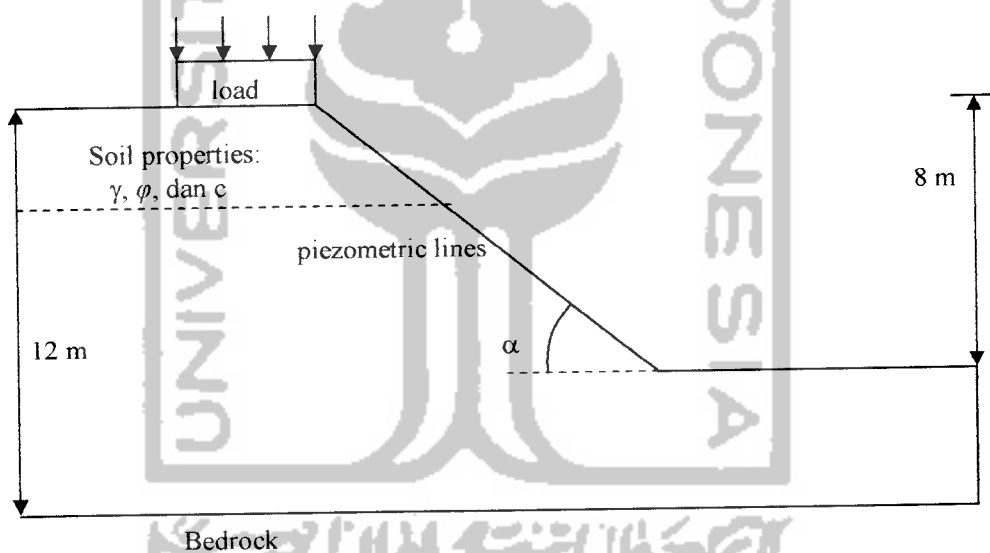
Geo-Slope merupakan software yang dipakai untuk menganalisis kestabilan lereng, termasuk didalamnya adalah menggunakan berbagai macam perkuatan, seperti geofabric dan angkur. Adapun hasil yang akan didapat adalah berupa grafik garis kelongsoran dan angka keamanan dari lereng tersebut, baik sebelum maupun setelah menggunakan perkuatan. Data parameter yang digunakan/diperlukan meliputi geometri tanah, muka air tanah, berat unit tanah, kohesi, sudut geser dalam elevasi muka air

tanah, dan sebagainya. Data-data yang ada harus dimasukkan sesuai dengan *flowchart Geo-Slope*, seperti pada gambar 4.3.

4.2 Pemodelan Lereng

Pemodelan yang dimaksud adalah penggunaan beberapa variasi elevasi muka air tanah, kemiringan lereng, dan perubahan beban pada puncak lereng untuk mencari hubungannya terhadap perubahan *slip surface* dengan bantuan program aplikasi geoslope.

Dalam pemodelan ini digunakan geometri lereng yang sama untuk setiap kasus untuk mengetahui perubahan yang signifikan untuk berbagai keadaan. Geometri lereng dapat dilihat pada gambar 4.1.



Gambar 4.1 Geometri lereng yang akan dianalisis

4.3 Teknik Penelitian

- 1) Untuk mengetahui pengaruh kenaikan/perubahan elevasi muka air tanah, dipakai:

$\gamma = 15 \text{ kN/m}^3$, $\phi = 30^\circ$, $c = 17 \text{ kPa}$, $\alpha = 50^\circ$, sedangkan variable elevasi muka air tanah adalah $h = 5\text{m}, 4\text{m}, 3\text{m}, \text{ dan } 2\text{m}$ dari puncak lereng.

2) Untuk mengetahui pengaruh kemiringan lereng, dipakai:

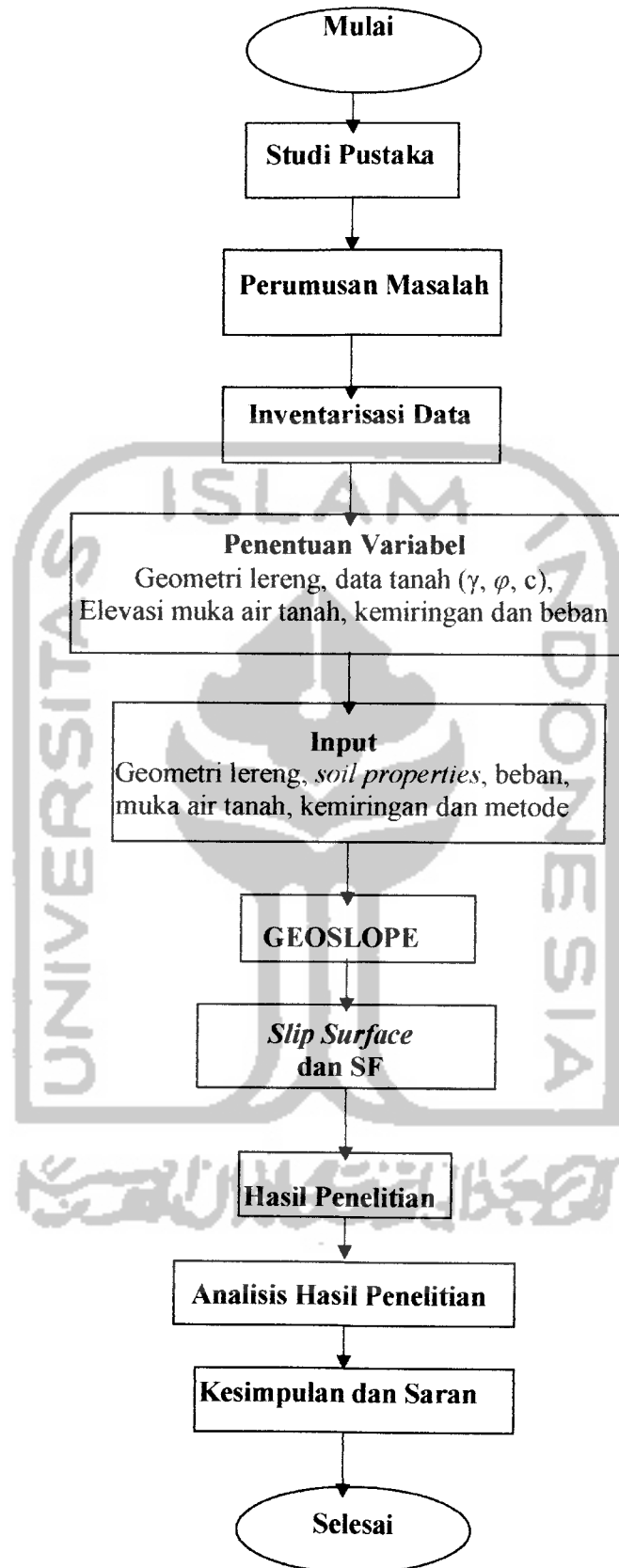
$\gamma = 15 \text{ kN/m}^3$, $\varphi = 30^\circ$, $c = 17 \text{ kPa}$, sedangkan variabel kemiringan lereng adalah $\alpha = 50^\circ, 60^\circ, 70^\circ$, dan 80°

3) Untuk mengetahui pengaruh pembebanan, dipakai:

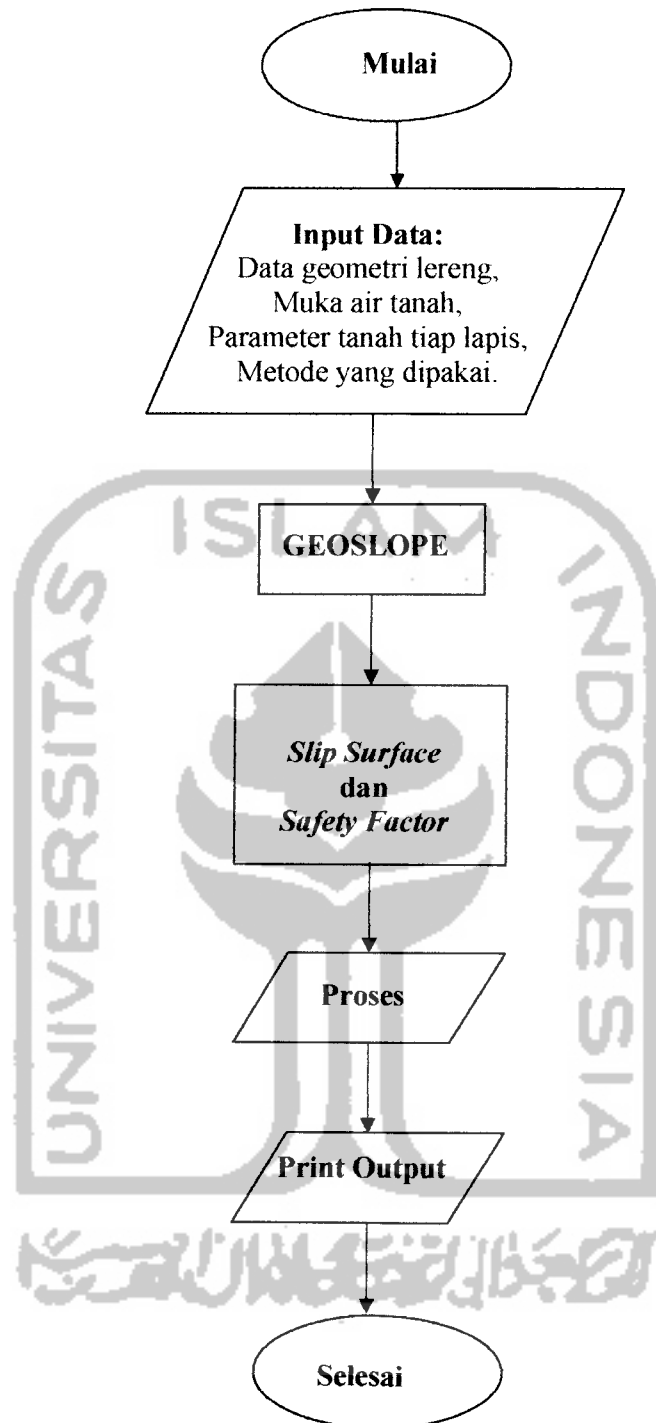
$\gamma = 15 \text{ kN/m}^3$, $\varphi = 30^\circ$, $c = 17 \text{ kPa}$, sedangkan variable jarak pembebanan adalah $L = 0,5\text{m}, 1,0\text{m}, 1,5\text{m}, 2\text{m}$.

Secara keseluruhan, penelitian yang dilakukan mengikuti prosedur seperti pada gambar 4.2 di bawah, sedangkan prosedur penelitian dengan menggunakan bantuan *software* geo-slope dapat dilihat pada gambar 4.3.





Gambar 4.2 Bagan Alir Penelitian



Gambar 4.3 Bagan Alir Geo-Slope

BAB V

HASIL PENELITIAN

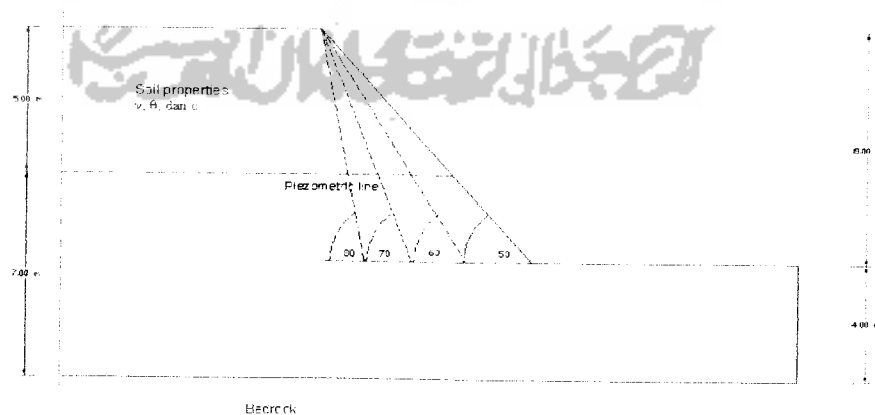
5.1 Tinjauan Umum

Berdasarkan pemodelan lereng yang dibuat oleh penulis untuk mengetahui kecenderungan perilaku kelongsoran lereng terhadap variasi geometri dan properti tanah yang terdiri dari kemiringan, elevasi muka air tanah, dan pembebanan, maka akan di peroleh suatu bidang longsor (*slip surface*) dan angka keamanan (*safety factor*).

Dalam analisis kelongsoran lereng ini dipakai metode Bishop dengan menggunakan program GEO SLOPE versi 5, dari Geo Slope Int.Ltd.

5.2 *Slip Surface* pada Lereng Akibat Pengaruh Kemiringan

Penelitian dilakukan dengan memasukkan data geometri lereng dan parameter-parameternya, seperti terlihat pada gambar 5.1 di bawah ini:



Gambar 5.1 Geometri lereng dengan variabel kemiringan

Untuk semua model dengan variabel kemiringan lereng, parameter tanah diambil sama. Tanah dianggap homogen dengan berat unit (γ) = 15 kN/m³, kohesi (c) = 17 kPa dan sudut gesek dalam 30°. Tinggi lereng dari tanah keras (*bedrock*) = 12 m, tinggi lereng dari kaki lereng (*toe slope*) = 8 m, kedalaman muka air tanah dari puncak lereng = 5 m (variabel tetap). Sedangkan kemiringan lereng sebagai variabel bebas diambil mulai dari sudut kemiringan 50°, 60°, 70°, 80°, terhadap empat model lereng yang akan diselidiki *slip surface* dan *safety factor*nya.

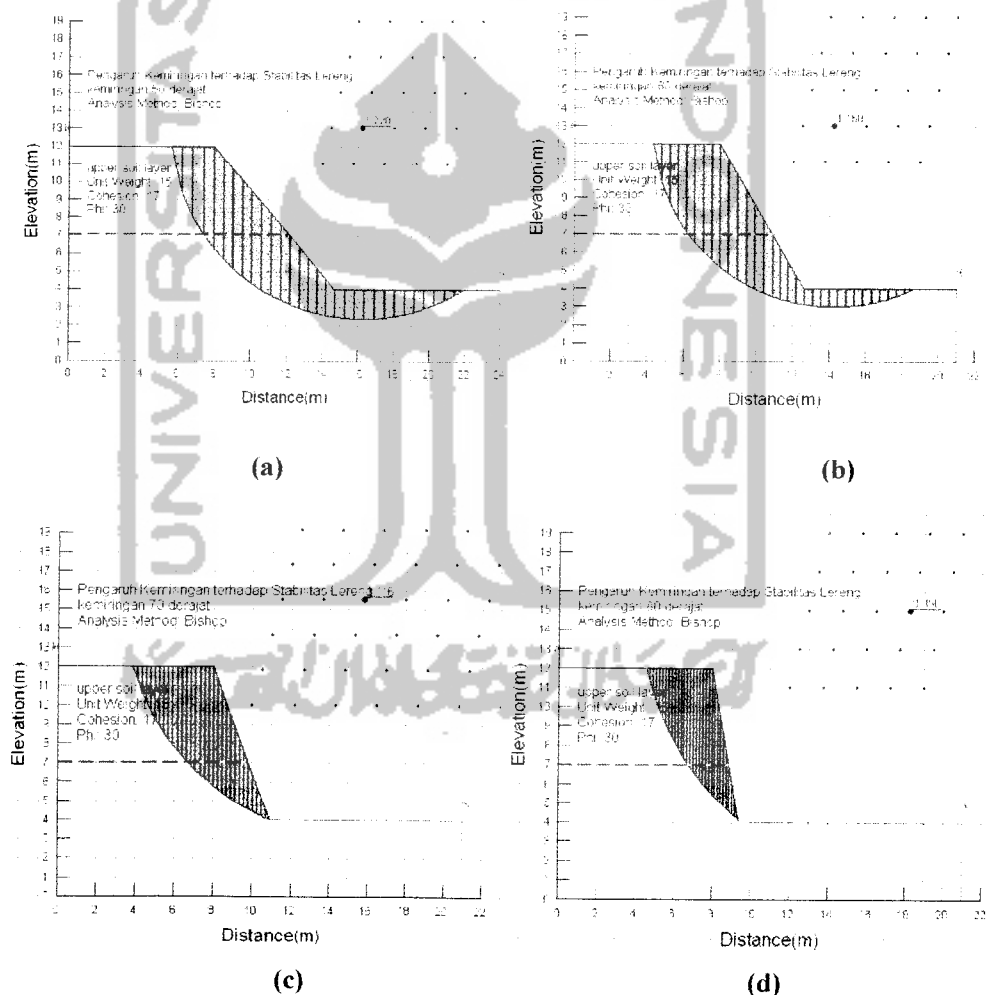
Setelah dimasukan data geometri dan parameter tanah termasuk kedalaman muka air tanah, maka dilakukan trial dengan membuat grid-grid yang diperkirakan sebagai pusat lingkaran bidang longsor terhadap radius lingkaran acuan. Pada penelitian ini diambil 25 titik pada grid sebagai pusat lingkaran bidang longsor terhadap empat radius lingkaran, dengan demikian masing-masing titik pusat lingkaran akan mentrial sebanyak empat kali, sehingga total untuk 25 titik pusat lingkaran adalah 100 kali trial. *Safety factor* minimum yang diperoleh harus berada di tengah grid sehingga *safety factor* minimum dapat dipertanggung jawabkan kebenarannya karena letak titik pusat lingkaran dengan SF sebenarnya berada disekitar titik pusat lingkaran yang di tampilkan oleh komputer dengan selisih yang sangat kecil. Sedangkan apabila diperoleh titik pusat lingkaran di bagian tepi grid, maka harus dilakukan pembuatan grid baru sehingga titik pusat lingkaran dapat berada di tengah-tengah grid.

Hasil dari trial tersebut berupa *slip surface* yang memiliki *safety factor* minimum. Untuk keempat pemodelan lereng yang dihitung angka keamanannya diperoleh hasil yang dapat dilihat pada tabel 5.1 sebagai berikut:

Tabel 5.1 Hubungan *safety factor* dengan kemiringan lereng

Kemiringan (deg)	<i>safety factor</i>
50	1.220
60	1.160
70	1.059
80	0.950

Perubahan *Slip Surface* akibat pengaruh kemiringan lereng dapat dilihat pada gambar 5.2.

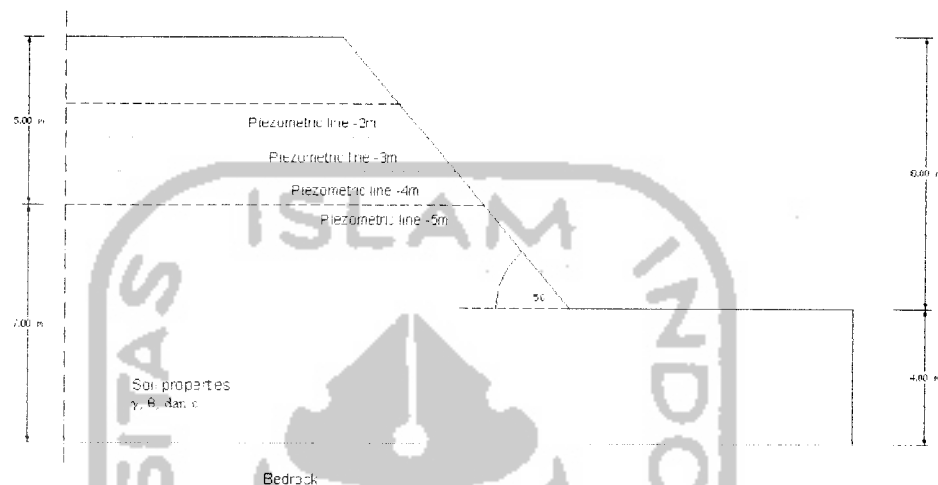


Gambar 5.2 Pengaruh perubahan kemiringan pada lereng; (a) sudut kemiringan 50° , (b) sudut kemiringan 60° , (c) sudut kemiringan 70° , (d) sudut kemiringan 80°



5.3 Slip Surface pada Lereng Akibat Pengaruh Elevasi Muka Air Tanah

Penelitian dilakukan dengan memasukkan data geometri lereng dan parameter-parameternya, seperti terlihat pada gambar 5.3 di bawah ini:



Gambar 5.3 Geometri lereng dengan variabel elevasi muka air tanah

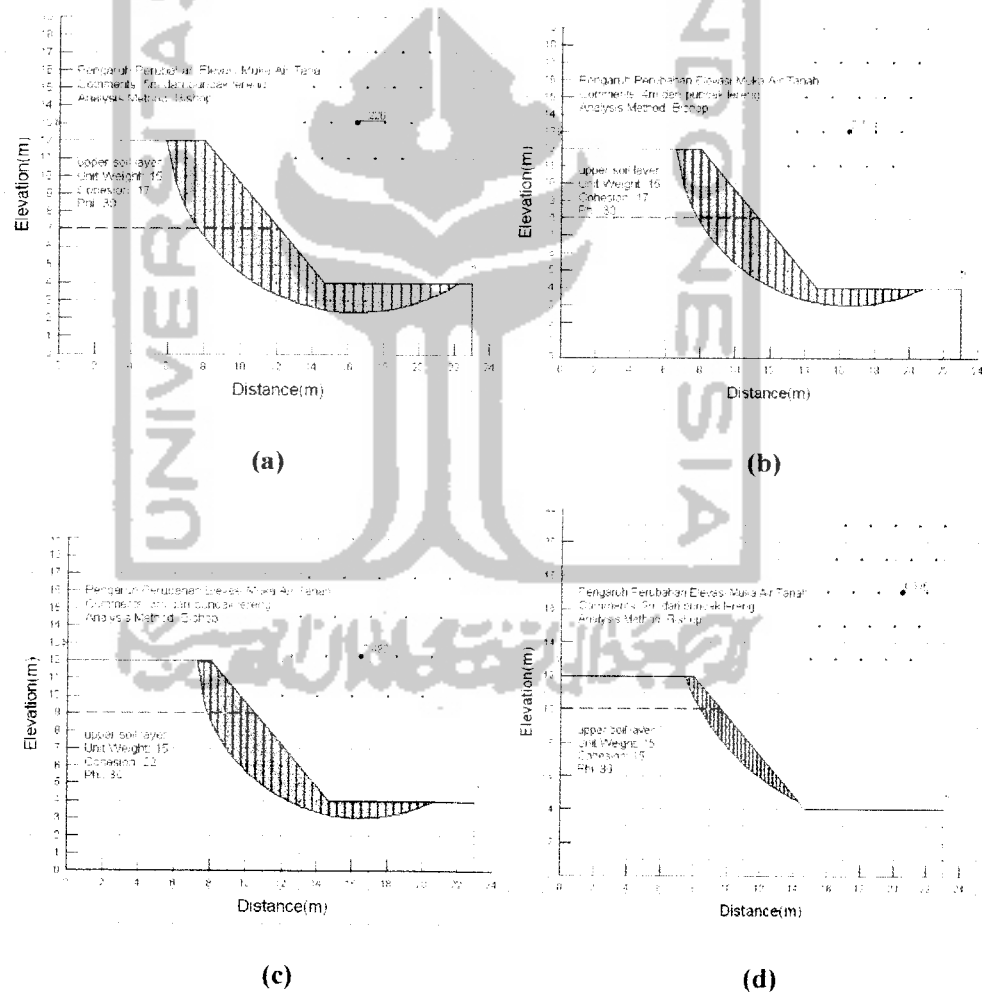
Untuk semua model dengan variabel elevasi muka air tanah, parameter tanah diambil sama. Tanah dianggap homogen dengan berat unit (γ) = 15 kN/m³, kohesi (c) = 17 kPa dan sudut gesek dalam 30°. Tinggi lereng dari tanah keras (*bedrock*) = 12 m, tinggi lereng dari kaki lereng (*toe slope*) = 8 m, kemiringan lereng = 50° (variabel tetap). Sedangkan elevasi muka air tanah sebagai variabel bebas diambil mulai dari kedalaman, 5m, 4m, 3m, 2m, dari puncak lereng.

Prinsip perhitungan untuk lereng dengan variabel elevasi muka air tanah sama dengan prinsip perhitungan sebelumnya. Hasil dari penghitungan tersebut berupa *slip surface* yang memiliki *safety factor* minimum. Untuk keempat pemodelan lereng yang dihitung angka keamananya diperoleh hasil yang dapat dilihat pada tabel 5.2 sebagai berikut :

Tabel 5.2 Hubungan *safety factor* dengan elevasi muka air tanah

muka air tanah (m)	<i>safety factor</i>
-5	1.226
-4	0.713
-3	0.490
-2	0.396

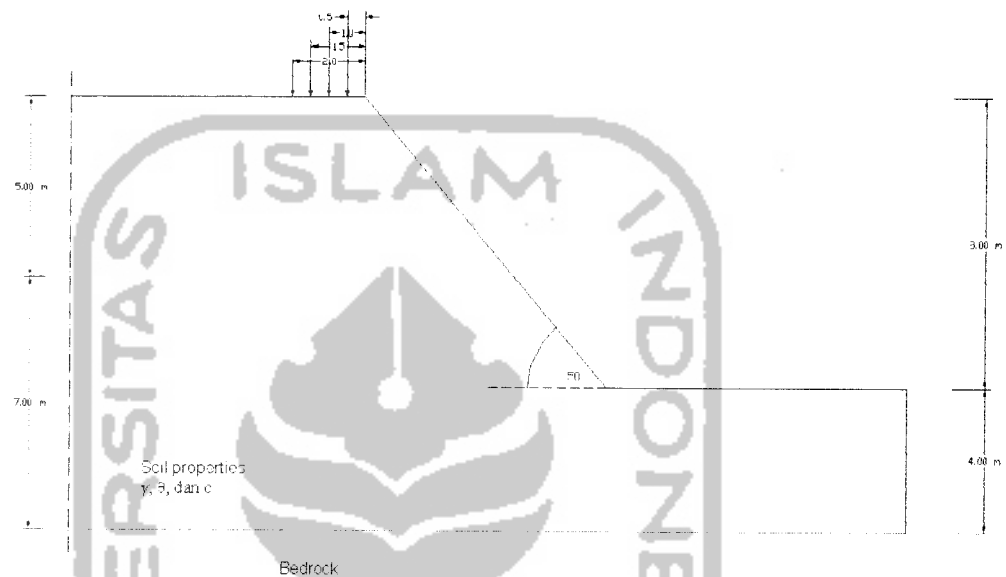
Sedangkan perubahan *Slip Surface* akibat pengaruh elevasi muka air tanah dapat dilihat pada gambar 5.4.



Gambar 5.4 Perubahan panjang *slip surface* akibat perubahan elevasi muka air tanah; (a) -5 m, (b) -4 m, (c) -3 m, (d) -2 m

5.4 *Slip Surface* pada Lereng Akibat Pengaruh Jarak Pembebanan pada Lereng

Penelitian dilakukan dengan memasukkan data geometri lereng dan parameter-parameternya, seperti terlihat pada gambar 5.5 di bawah ini:



Gambar 5.5 Geometri lereng dengan variabel beban

Untuk semua model dengan variabel beban, parameter tanah diambil sama. Tanah dianggap homogen dengan berat unit (γ) = 15 kN/m³, kohesi (c) = 17 kPa dan sudut gesek dalam 30°. Tinggi lereng dari tanah keras (*bedrock*) = 12 m, tinggi lereng dari kaki lereng (*toe slope*) = 8 m. Kemiringan lereng = 50° dan elevasi muka air = 5m dari puncak lereng. Sedangkan jarak beban sebagai variabel bebas diambil mulai dari jarak 0,5 m; 1,0 m; 1,5 m dan 2,0 m dari tebing lereng.

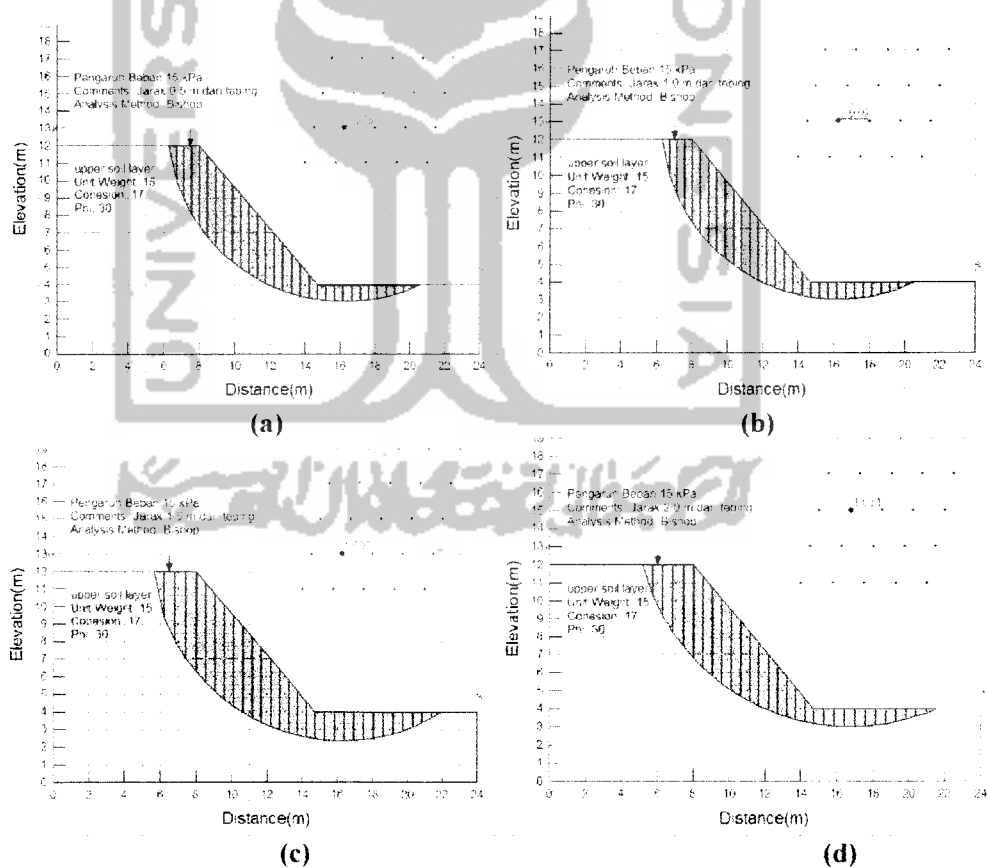
Prinsip perhitungan stabilisasi lereng dengan variabel beban sama dengan prinsip perhitungan stabilisasi lereng dengan variabel kemiringan dan elevasi

muka air tanah. Hasil dari penghitungan tersebut berupa *slip surface* yang memiliki *safety factor* minimum. Untuk keempat pemodelan lereng yang dihitung angka keamanannya diperoleh hasil yang dapat dilihat pada tabel 5.3 sebagai berikut

Tabel 5.3 Hubungan *safety factor* dengan posisi beban

Posisi beban (m)	<i>safety factor</i>
0.5	0.978
1.0	0.976
1.5	1.005
2.0	1.031

Perubahan *Slip Surface* akibat pengaruh pembebanan pada puncak lereng dapat dilihat pada gambar 5.6.



Gambar 5.6 Perubahan panjang *slip surface* akibat perubahan posisi beban pada puncak lereng

BAB VI

ANALISIS HASIL PENELITIAN

6.1 Tinjauan Umum

Dalam analisis stabilitas lereng menggunakan program geo-slope, angka keamanan (SF) dihitung dengan memasukkan data parameter-parameter tanah dan geometri lereng yang akan dianalisis. Dari data parameter tersebut, penulis dapat mengetahui kecenderungan perilaku lereng akibat pengaruh kemiringan, elevasi muka air tanah, dan jarak pembebanan pada puncak lereng, yang ditunjukkan dengan perubahan *slip surface* dan *safety factor*.

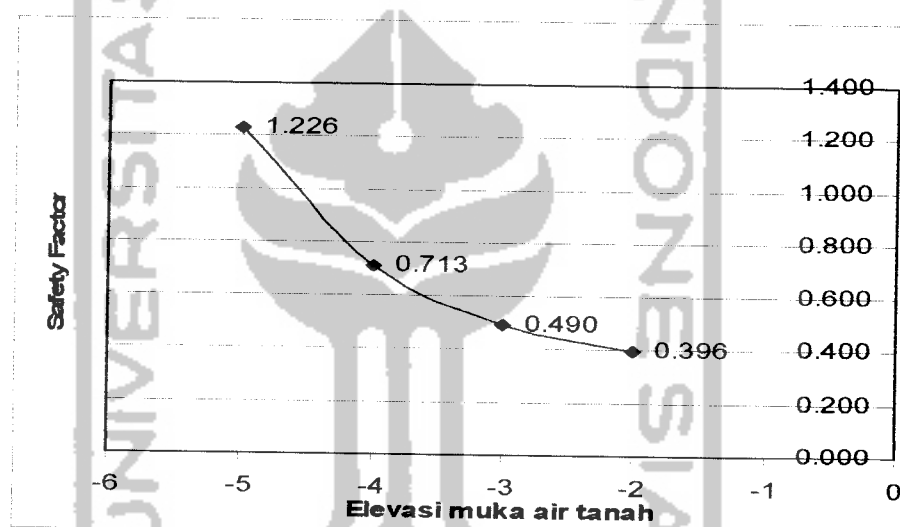
6.2 Analisis Angka Keamanan terhadap Pengaruh Elevasi Muka Air Tanah

Untuk mengetahui seberapa besar pengaruh elevasi muka air tanah terhadap angka keamanan pada lereng, maka dilakukan pemodelan dengan variabel elevasi muka air tanah pada lereng yang mempunyai kemiringan 50° . Dalam hal ini bagian lereng yang jenuh bertambah akibat turunnya hujan, sedangkan pada bagian bawah atau kaki lereng tidak terjadi penggenangan. Intensitas hujan yang tinggi dengan durasi yang lama dapat menyebabkan bagian lereng yang jenuh menjadi bertambah dan dapat memicu terjadinya longsor. Elevasi muka air tanah dapat pula ditunjukkan sebagai *piezometric line*, dinaikkan tiap 1 meter sehingga diperoleh perbedaan angka keamanannya. Penelitian tersebut menghasilkan nilai faktor keamanan yang tercantum dalam tabel 6.1.

Tabel 6.1 Pengaruh naiknya elevasi muka air tanah terhadap *safety factor*

muka air tanah	<i>Safety factor</i>
-5	1.226
-4	0.713
-3	0.490
-2	0.396

Sedangkan trend angka keamanan (*safety factor*) terhadap kemiringan lereng dapat dilihat pada grafik 6.1 di bawah ini.

Grafik 6.1 Hubungan antara *safety factor* dan elevasi muka air tanah

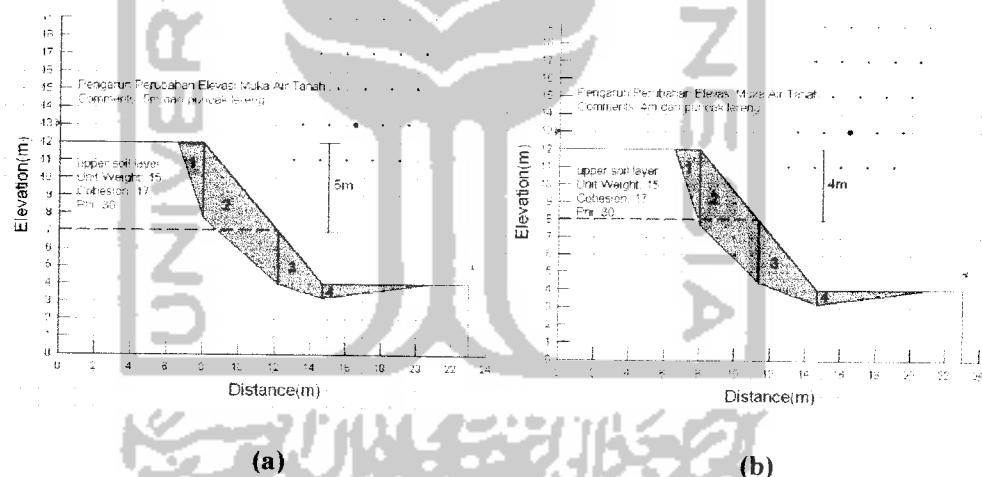
Pada grafik 6.1 dapat diketahui bahwa angka keamanan menurun dengan naiknya elevasi muka air tanah. Sesuai dengan yang tertulis pada bab II (Tinjauan Pustaka), bahwa *safety factor* didefinisikan sebagai perbandingan antara *shear strength* (kuat geser) dengan *shear stress* (tegangan geser).

$$SF = \frac{\text{shear strength}}{\text{shear stress}}$$

Jika elevasi muka air tanah naik, maka secara umum *shear strength* akan menurun akibat naiknya tekanan air pori, sedangkan *shear stress* akan bertambah akibat naiknya massa tanah pada lereng karena proses penjumlahan.

6.2.1 Analisis pengaruh elevasi muka air tanah terhadap tegangan normal

Jika elevasi muka air tanah naik, maka bagian lereng yang jenuh akan bertambah, karena air akan mengisi pori-pori tanah sehingga lereng menjadi bertambah berat. Hal ini akan berpengaruh terhadap gaya-gaya yang terjadi di sepanjang *slip surface* lereng, yaitu tegangan normal (N), tegangan tangensial (T), dan berat (W). Pengaruh naiknya elevasi muka air tanah terhadap gaya-gaya tersebut diilustrasikan oleh model lereng di bawah ini:



Gambar 6.1 Kenaikan elevasi muka air tanah pada lereng (a) kedalaman -5 m, (b) kedalaman -4 m

Pada gambar 6.1a, elevasi muka air tanah pada lereng adalah -5 m. Akibat turunnya hujan, maka elevasi muka air tanah naik pada kedalaman -4 m dari puncak lereng (gambar 6.1b). Akibat naiknya elevasi muka air tanah, bagian lereng yang jenuh bertambah, seperti yang ditunjukkan oleh gambar 6.1a dan 6.1b

di atas. Pada model lereng yang sama, jika elevasi muka air tanah naik, maka gaya berat (W) akan lebih besar pada model lereng dengan elevasi muka air tanah -4 meter, karena $\gamma_{sat} > \gamma_b$.

Jika W bertambah besar, maka tegangan normal (N) dan tegangan tangensial (T) bertambah besar

$$N = W \cos \alpha$$

$$T = W \sin \alpha$$

sedangkan besar tegangan normal total σ :

$$\sigma = \frac{N}{A} \quad \text{dengan } A \text{ adalah luas tampang slice}$$

Dalam analisis stabilitas lereng yang dipengaruhi oleh air tanah atau rembesan, tegangan normal yang dipakai adalah tegangan normal efektifnya (σ');

$$\sigma' = \sigma - u$$

dengan $\sigma' =$ tegangan normal efektif

$\sigma =$ tegangan normal total

$u =$ tekanan air pori

Dari penelitian yang dilakukan dengan *software* geo-slope terhadap kedua lereng pada gambar 6.1 di atas, diperoleh hasil sebagai berikut:

Tabel 6.2 Perhitungan model lereng pada gambar 6.1a

Slice	ΔL_n	a_n	W	N	T	PWP	U	N-U
1	4.5074	71.236	62.202	20.009	71.869	0	0	20.009
2	5.6322	41.855	263.13	195.989	126.080	16.718	94.159	101.830
3	2.643	17.905	76.368	72.669	27.604	34.665	91.620	-18.950
4	6.2058	7.7652	84.593	83.817	12.710	39.06	242.399	-158.581
	18.988				238.263			-55.693

$$SF = \frac{17 \times 18,988 + (-55,693) \tan 30^\circ}{238,263} = 1,220$$

Tabel 6.3 Perhitungan model lereng pada gambar 6.1b

<i>Slice</i>	ΔL_n	α_n	W	N	T	PWP	U	N-U
1	4.5074	71.236	62.202	20.009	98.350	0	0	20.009
2	4.7121	44.585	217.05	154.585	119.400	22.886	107.841	46.744
3	3.4839	20.634	119.73	112.049	40.504	43.185	150.452	-38.403
4	6.2058	7.7652	84.593	83.817	22.159	49.031	304.277	-220.459
	18.909				280.413			-192.110

$$SF = \frac{17 \times 18,909 + (-192,110) \tan 30^\circ}{280,413} = 0,751$$

keterangan:

ΔL_n = panjang dasar tiap *slice*

α_n = sudut kemiringan tiap *slice*

W = berat tiap irisan

N = tegangan normal total

T = tegangan tangensial

PWP = *pore water pressure*

U = *pore water force*

N-U = tegangan normal efektif

c = kohesi

$$SF = \frac{(cx\Delta L_n) + (N - U) \tan \phi}{T}$$

Dari tabel 6.2 dan 6.3 di atas tampak bahwa pada geometri lereng yang sama, lereng dengan elevasi muka air tanah -4 m lebih berat dibandingkan lereng dengan elevasi muka air tanah -5 m. Akibatnya, tegangan normal dan tangensial yang terjadi di sepanjang *slip surface* akan mengalami peningkatan. Selain itu, akibat naiknya elevasi muka air tanah, tegangan air pori (*pore water pressure*) akan meningkat, sehingga tegangan normal efektif (σ') dan *shear strength* akan berkurang, sebaliknya *shear stress* akan meningkat di sepanjang *slip surface*. Akibat berkurangnya *shear strength* dan meningkatnya *shear stress*, maka *safety factor* menurun.

Selain itu air juga akan mengisi pori diantara butiran-butiran tanah dan akan mengikis sedimen yang ada di sekitar butiran tanah, akibatnya kontak antar-butiran tanah akan berkurang dan pergelinciran material penyusun lereng semakin mudah terjadi. Sedangkan *shear stress* akan meningkat akibat bertambah beratnya *slice* akibat bertambahnya bagian tanah yang jenuh. Dari analisis di atas, ternyata elevasi muka air tanah sangat berpengaruh terhadap *shear strength* dan *shear stress* pada suatu lereng.

Pada tanah granular, sudut gesek dalam (ϕ), secara umum akan bertambah besar jika gradasi dan kekasaran partikel tanah baik, serta kerapatan relatifnya (*relative density*) bertambah. Kerapatan relatif sangat dipengaruhi oleh air tanah. Sedangkan pada tanah lempung (*clay*), kuat geser sangat bergantung pada sejarah tegangan yang pernah dialaminya, yaitu lempung terkonsolidasi normal (*normally consolidated*) dan terkonsolidasi berlebihan (*over consolidated*). Harga ϕ secara umum akan berkurang jika indeks plastisitas meningkat. Indeks

plastisitas merupakan interval kadar air dimana tanah masih bersifat plastis, karena itu indeks plastisitas menunjukkan sifat keplastisan tanah (Atterberg, 1911). Jika tanah mempunyai indeks plastisitas tinggi, maka tanah mengandung banyak butiran/fraksi lempung. Dari batasan yang diberikan oleh Atterberg (1911) mengenai indeks plastisitas, sifat, dan macam tanah, dapat diketahui bahwa tanah pasir mempunyai indeks plastisitas rendah (0), sifatnya non-plastis dan non-kohef. Sedangkan tanah lempung mempunyai indeks plastisitas tinggi dan bersifat kohef.

Kohesi tanah bergantung pada jenis tanah, yaitu tanah pasir atau lempung. Maka secara umum kohesi tanah tidak mengalami perubahan selama penjenruhan, tetapi dalam jangka waktu relatif lama proses penjenruhan dapat menghancurkan ikatan kohesi dan mengikis mineral-mineral penyusun tanah pada lereng, akibatnya kuat geser akan berkurang. Secara signifikan, menurunnya kohesi dan kuat geser tanah akibat proses penjenruhan dapat dilihat pada tanah lempung yang sangat dipengaruhi oleh air asin (*marine*).

Pengaruh naiknya elevasi muka air tanah pada lereng dapat dijelaskan oleh rumus Coulomb berikut ini:

$$\tau = c + \sigma' \operatorname{tg} \phi \quad (\text{Coulomb, 1776})$$

atau

$$\tau = c + (\sigma - u) \operatorname{tg} \phi$$

dengan:

$$\tau = \text{kuat geser tanah (kN/m}^2\text{)}$$

$$c = \text{kohesi tanah (kN/m}^2\text{)}$$

ϕ = sudut gesek dalam tanah (derajat)

σ = tegangan normal pada bidang runtuh (kN/m^2)

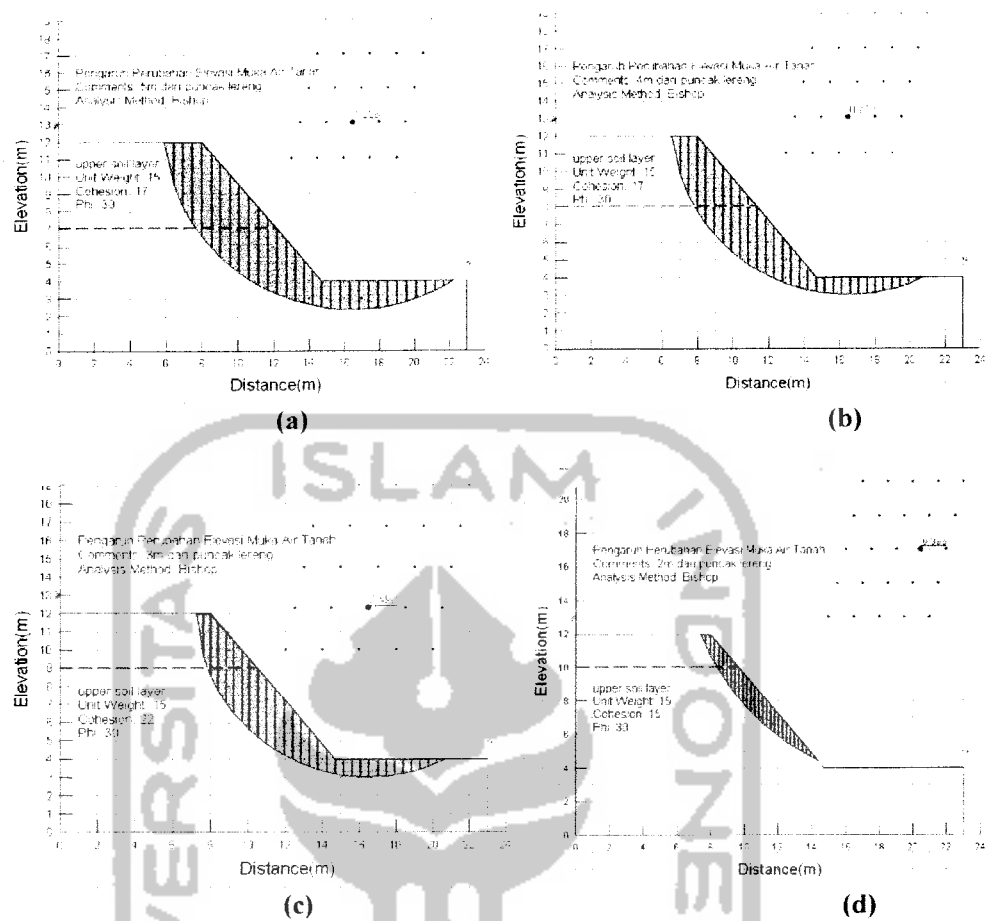
σ' = tegangan normal efektif pada bidang runtuh (kN/m^2)

u = tegangan air pori (kN/m^2)

Sedangkan *shear stress* akan meningkat dengan naiknya elevasi muka air tanah. Hal ini dikarenakan pori-pori tanah akan terisi air selama proses penjenruhan, sehingga massa tanah akan bertambah berat dan massa tanah tersebut akan mempunyai kecenderungan bergerak ke bawah (*driving force* akan meningkat) akibat adanya pengaruh gaya gravitasi, dengan demikian lereng menjadi tidak stabil sehingga akan mengalami kelongsoran (Hunt, 1986).

6.2.2 Analisis perubahan *slip surface* akibat naiknya elevasi muka air tanah

Safety factor dapat pula diartikan sebagai perbandingan antara *resisting moment* dan *driving activating moment*. Jika elevasi muka air tanah naik maka lereng akan membentuk *slip surface* baru yang lebih memungkinkan untuk terjadinya longsor. Bidang longsor tersebut biasanya lebih pendek dan dangkal dengan massa tanah longsor yang lebih kecil pula. Perubahan panjang *slip surface* dan massa tanah yang longsor akibat pengaruh naiknya elevasi muka air tanah dapat dilihat pada gambar 6.2 di bawah ini:



Gambar 6.2 Perubahan panjang *slip surface* akibat perubahan elevasi muka air tanah; (a) -5 m, (b) -4 m, (c) -3 m, (d) -2 m.

Panjang tiap *slip surface* akibat variabel elevasi muka air tanah dapat dilihat pada Tabel 6.4 di bawah ini:

Tabel 6.4 Pengaruh elevasi muka air tanah terhadap panjang *slip surface*

<i>Water Level</i> (m)	<i>Panjang Slip Surface</i> (m)	<i>Total Massa</i> (kN/m ²)	α_n Rata-rata (deg)
-5	21.78723	661.7	15.843
-4	19.20838	456.14	18.547
-3	18.61246	399.28	19.739
-2	10.52024	133.98	44.163

Dari gambar 6.2 dan tabel 6.4 di atas tampak bahwa semakin tinggi elevasi muka air tanah pada lereng, *slip surface*-nya semakin pendek dengan massa tanah (W) yang longsor kecil. Untuk melihat pengaruh panjang *slip surface* dan massa tanah yang longsor pada *safety factor* dapat diterangkan dengan rumus analisis stabilitas lereng berdasarkan metode irisan, seperti yang telah tertulis pada landasan teori dari penelitian ini:

$$F_s = \frac{\sum_{n=1}^{n=p} (c\Delta L_n + W_n \cos \alpha_n \cdot \tan \phi)}{\sum_{n=1}^{n=p} W_n \sin \alpha_n}$$

dengan ΔL_n = panjang dasar tiap *slice*

W_n = berat tiap *slice*

α_n = sudut antara W_n dan garis normal

Dari rumus SF di atas, *shear strength* akan berkurang jika *slip surface* semakin pendek karena kohesi yang terjadi di sepanjang *slip surface* pun menjadi kecil. Sedangkan gaya normal akan dipengaruhi oleh W_n dan α_n , semakin besar α_n yang terjadi, maka *driving force* akan semakin besar sebaliknya *resisting force*-nya menurun (nilai sinus semakin besar, sedangkan nilai cosinus berkurang).

Dari pembahasan di atas, tampak bahwa jika elevasi muka air tanah pada lereng naik, maka lereng akan membentuk *slip surface* baru yang merupakan lokasi yang paling memungkinkan untuk terjadinya *slip*. *Slip surface* yang baru terbentuk itu mempunyai panjang lintasan yang lebih pendek dengan kemiringan yang relatif besar dan massa yang lebih kecil dibanding dengan *slip surface* sebelumnya, seperti yang tampak pada tabel 6.3 di atas, akibatnya akan terjadi

penurunan *resisting moment*, sedangkan *driving moment* akan mengalami peningkatan. Jika elevasi muka air tanah terus dinaikkan, maka *resisting moment* terus menurun sampai di bawah *driving moment*-nya, sehingga perbandingan antara *resisting moment* dengan *driving moment*-nya kurang dari satu ($SF < 1$). Telah disebutkan sebelumnya bahwa *resisting moment* akan berkurang dikarenakan tegangan normal efektif di sepanjang permukaan bidang runtuh yang berkurang karena meningkatnya tegangan air pori, sedangkan *driving moment* bertambah akibat bertambahnya massa tanah karena proses penjenjutan. Besarnya *resisting moment* dan *driving moment* yang terjadi pada setiap model lereng akibat pengaruh naiknya elevasi muka air tanah dapat dilihat pada tabel 6.4 berikut ini:

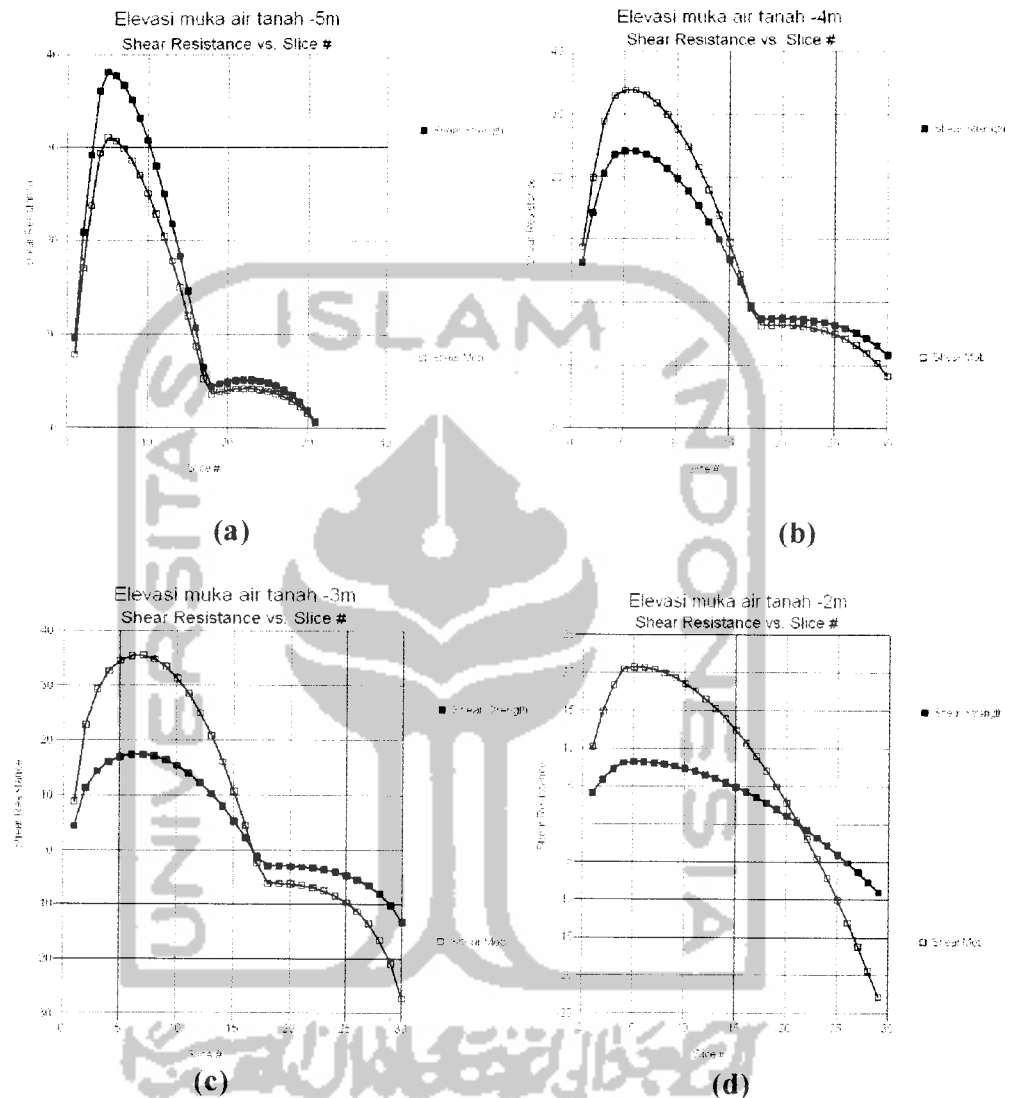
Tabel 6.5 Pengaruh elevasi muka air tanah terhadap *resisting moment* dan *driving moment*

Lereng	Water Level (m)	Resisting Moment (kN.m)	Driving Moment (kN.m)	Safety Factor = RM/DM
1	-5	3929.1	3204.9	1.226
2	-4	1694.8	2375.6	0.713
3	-3	943.01	1923.9	0.490
4	-2	534.41	1348.4	0.396

6.2.3 Analisis tipe-tipe keruntuhan akibat naiknya elevasi muka air tanah

Akibat berkurangnya *shear strength* dan bertambahnya *shear stress*, maka *slip surface* semakin pendek dan *safety factor* semakin kecil, pada kondisi tersebut lereng akan semakin mudah longsor. Besarnya *shear strength* dan *shear*

stress yang terjadi pada tiap irisan (*slice*) untuk masing masing model lereng dapat dilihat pada grafik 6.2 di bawah ini.



Grafik 6.2 Besarnya *shear resistance* yang terjadi pada tiap *slice*

Pada grafik 6.2 di atas terlihat bahwa besarnya *shear strength* dan *shear stress* sebanding dengan berat tanah pada tiap irisan (*slice*). Daerah di sekitar kaki lereng merupakan daerah kritis. Apabila daerah disekitar kaki lereng ini tidak cukup kuat menahan beban di atasnya maka keruntuhan akan terjadi di sepanjang

suatu permukaan yang terletak di bawah ujung kaki lereng, keruntuhan semacam ini disebut keruntuhan dasar lereng (*base slope failure*), seperti yang ditunjukkan pada grafik 6.2a, 6.2b, 6.2c. Sedangkan apabila daerah di sekitar kaki lereng cukup kuat menahan beban di atasnya maka keruntuhan akan terjadi di sepanjang bidang yang memotong kemiringan lereng atau di atas kaki lereng, keruntuhan ini disebut keruntuhan lereng dangkal (*shallow slope failure*), seperti yang ditunjukkan pada grafik 6.2d di atas.

6.3 Analisis Angka Keamanan terhadap Pengaruh Kemiringan Lereng

Untuk mengetahui seberapa besar pengaruh kemiringan lereng terhadap angka keamanan, maka dilakukan pemodelan dengan variabel sudut kemiringan lereng. Penelitian tersebut menghasilkan beberapa nilai faktor keamanan yang tercantum dalam Tabel 6.6.

Tabel 6.6 Pengaruh sudut kemiringan lereng terhadap *safety factor*

Kemiringan	<i>safety factor</i>
50	1.220
60	1.160
70	1.116
80	0.950

Sedangkan *trend safety factor* terhadap pengaruh kemiringan lereng dapat dilihat pada grafik 6.3 di bawah ini.

Pada *slice* tersebut bekerja gaya berat yang besarnya, $W = (\text{volume slice}) \times (\text{berat unit tanah})$. Akibat berat elemen tanah ini, akan menyebabkan bekerjanya gaya-gaya yang tegak lurus dan sejajar (parallel) terhadap bidang runtuh (*slip surface*).

1. Gaya yang tegak lurus bidang runtuh adalah $N = W \cos \alpha_n$
2. Gaya yang parallel terhadap bidang runtuh adalah $T = W \sin \alpha_n$. Gaya T ini cenderung menyebabkan kelongsoran di sepanjang bidang runtuh.

Untuk melihat pengaruh sudut kemiringan ditinjau dari ilmu mekanika, maka dilakukan analisis terhadap sebuah *slice* seperti tampak pada gambar 6.4 di bawah ini:



Gambar 6.4 Gaya-gaya yang bekerja pada dasar sebuah *slice* (Das, 1985).

Jika berat *slice* diambil 40 kN/m^2 , tanpa pengaruh muka air tanah dan sudut α_n diambil mulai dari 50° , 60° , 70° dan 80° , maka besarnya *resisting force* (Nr) dan *driving force* (Tr) yang terjadi pada *slice* tanah tersebut dapat dilihat pada tabel 6.7 di bawah ini:

Tabel 6.7 Besarnya *resisting force* dan *driving force* pada dasar suatu *slice*

Sudut kemiringan α_n (deg)	<i>Resisting Force</i> (N_r) $=W_n \cos \alpha_n$ (kN/m ²)	<i>Driving Force</i> (T_r) $=W_n \sin \alpha_n$ (kN/m ²)
50 ⁰	25.712	30.642
60 ⁰	20.000	34.641
70 ⁰	13.681	37.588
80 ⁰	6.946	39.392

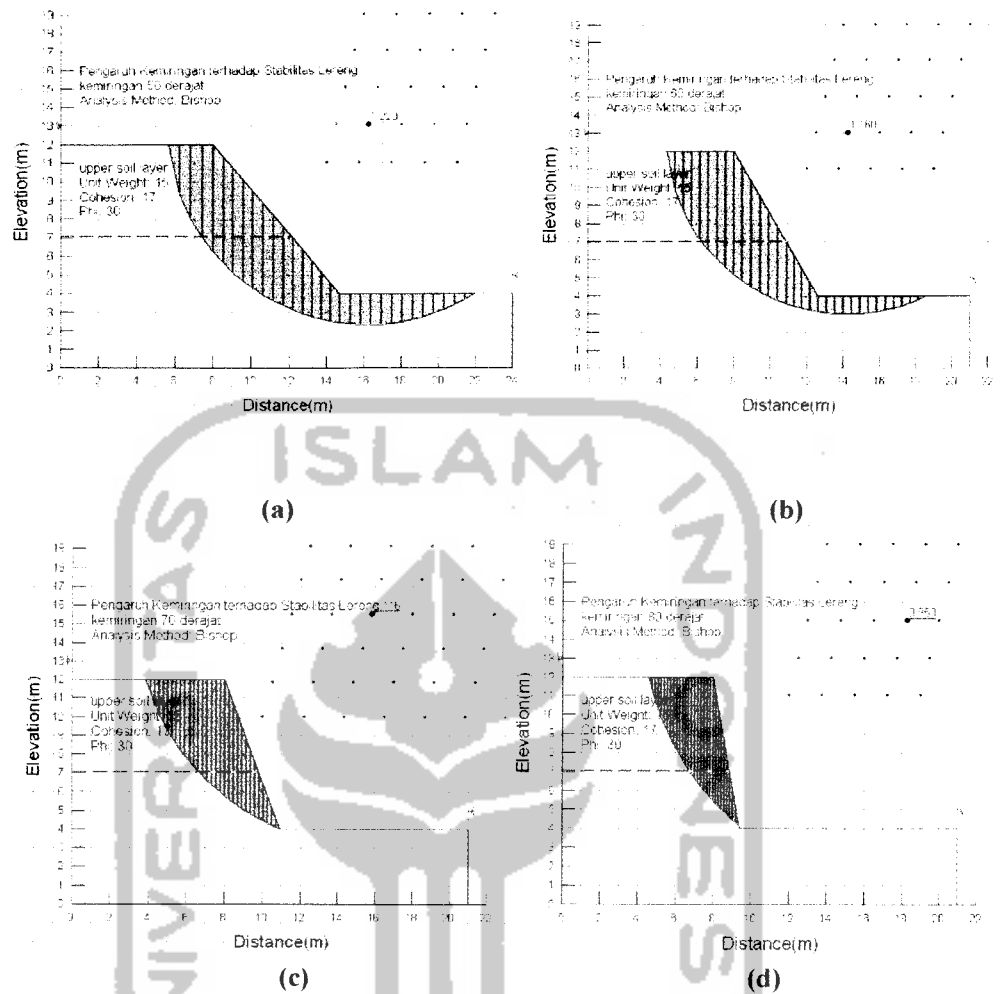
Dari tabel 6.7 dapat diketahui bahwa bertambahnya sudut kemiringan pada dasar tiap *slice* akan menyebabkan menurunnya *resisting force*, sebaliknya *driving force* akan meningkat. Oleh karena itu keruntuhan lereng sering kali terjadi akibat bertambahnya sudut kemiringan lereng.

Tegangan normal σ dan tegangan geser τ yang terjadi pada dasar irisan (*slice*) menurut ilmu mekanika adalah sebagai berikut:

$$\sigma = \frac{N_r}{A} \quad \text{dan} \quad \tau = \frac{T_r}{A}$$

dengan A adalah luas penampang irisan (*slice*). Tegangan normal σ berbanding lurus dengan gaya N_r . Semakin besar sudut kemiringan α_n , gaya N_r semakin kecil, akibatnya tegangan normal σ berkurang. Sedangkan tegangan geser τ semakin besar jika sudut kemiringan α_n bertambah besar dikarenakan gaya T_r semakin besar pula. Maka pada kondisi batas kemiringan tertentu, tegangan normal σ tidak mampu menahan tegangan geser τ yang terjadi, akibatnya lereng akan mengalami keruntuhan (*failure*).

Pengaruh sudut kemiringan terhadap panjang *slip surface* dan massa tanah yang runtuh diilustrasikan oleh gambar 6.5 di bawah ini.



Gambar 6.5 Pengaruh perubahan kemiringan pada lereng; (a) sudut kemiringan 50°. (b) sudut kemiringan 60°, (c) sudut kemiringan 70°, (d) sudut kemiringan 80°

Pada saat kemiringan lereng berubah menjadi semakin besar (curam), *slip surface* yang terjadi menjadi semakin pendek dan sudut α_n yang terjadi semakin besar, sehingga gaya normal N sebagai *resisting force* menjadi bertambah kecil sesuai dengan rumus $N = W \cos \alpha_n$. Sebaliknya gaya geser T sebagai *driving force* bertambah besar akibat bertambahnya sudut kemiringan lereng. Perubahan panjang lintasan *slip surface*, dan rerata sudut kemiringan pada

dasar *slice* α_n akibat bertambahnya kemiringan lereng dapat dilihat pada tabel 6.8 di bawah ini:

Tabel 6.8 Pengaruh kemiringan terhadap panjang *slip surface*

Kemiringan (deg)	Panjang <i>Slip Surface</i> (m)	α_n Rata-rata (deg)
50 ⁰	21.786	15.516
60 ⁰	19.209	18.580
70 ⁰	10.724	52.434
80 ⁰	9.363	54.790

Dari tabel 6.8 dan gambar 6.4 di atas, tampak bahwa semakin besar sudut kemiringan suatu lereng, *slip surface*-nya semakin pendek sedangkan rerata sudut α_n semakin besar. Akibat berkurangnya panjang *slip surface*, maka kohesi yang terjadi di sepanjang permukaan bidang runtuh menjadi kecil. Selain itu perubahan sudut kemiringan akan berpengaruh pada *resisting moment* dan *driving moment* yang bekerja pada lereng tersebut. Berikut ini adalah besarnya *resisting moment* dan *driving moment* yang terjadi pada setiap model lereng akibat pertambahan sudut kemiringan lereng:

Tabel 6.9 Pengaruh kemiringan lereng terhadap *resisting moment* dan *driving moment*

Lereng	Kemiringan (deg)	<i>Resisting Moment</i> (kN.m)	<i>Driving Moment</i> (kN.m)	<i>Safety Factor</i> = RM/DM
1	50 ⁰	4096.2	3357.9	1.220
2	60 ⁰	3654.3	3149.8	1.160
3	70 ⁰	3568.4	3198.4	1.116
4	80 ⁰	2875.9	3026.7	0.950

Pada tabel 6.9 di atas tampak bahwa *safety factor* merupakan perbandingan antara momen yang menahan (*resisting moment*) dan moment yang menyebabkan keruntuhan (*driving moment*). Semakin besar sudut kemiringan lereng, maka *safety factor*-nya semakin kecil.

Sudut kemiringan lereng yang baru setelah terjadinya longsor menurut Culmann (1875) adalah sebagai berikut.

$$\theta_{cr} = \frac{\alpha + \phi_d}{2}$$

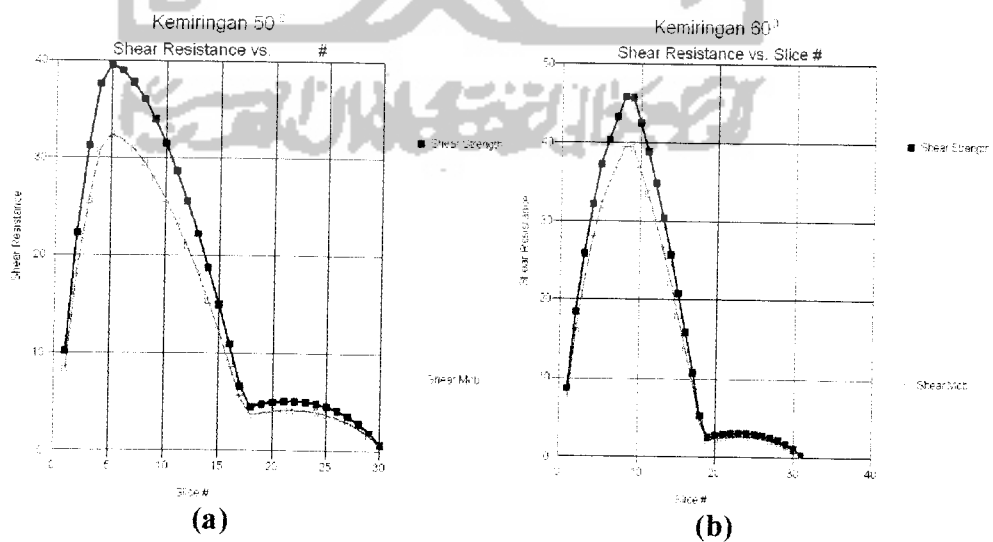
dengan θ_{cr} = sudut baru setelah terjadi keruntuhan

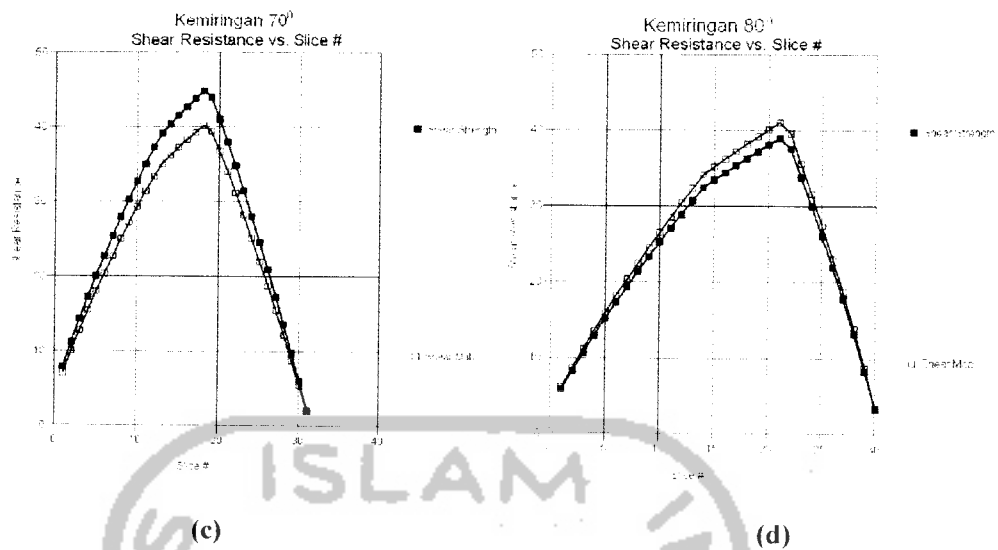
α = sudut lereng sebelum terjadi keruntuhan

ϕ_d = sudut gesek dalam tanah di sepanjang bidang longsor

6.3.1 Analisis tipe-tipe keruntuhan akibat bertambahnya kemiringan lereng

Besarnya *shear strength* dan *shear stress* yang terjadi pada tiap irisan (*slice*) untuk masing masing model lereng dapat dilihat pada grafik 6.4 di bawah ini.





Grafik 6.4 Besarnya *shear resistance* yang terjadi pada tiap *slice*

Pada grafik di atas terlihat bahwa pada grafik 6.4a dan 6.4b keruntuhan terjadi di sepanjang suatu permukaan yang terletak di bawah ujung kaki lereng, keruntuhan semacam ini disebut keruntuhan dasar lereng (*base slope failure*). Keruntuhan dasar ini terjadi karena daerah di sekitar kaki lereng tidak mampu menahan beban yang ada di atasnya. Sedangkan pada grafik 6.4c dan 6.4d keruntuhan terjadi di sepanjang bidang yang memotong kemiringan lereng atau diatas kaki lereng, keruntuhan ini disebut keruntuhan lereng dangkal (*shallow slope failure*).

6.4 Analisis Angka Keamanan terhadap Pengaruh Posisi Beban

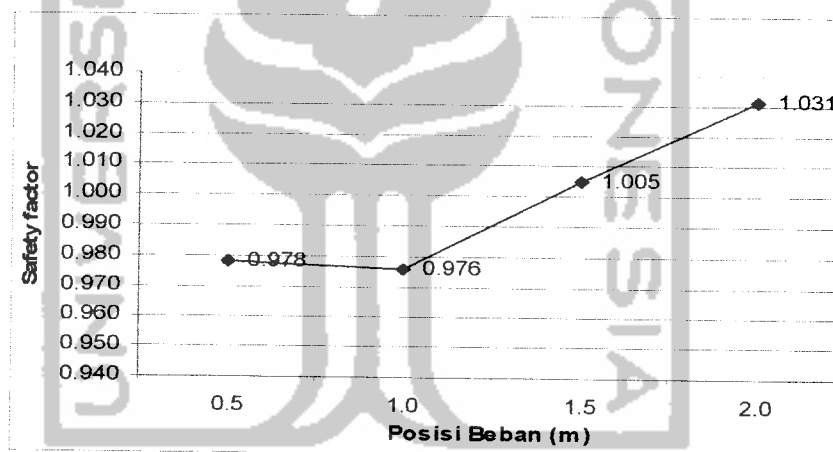
Untuk mengetahui seberapa besar pengaruh jarak pembebanan pada tebing lereng terhadap angka keamanan, maka penulis melakukan pemodelan dengan beban titik (*point force*) sebesar 15 kPa yang dikerjakan pada puncak lereng. Beban titik tersebut dapat berupa pondasi tapak (*foot plate*). Beban

dikerjakan mulai dari jarak 0,5 m; 1,0 m; 1,5 m dan 2,0 m dari tebing lereng untuk mengetahui pengaruhnya pada stabilitas lereng. Penelitian tersebut menghasilkan beberapa nilai faktor keamanan yang tercantum dalam tabel 6.10.

Tabel 6.10 Pengaruh posisi beban terhadap *safety factor*

Posisi beban	<i>safety factor</i>
0.5 m	0.978
1.0 m	0.976
1.5 m	1.005
2.0 m	1.031

Sedangkan trend *safety factor* pada lereng akibat pengaruh jarak pembebanan yang dilakukan penulis dapat dilihat pada grafik 6.5.



Grafik 6.5 Hubungan antara posisi beban dan *safety factor*

Pada grafik 6.5 dapat dilihat bahwa angka keamanan (SF) akan menurun pada saat beban semakin dekat dengan tebing lereng, pada suatu jarak tertentu, yaitu 1,0 m dari tebing lereng, angka keamanan mempunyai angka minimal, kemudian meningkat secara perlahan-lahan hingga jarak 0 m dari tebing lereng,

Jika titik a berada pada koordinat (8,8) atau 4 m di bawah puncak lereng dan y diambil = 0, dengan beban $P = 15$ kPa, maka besarnya tegangan-tegangan yang terjadi pada titik a tersebut dapat dilihat pada tabel 6.11 di bawah ini:

Tabel 6.11 Penambahan tegangan arah horizontal dan vertikal yang diakibatkan oleh beban terpusat

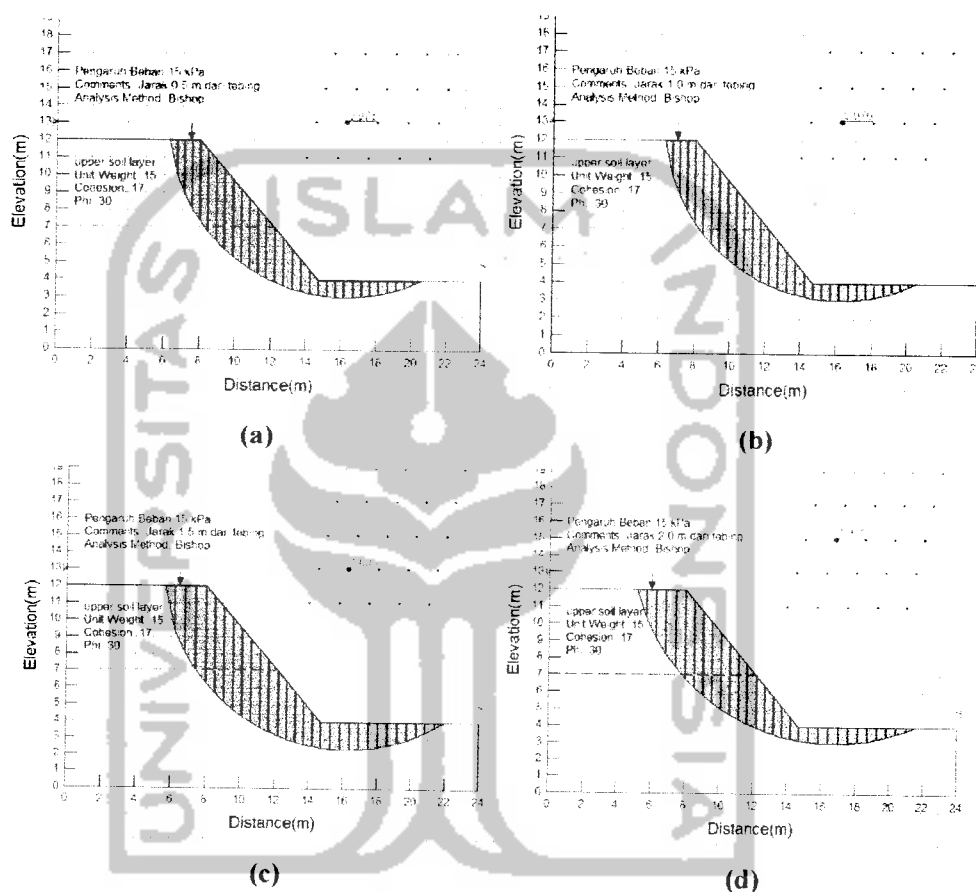
Beban no.	x	y	z	r = x	L	Δp_x	Δp_z
1	0.5	0	4	0.5	4.031	$0.148\mu - 0.0671$	0.431
2	1.0	0	4	1.0	4.123	$0.1425\mu - 0.0475$	0.385
3	1.5	0	4	1.5	4.272	$0.135\mu - 0.0222$	0.322
4	2.0	0	4	2.0	4.472	$0.126\mu + 0.00095$	0.256

Dari perhitungan pada tabel 6.11 di atas, tegangan normal dalam arah horizontal (Δp_x) bergantung pada angka Poisson mediumnya, sedangkan tegangan normal arah vertikal (Δp_z) tidak tergantung pada angka Poisson. Semakin jauh jarak beban, Δp_x dan Δp_z semakin kecil. Hal ini membuktikan bahwa letak beban pada puncak lereng berpengaruh pada besarnya tegangan normal yang terjadi di dalam lereng. Semakin jauh posisi beban dari tebing lereng *shear stress*-nya akan berkurang, sehingga lereng aman dari keruntuhan (*failure*). Sebaliknya semakin dekat jarak beban terhadap tebing lereng, *shear stress* yang terjadi bertambah besar dan akan menyebabkan kelongsoran pada lereng.

6.4.2 Analisis perubahan *slip surface* akibat pengaruh posisi beban

Safety factor dapat pula diartikan sebagai perbandingan antara *resisting moment* dan *driving/activating moment*. Secara umum, akibat bekerjanya beban pada puncak lereng akan menyebabkan meningkatnya *driving/activating moment*.

Posisi beban tersebut akan sangat menentukan *safety factor* dan *slip surface* yang terjadi. Perubahan panjang *slip surface* pada suatu lereng akibat posisi beban pada lereng dapat dilihat pada gambar 6.7 di bawah ini:



Gambar 6.7 Perubahan *slip surface* akibat perubahan posisi beban pada puncak lereng (a) jarak 0,5m (b) jarak 1,0m (c) jarak 1,5m (d) jarak 2,0m

Panjang tiap *slip surface* akibat posisi beban pada puncak lereng dapat dilihat pada tabel 6.12 di bawah ini:

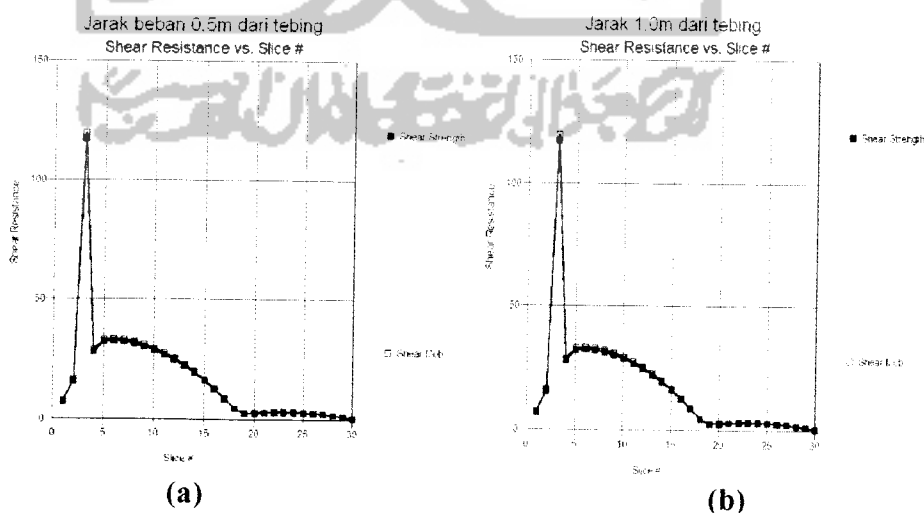
Tabel 6.12 Pengaruh posisi beban terhadap panjang dan kemiringan *slip surface*

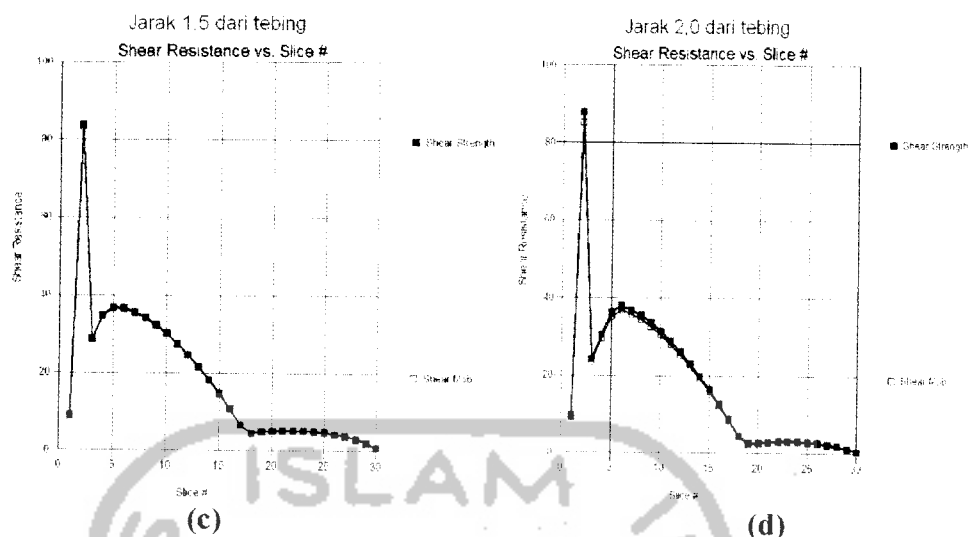
Posisi Beban	Panjang <i>Slip Surface</i>
0,5	19,210
1,0	19,897
1,5	21,786
2,0	21,913

Dari gambar 6.2 dan tabel 6.12 di atas tampak bahwa semakin jauh jarak beban dari tebing lereng, *slip surface*-nya semakin panjang, akibatnya bidang gesek di sepanjang *slip surface* tersebut menjadi lebih besar sehingga *shear strength* bertambah besar.

6.4.3 Analisis tipe-tipe keruntuhan akibat jarak beban pada puncak lereng

Jika beban titik dikerjakan pada puncak suatu lereng, maka tepat di bawah beban tersebut akan terjadi peningkatan tegangan normal, seperti yang tampak pada grafik 6.6. Pada *slice* yang dibebani beban titik, tegangan normalnya akan meningkat dengan tajam. Besarnya *shear strength* dan *shear stress* yang terjadi pada tiap irisan (*slice*) untuk masing-masing model lereng dapat dilihat pada grafik 6.6 di bawah ini.





Grafik 6.6 Besarnya *shear resistance* yang terjadi pada tiap *slice*

Pada grafik di atas terlihat bahwa pada grafik 6.6a, 6.6b, 6.6c dan 6.6d keruntuhan terjadi di sepanjang suatu permukaan yang terletak di bawah ujung kaki lereng, keruntuhan semacam ini disebut keruntuhan dasar lereng (*base slope failure*). Keruntuhan dasar ini terjadi karena daerah di sekitar kaki lereng tidak mampu menahan beban yang ada di atasnya. Pada grafik 6.6 di atas *shear resistance* menjadi meningkat tajam (pada *slice* ke-2 dan ke-3), hal ini dikarenakan pada daerah tersebut bekerja beban titik (*point force*) sebesar 15 kPa yang bekerja pada zona aktif lereng.

BAB VII

KESIMPULAN DAN SARAN

6.1 Kesimpulan

Berdasarkan analisis yang kami lakukan terhadap beberapa model lereng terhadap pengaruh elevasi muka air, kemiringan, dan jarak pembebanan diperoleh beberapa kesimpulan sebagai berikut:

1. Elevasi muka air tanah sangat berpengaruh terhadap angka keamanan (SF) lereng. Makin tinggi elevasi muka air tanah, *slip surface* yang terjadi makin pendek, maka angka keamanannya akan makin menurun.
2. Dari penelitian yang dilakukan, angka keamanan akan menurun rata-rata sekitar 30 % bersamaan dengan naiknya elevasi muka air tanah pada lereng jika dinaikkan tiap 1 meter.
3. Sudut kemiringan lereng sangat berpengaruh terhadap angka keamanan (SF) lereng. Makin besar sudut kemiringan lereng, maka *slip surface* yang terjadi makin pendek dan angka keamanan makin menurun.
4. Dari penelitian yang dilakukan, angka keamanan akan menurun rata-rata sekitar 8 % bersamaan dengan bertambahnya sudut kemiringan lereng.
5. Posisi beban pada puncak lereng yang diukur dari tepi lereng sangat berpengaruh terhadap angka keamanan (SF) lereng. Makin dekat posisi beban terhadap tepi lereng, maka *slip surface* yang terjadi makin pendek dan angka keamanan makin menurun.

6. Dari penelitian yang dilakukan, angka keamanan akan bertambah rata-rata sekitar 2 % bersamaan dengan bertambah dekatnya posisi beban terhadap tepi lereng jika beban bekerja tiap jarak 0,5 m dari tepi lereng..

6.2 Saran dan Rekomendasi

Materi penulisan ini diharapkan dapat menjadi solusi terhadap berbagai masalah kelongsoran dan memberikan wawasan baru bagi mereka yang tertarik dengan dunia geoteknik, khususnya dalam menganalisis perilaku kelongsoran lereng.

Adapun hal-hal yang perlu diperhatikan :

1. Berdasarkan penelitian yang dilakukan, untuk mencegah terjadinya longsor akibat naiknya elevasi muka air tanah, maka perlu direncanakan dan dibuat sistem drainase yang baik, sehingga elevasi muka air tanah pada lereng tetap terjaga.
2. Berdasarkan penelitian yang dilakukan, maka pengawasan dan pengendalian terhadap kondisi di sekitar lereng sangat penting dilakukan untuk mencegah berbagai kegiatan manusia yang dapat menyebabkan terjadinya longsor, seperti perluasan lahan pertanian, perkebunan, jalan, perumahan dan lain-lain yang memotong kemiringan lereng, sehingga kemiringannya bertambah besar dan dapat menyebabkan longsor.
3. Pengawasan dan pengendalian pun perlu dilakukan terhadap beban-beban yang bekerja di atas lereng, seperti beban bangunan perumahan, jalan, tiang listrik, pagar pembatas dan lain-lain. Penempatan bangunan-

bangunan tersebut disarankan tidak terlalu dekat dengan tepi lereng karena dapat menyebabkan bertambahnya *driving force* yang menyebabkan keruntuhan pada lereng.

4. Penggunaan *software* dalam analisis geoteknik khususnya analisis stabilitas lereng sangat penting mengingat berbagai kemudahan dan keuntungan yang didapat. Dengan *software* geoslope yang dikembangkan oleh Geo-Slope International, Ltd. diharapkan dapat merangsang berbagai macam penelitian lanjutan untuk menganalisis stabilitas lereng dan upaya pencegahan longsor itu sendiri, seperti:

- Analisis perubahan *slip surface* dan *safety factor* dengan parameter tanah, geometri, dan lapisan tanah yang berbeda.
- Analisis stabilitas lereng dengan menggunakan perkuatan, seperti ankur, *retaining wall*.
- Analisis stabilitas lereng akibat adanya pengaruh gempa, dan lain-lain.

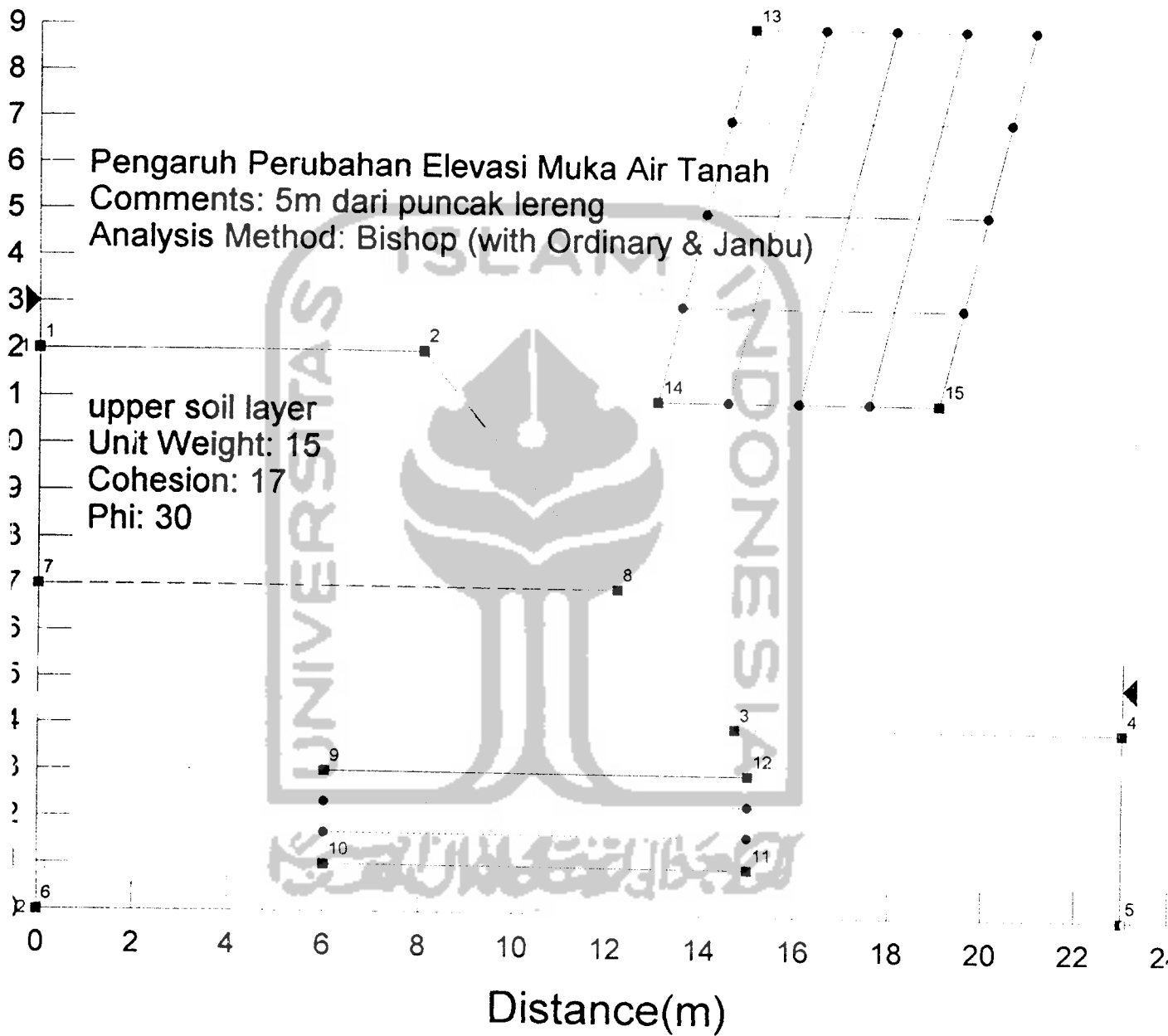
DAFTAR PUSTAKA

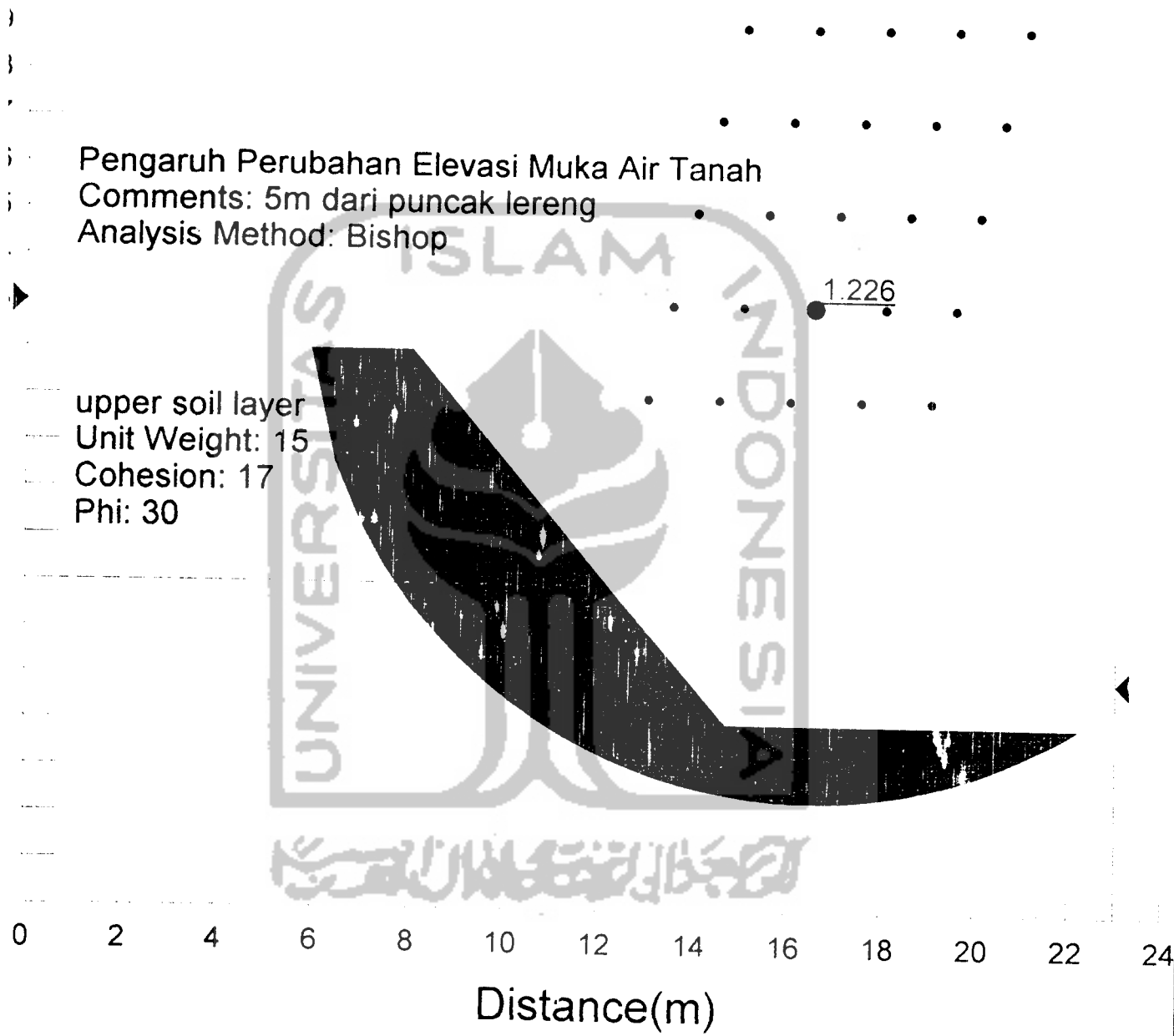
- Abramson, Lee, Sunil S, and G.M Boyce, 1985, Slope Stability and Stabilization Methods, John Wiley & Sons, inc.
- Bishop, A. W. 1955, The Use of the Slip Circle in the Stability Analysis of Earth Slopes, Geotechnique, London.
- Bowles, J. E. 1977, Foundation Analysis and Design, McGraw-Hill Kogakusha, Ltd.
- Bowles, J. E. 1984, Phisycal and geotechnical Properties of Soil, McGraw-Hill, inc.
- Boussinesq, J. 1883, Aplication des Potentials a L'Etude de L'Equilibre et du Mouvement des Solides Elastiques, Gauthier-Villars, Paris.
- Bjerrum, L. 1966, Progressive Failure in Slopes of Overconsolidated Plastic Clay and Clay Shale, New York.
- Budhu, M. (1979), Soil Mechanics & Foundations, John Wiley & Sons, inc.
- Chowdury, R. N. 1978, Slope Analysis: Development in Geotechnical Engineering vol 22, Elsevier Scientific Publishing Company.
- Corps of Engineers, 1982, Slope Stability Manual EM-1110-2-1902, Washington DC: Department of the Army, Office of the Chief of Engineers.
- Coulomb, C. A. 1776, Essai sur une Application des Regles de Maximis et Minimis a quelques Problemes de Statique, relatifs a l'Architecture, Mem. Roy. des Sciences, Paris, Vol. 3.
- Culmann, C. 1875, Die Graphische Statik, Meyer and Zeller, Zurich.
- Das, B.M. 1985, Principle of Geotechnical Engineering, PWS Publishing Company.
- Fellenius, W. 1927, Calculation of Stability of Slopes, W. Ernst and Sons, Berlin.
- Fellenius, W. 1936, Calculation of Stability of Earth Dams, Transactions, 2nd Congress Large Dams, Washington DC.
- Fredlund, D. G. and J. Krahn, 1977, Comparison of Slope Stability Methods of Analysis, Canadian Geotechnical Journal, Vol. 14.

- Hardiyatmo H. C. M. Eng.DEA , 2002, Mekanika Tanah 1, Gadjah Mada University Press, Jogjakarta.
- Hardiyatmo H. C. M. Eng. DEA, 1994, Mekanika Tanah 2, PT Gramedia, Jakarta.
- Hunt, R. E. 1986, Geotechnical Engineering Techniques and Practices, McGraw-Hill, inc
- Janbu, N. 1957, Stability Analysis of Slopes with Dimensionless Parameters, Harvard Soil Mech. Ser. No. 46 Harvard University, Cambridge, Mass.
- Janbu, N. 1973, Slope Stability Computations, Embankments Dam Engineering, Hirschfield and Poulos, eds. John Wiley and Sons, New York.
- Lowe, J. and L. Karafiath, 1960, Stability of Earth Dams Upon Drawdown, Proceeding of the 1st Pan American Conference on Soil Mechanics and Foundation Engineering, Mexico City.
- Mohr, O. 1900, Welche Ustade Bedingen die Elastizitatzgrenze und den Bruch eines Materiales, Zeitschrift des Vereines Deutscher Ingenieure, Vol. 44, 1524-1530, 1527-1577.
- Morgenstern, N. R. and V. E. Price, 1965, The Analysis of the Stability of General Slip Surface, Geotechnique, Vol. 15.
- Sarma, S. K., 1973, Stability Analysis of Embankments and Slopes, Geotechnique vol. 23, London.
- Spencer, E. 1967, A Method of Analysis of the Stability of Embankments Assuming Parallel Inter-Slice Forces, Geotechnique, London
- Spencer, E. 1973, Thrust Line Criterion in Embankment Stability Analysis, Geotechnique, London.
- Suryolelono, K. B. Prof. DR. Ir. Dip. H.E. D.E.A, 1995, Bencana Alam Tanah Longsor Perspektif Ilmu Geoteknik, Pidato Pengukuhan Guru Besar FT UGM.
- Terzaghi, K.and R. B. Peck 1967, Soil Mechanics in Engineering Practice, New York, Wiley.
- Winterkorn, H. F. and H. Y. Fang, eds., 1975, Foundation Engineering Handbook, Van Nostrand Reinhold Co., New York.



LAMPIRAN I



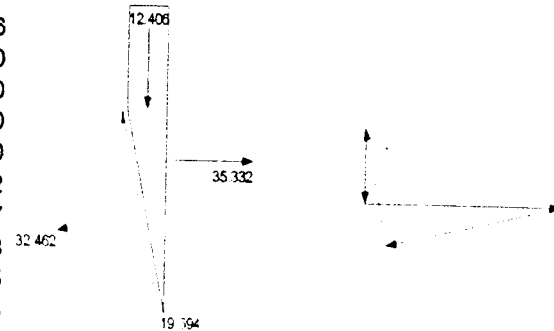


OUT PUT ANALISIS STABILITAS LERENG DENGAN ELEVASI MUKA AIR TANAH -5M

Slice 1 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	42.786
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52992
Mid-Height	1.5607
Base Length	2.5168
Base Angle	77.845
Polygon Closure	0.17666
Anisotropic Strength Modifier	1
Weight	12.406
Base Shear Force	19.694
Base Normal Force	32.462
Right Side Normal Force	35.332

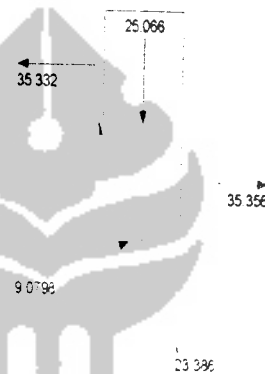
Slice 1 - Bishop Method



Slice 2 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	23.411
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52992
Mid-Height	3.1534
Base Length	1.3771
Base Angle	67.369
Polygon Closure	0.62665
Anisotropic Strength Modifier	1
Weight	25.066
Base Shear Force	23.386
Base Normal Force	9.0798
Left Side Normal Force	35.332
Right Side Normal Force	35.358

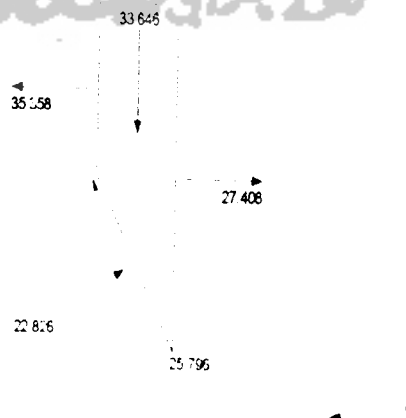
Slice 2 - Bishop Method



Slice 3 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	18.439
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52992
Mid-Height	4.2329
Base Length	1.0846
Base Angle	60.753
Polygon Closure	0.67292
Anisotropic Strength Modifier	1
Weight	33.646
Base Shear Force	25.796
Base Normal Force	22.826
Left Side Normal Force	35.358
Right Side Normal Force	27.408

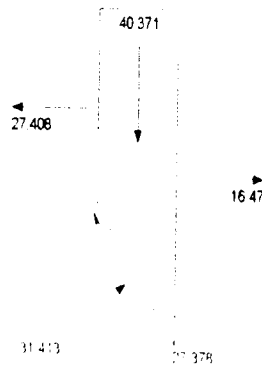
Slice 3 - Bishop Method



Slice 4 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	15.839
Pore Water Pressure	0.77419
Pore Water Force	0.72132
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52992
Mid-Height	5.0789
Base Length	0.93171
Base Angle	55.336
Polygon Closure	0.60556
Anisotropic Strength Modifier	1
Weight	40.371
Base Shear Force	27.378
Base Normal Force	31.413
Left Side Normal Force	27.408
Right Side Normal Force	16.47

Slice 4 - Bishop Method



Slice 5 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	14.048
Pore Water Pressure	7.6136
Pore Water Force	6.2916
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	5.4637
Base Length	0.82636
Base Angle	50.613
Polygon Closure	0.84462
Anisotropic Strength Modifier	1
Weight	42.975
Base Shear Force	25.675
Base Normal Force	36.472
Left Side Normal Force	16.47
Right Side Normal Force	3.9442

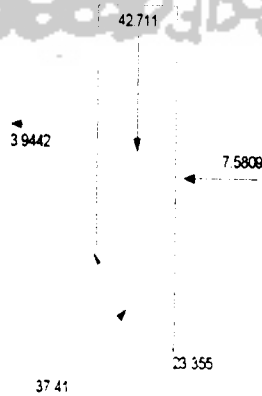
Slice 5 - Bishop Method



Slice 6 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	12.915
Pore Water Pressure	13.414
Pore Water Force	10.191
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	5.43
Base Length	0.75971
Base Angle	46.352
Polygon Closure	0.42711
Anisotropic Strength Modifier	1
Weight	42.711
Base Shear Force	23.355
Base Normal Force	37.41
Left Side Normal Force	3.9442
Right Side Normal Force	7.5809

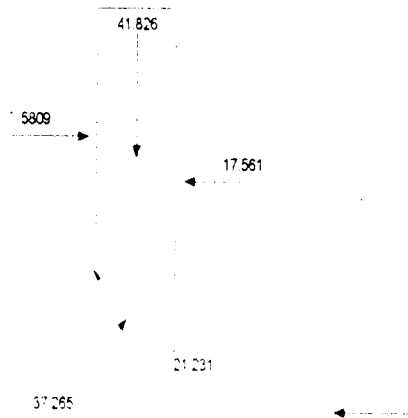
Slice 6 - Bishop Method



Slice 7 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	12.072
Pore Water Pressure	18.442
Pore Water Force	13.096
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	5.3175
Base Length	0.71014
Base Angle	42.404
Polygon Closure	0.20913
Anisotropic Strength Modifier	1
Weight	41.826
Base Shear Force	21.231
Base Normal Force	37.265
Left Side Normal Force	7.5809
Right Side Normal Force	17.561

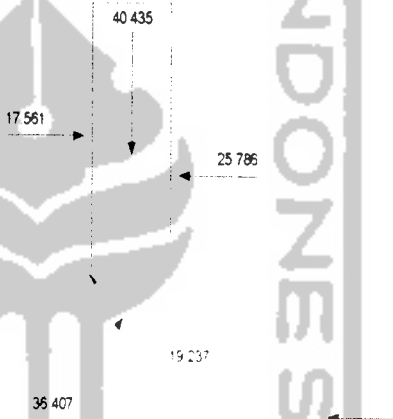
Slice 7 - Bishop Method



Slice 8 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	11.421
Pore Water Pressure	22.836
Pore Water Force	15.342
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	5.1407
Base Length	0.67182
Base Angle	38.691
Polygon Closure	0.40435
Anisotropic Strength Modifier	1
Weight	40.435
Base Shear Force	19.237
Base Normal Force	36.407
Left Side Normal Force	17.561
Right Side Normal Force	25.786

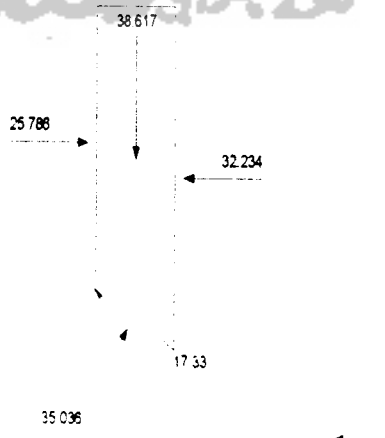
Slice 8 - Bishop Method



Slice 9 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	10.904
Pore Water Pressure	26.7
Pore Water Force	17.126
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	4.9096
Base Length	0.64143
Base Angle	35.164
Polygon Closure	0.38617
Anisotropic Strength Modifier	1
Weight	38.617
Base Shear Force	17.33
Base Normal Force	35.036
Left Side Normal Force	25.786
Right Side Normal Force	32.234

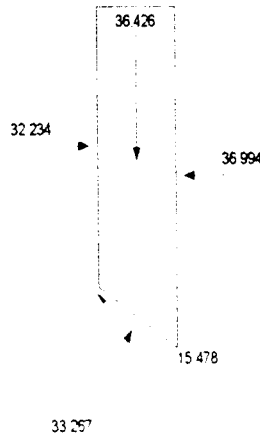
Slice 9 - Bishop Method



Slice 10 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	10.487
Pore Water Pressure	30.098
Pore Water Force	18.567
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52438
Mid-Height	4.6311
Base Length	0.61689
Base Angle	31.784
Polygon Closure	0.36426
Anisotropic Strength Modifier	1
Weight	36.426
Base Shear Force	15.478
Base Normal Force	33.267
Left Side Normal Force	32.234
Right Side Normal Force	36.994

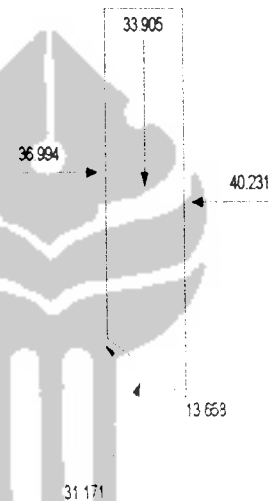
Slice 10 - Bishop Method



Slice 11 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	10.146
Pore Water Pressure	33.084
Pore Water Force	19.745
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	4.3105
Base Length	0.59681
Base Angle	28.524
Polygon Closure	0.33905
Anisotropic Strength Modifier	1
Weight	33.905
Base Shear Force	13.658
Base Normal Force	31.171
Left Side Normal Force	36.994
Right Side Normal Force	40.231

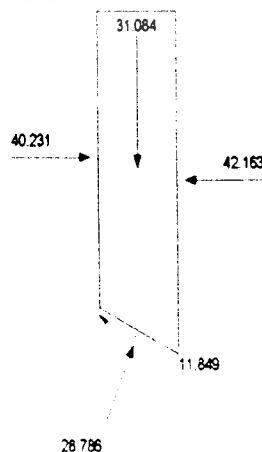
Slice 11 - Bishop Method



Slice 12 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.8652
Pore Water Pressure	35.897
Pore Water Force	20.715
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52438
Mid-Height	3.9519
Base Length	0.58031
Base Angle	25.362
Polygon Closure	0.15542
Anisotropic Strength Modifier	1
Weight	31.084
Base Shear Force	11.849
Base Normal Force	28.786
Left Side Normal Force	40.231
Right Side Normal Force	42.163

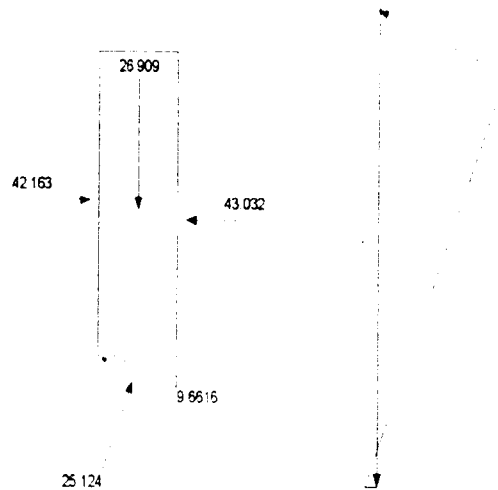
Slice 12 - Bishop Method



Slice 13 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.245
Pore Water Pressure	37.922
Pore Water Force	20.623
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	3.5665
Base Length	0.54383
Base Angle	22.342
Polygon Closure	0.26909
Anisotropic Strength Modifier	1
Weight	26.909
Base Shear Force	9.6616
Base Normal Force	25.124
Left Side Normal Force	42.163
Right Side Normal Force	43.032

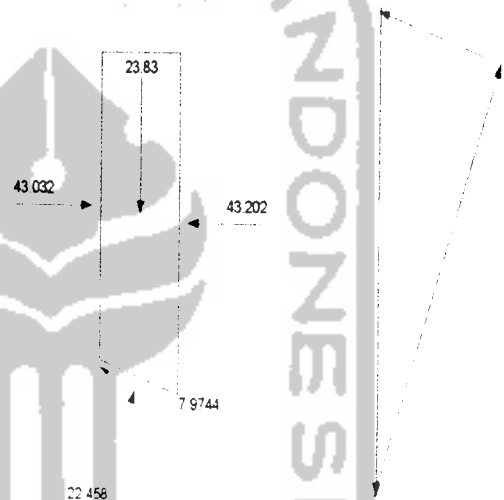
Slice 13 - Bishop Method



Slice 14 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.0685
Pore Water Pressure	39.808
Pore Water Force	21.234
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	3.1584
Base Length	0.53344
Base Angle	19.449
Polygon Closure	0.2383
Anisotropic Strength Modifier	1
Weight	23.83
Base Shear Force	7.9744
Base Normal Force	22.458
Left Side Normal Force	43.032
Right Side Normal Force	43.202

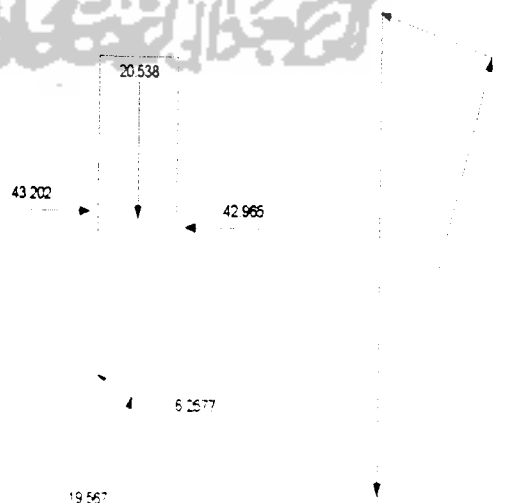
Slice 14 - Bishop Method



Slice 15 - Bishop Method

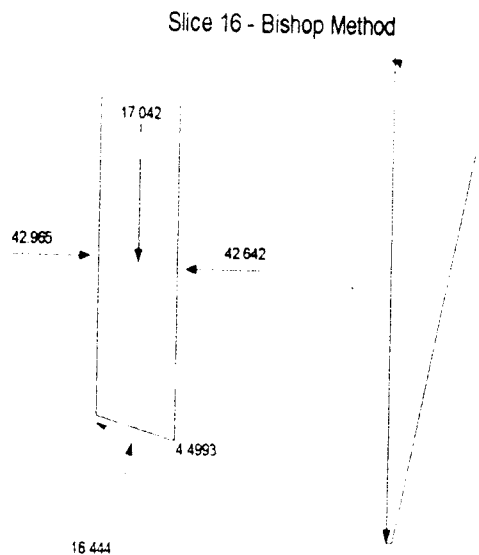
Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	8.9232
Pore Water Pressure	41.41
Pore Water Force	21.736
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.7221
Base Length	0.52489
Base Angle	16.606
Polygon Closure	0.10269
Anisotropic Strength Modifier	1
Weight	20.538
Base Shear Force	6.2577
Base Normal Force	19.567
Left Side Normal Force	43.202
Right Side Normal Force	42.965

Slice 15 - Bishop Method



Slice 16 - Bishop Method

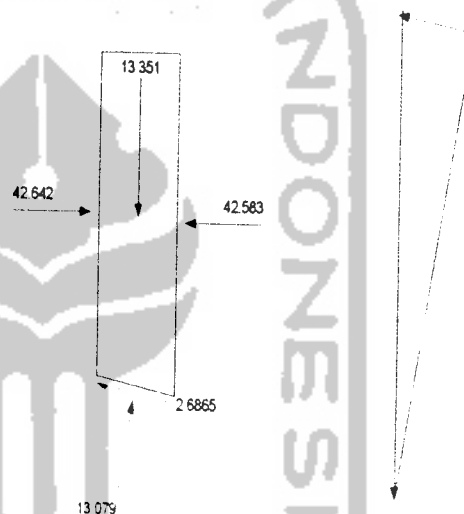
Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	8.8053
Pore Water Pressure	42.75
Pore Water Force	22.143
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.2587
Base Length	0.51796
Base Angle	13.805
Polygon Closure	0.17042
Anisotropic Strength Modifier	1
Weight	17.042
Base Shear Force	4.4993
Base Normal Force	16.444
Left Side Normal Force	42.965
Right Side Normal Force	42.642



Slice 17 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	8.7122
Pore Water Pressure	43.836
Pore Water Force	22.465
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	1.7695
Base Length	0.51248
Base Angle	11.037
Polygon Closure	0.13351
Anisotropic Strength Modifier	1
Weight	13.351
Base Shear Force	2.6865
Base Normal Force	13.079
Left Side Normal Force	42.642
Right Side Normal Force	42.583

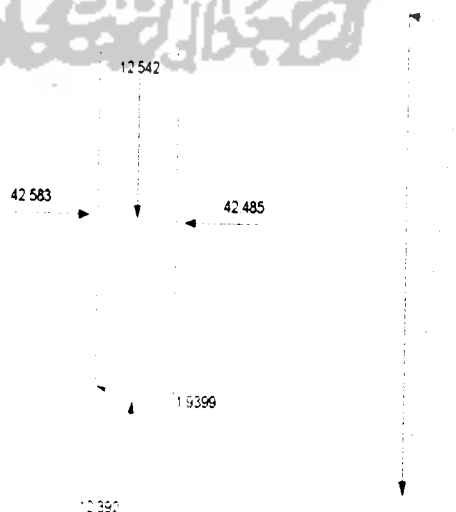
Slice 17 - Bishop Method



Slice 18 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.22
Pore Water Pressure	44.702
Pore Water Force	24.244
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.5368
Mid-Height	1.5576
Base Length	0.54235
Base Angle	8.2039
Polygon Closure	0.12542
Anisotropic Strength Modifier	1
Weight	12.542
Base Shear Force	1.9399
Base Normal Force	12.392
Left Side Normal Force	42.583
Right Side Normal Force	42.485

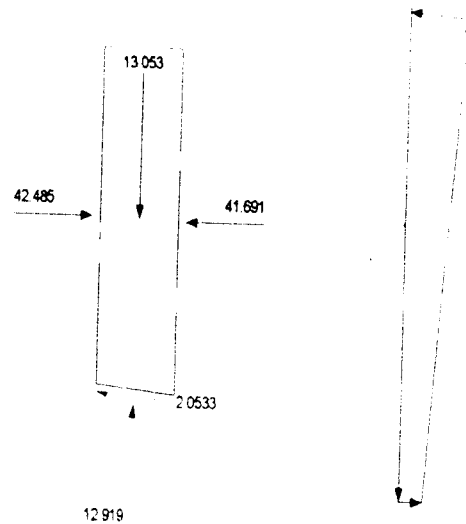
Slice 18 - Bishop Method



Slice 19 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.1648
Pore Water Pressure	45.323
Pore Water Force	24.434
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.5368
Mid-Height	1.6211
Base Length	0.5391
Base Angle	5.2991
Polygon Closure	0.13053
Anisotropic Strength Modifier	1
Weight	13.053
Base Shear Force	2.0533
Base Normal Force	12.919
Left Side Normal Force	42.485
Right Side Normal Force	41.691

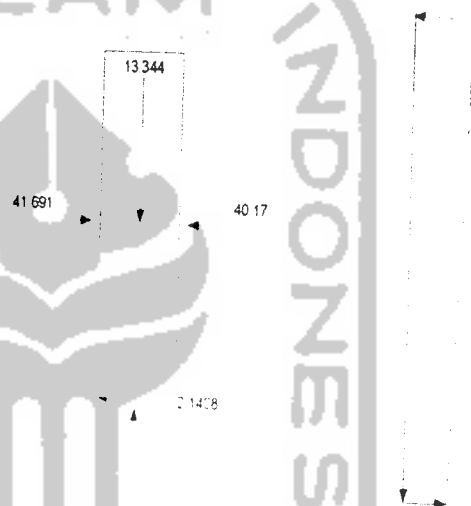
Slice 19 - Bishop Method



Slice 20 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.1337
Pore Water Pressure	45.679
Pore Water Force	24.542
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.5368
Mid-Height	1.6573
Base Length	0.53727
Base Angle	2.4079
Polygon Closure	0.13344
Anisotropic Strength Modifier	1
Weight	13.344
Base Shear Force	2.1408
Base Normal Force	13.266
Left Side Normal Force	41.691
Right Side Normal Force	40.17

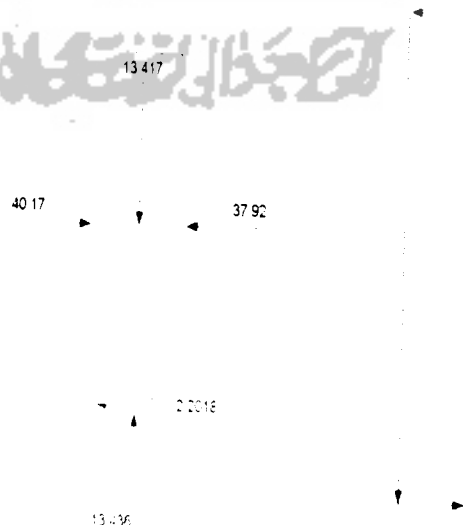
Slice 20 - Bishop Method



Slice 21 - Bishop Method

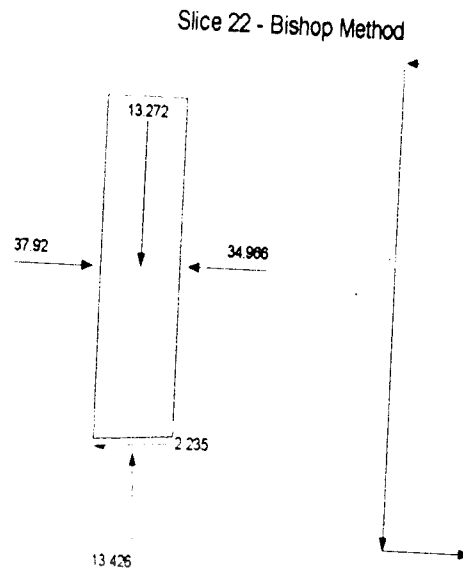
Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.1259
Pore Water Pressure	45.768
Pore Water Force	24.569
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.5368
Mid-Height	1.6663
Base Length	0.53682
Base Angle	0.47719
Polygon Closure	0.06718
Anisotropic Strength Modifier	1
Weight	13.417
Base Shear Force	2.2018
Base Normal Force	13.436
Left Side Normal Force	40.17
Right Side Normal Force	37.92

Slice 21 - Bishop Method



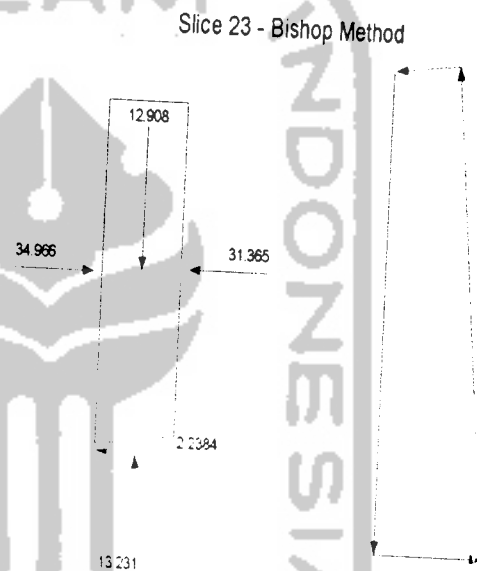
Slice 22 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.1413
Pore Water Pressure	45.59
Pore Water Force	24.515
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.5368
Mid-Height	1.6483
Base Length	0.53772
Base Angle	3.3633
Polygon Closure	0.06713
Anisotropic Strength Modifier	1
Weight	13.272
Base Shear Force	2.235
Base Normal Force	13.426
Left Side Normal Force	37.92
Right Side Normal Force	34.966



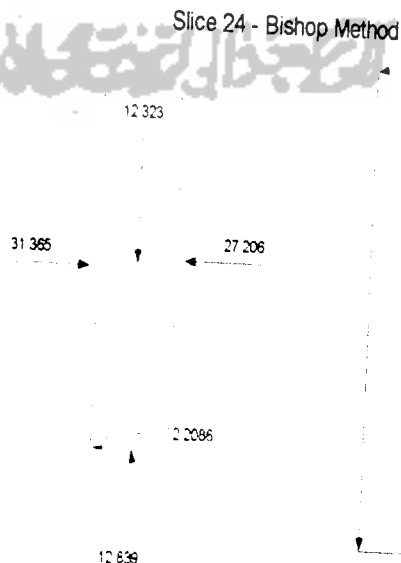
Slice 23 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.1802
Pore Water Pressure	45.149
Pore Water Force	24.381
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.53679
Mid-Height	1.6031
Base Length	0.54001
Base Angle	6.2583
Polygon Closure	0.06616
Anisotropic Strength Modifier	1
Weight	12.908
Base Shear Force	2.2384
Base Normal Force	13.231
Left Side Normal Force	34.966
Right Side Normal Force	31.365



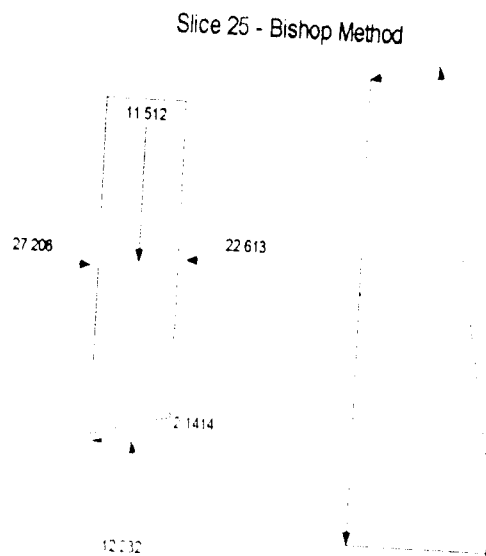
Slice 24 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.2437
Pore Water Pressure	44.434
Pore Water Force	24.161
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.5368
Mid-Height	1.5305
Base Length	0.54375
Base Angle	9.1692
Polygon Closure	0.0642
Anisotropic Strength Modifier	1
Weight	12.323
Base Shear Force	2.2086
Base Normal Force	12.839
Left Side Normal Force	31.365
Right Side Normal Force	27.206



Slice 25 - Bishop Method

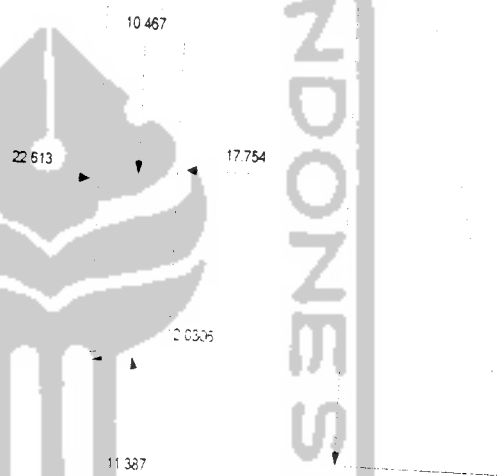
Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.3331
Pore Water Pressure	43.446
Pore Water Force	23.852
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.5368
Mid-Height	1.4297
Base Length	0.54901
Base Angle	12.104
Polygon Closure	0
Anisotropic Strength Modifier	1
Weight	11.512
Base Shear Force	2.1414
Base Normal Force	12.232
Left Side Normal Force	27.206
Right Side Normal Force	22.613



Slice 26 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.4507
Pore Water Pressure	42.175
Pore Water Force	23.446
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.5368
Mid-Height	1.3
Base Length	0.55592
Base Angle	15.072
Polygon Closure	0.05694
Anisotropic Strength Modifier	1
Weight	10.467
Base Shear Force	2.0306
Base Normal Force	11.387
Left Side Normal Force	22.613
Right Side Normal Force	17.754

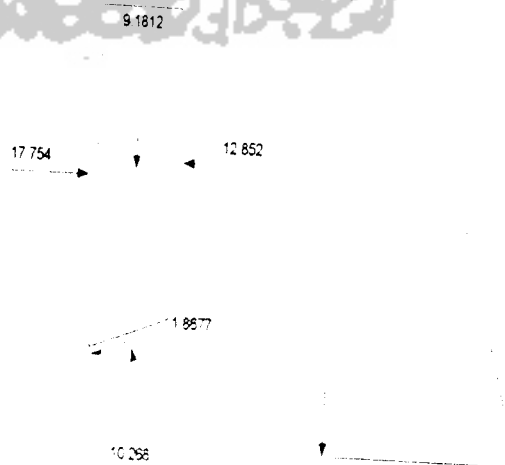
Slice 26 - Bishop Method



Slice 27 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.5997
Pore Water Pressure	40.608
Pore Water Force	22.931
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.5368
Mid-Height	1.1402
Base Length	0.56469
Base Angle	18.082
Polygon Closure	0.05134
Anisotropic Strength Modifier	1
Weight	9.1812
Base Shear Force	1.8677
Base Normal Force	10.268
Left Side Normal Force	17.754
Right Side Normal Force	12.852

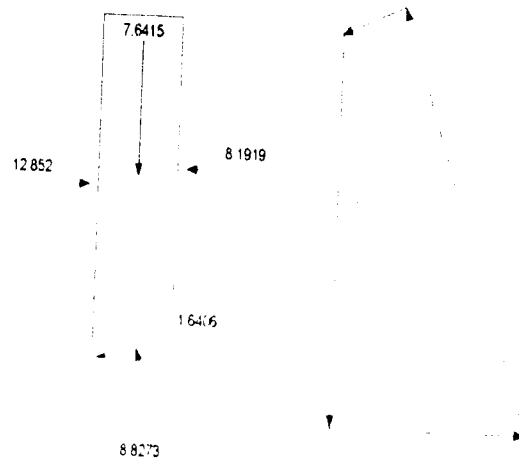
Slice 27 - Bishop Method



Slice 28 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	9.7844
Pore Water Pressure	38.733
Pore Water Force	22.293
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.5368
Mid-Height	0.94902
Base Length	0.57555
Base Angle	21.145
Polygon Closure	0.04414
Anisotropic Strength Modifier	1
Weight	7.6415
Base Shear Force	1.6406
Base Normal Force	8.8273
Left Side Normal Force	12.852
Right Side Normal Force	8.1919

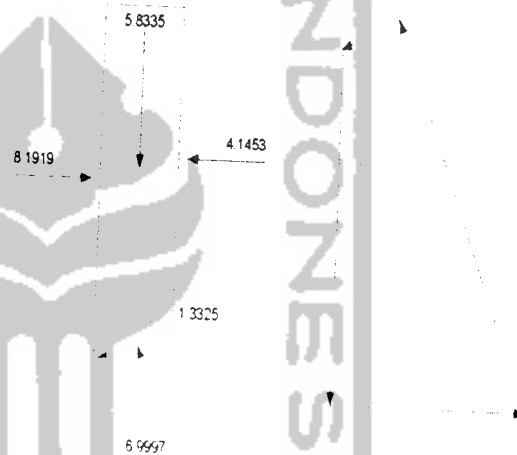
Slice 28 - Bishop Method



Slice 29 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	10.011
Pore Water Pressure	36.53
Pore Water Force	21.511
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.5368
Mid-Height	0.72448
Base Length	0.58886
Base Angle	24.273
Polygon Closure	0.035
Anisotropic Strength Modifier	1
Weight	5.8335
Base Shear Force	1.3325
Base Normal Force	6.9997
Left Side Normal Force	8.1919
Right Side Normal Force	4.1453

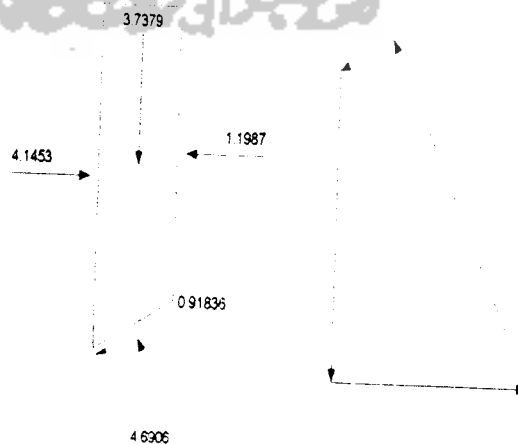
Slice 29 - Bishop Method



Slice 30 - Bishop Method

Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	10.286
Pore Water Pressure	33.978
Pore Water Force	20.559
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.5368
Mid-Height	0.46422
Base Length	0.60507
Base Angle	27.48
Polygon Closure	0.02345
Anisotropic Strength Modifier	1
Weight	3.7379
Base Shear Force	0.91836
Base Normal Force	4.6906
Left Side Normal Force	4.1453
Right Side Normal Force	1.1987

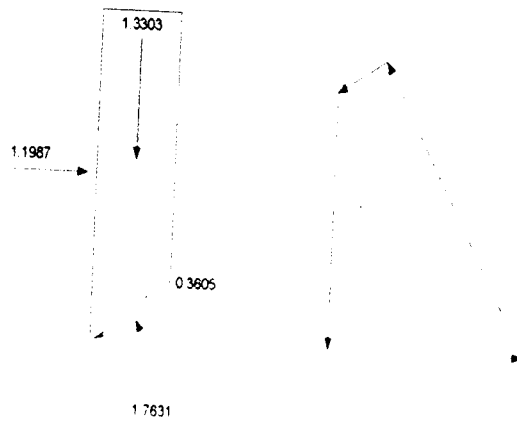
Slice 30 - Bishop Method



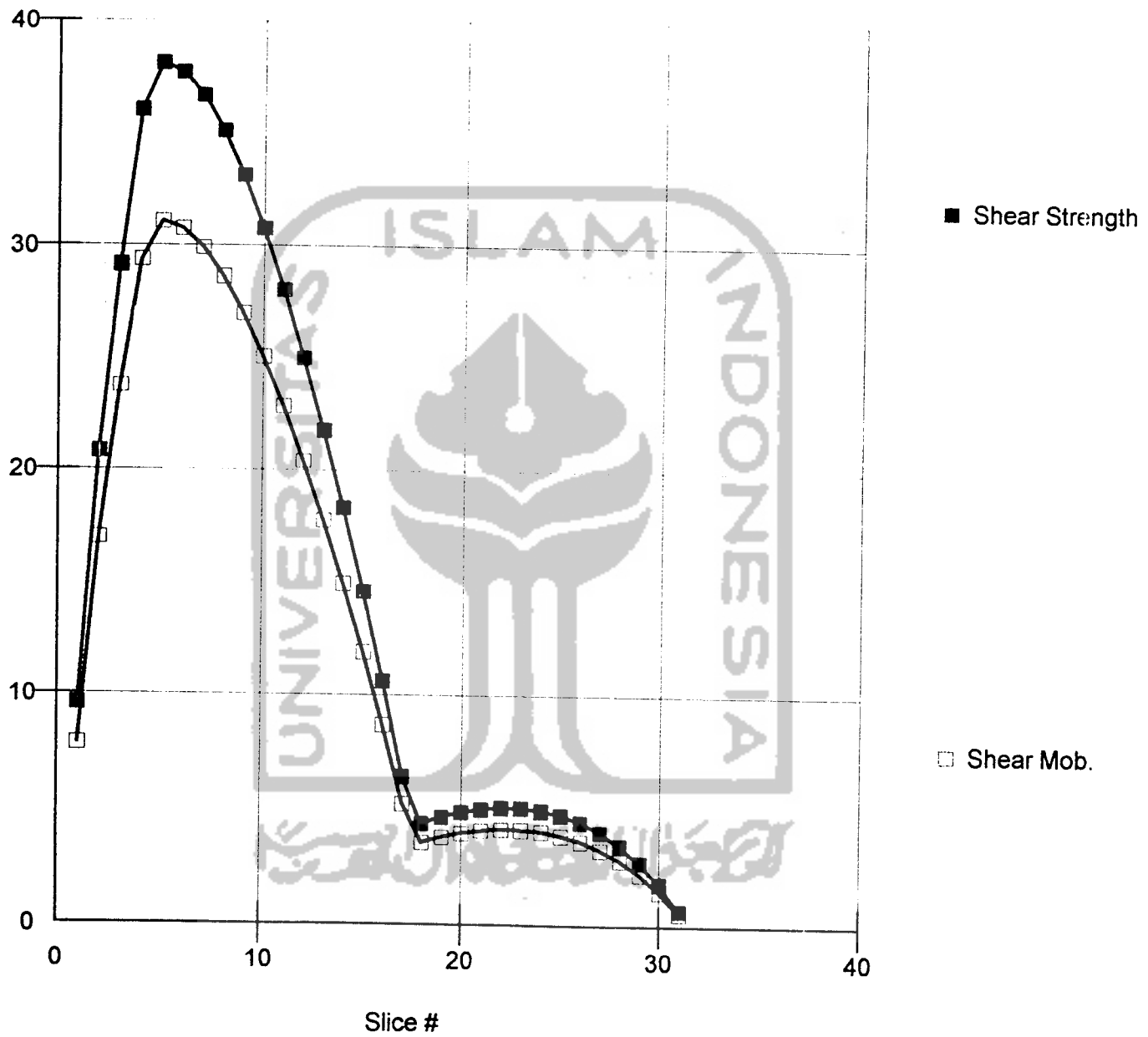
Slice 31 - Bishop Method

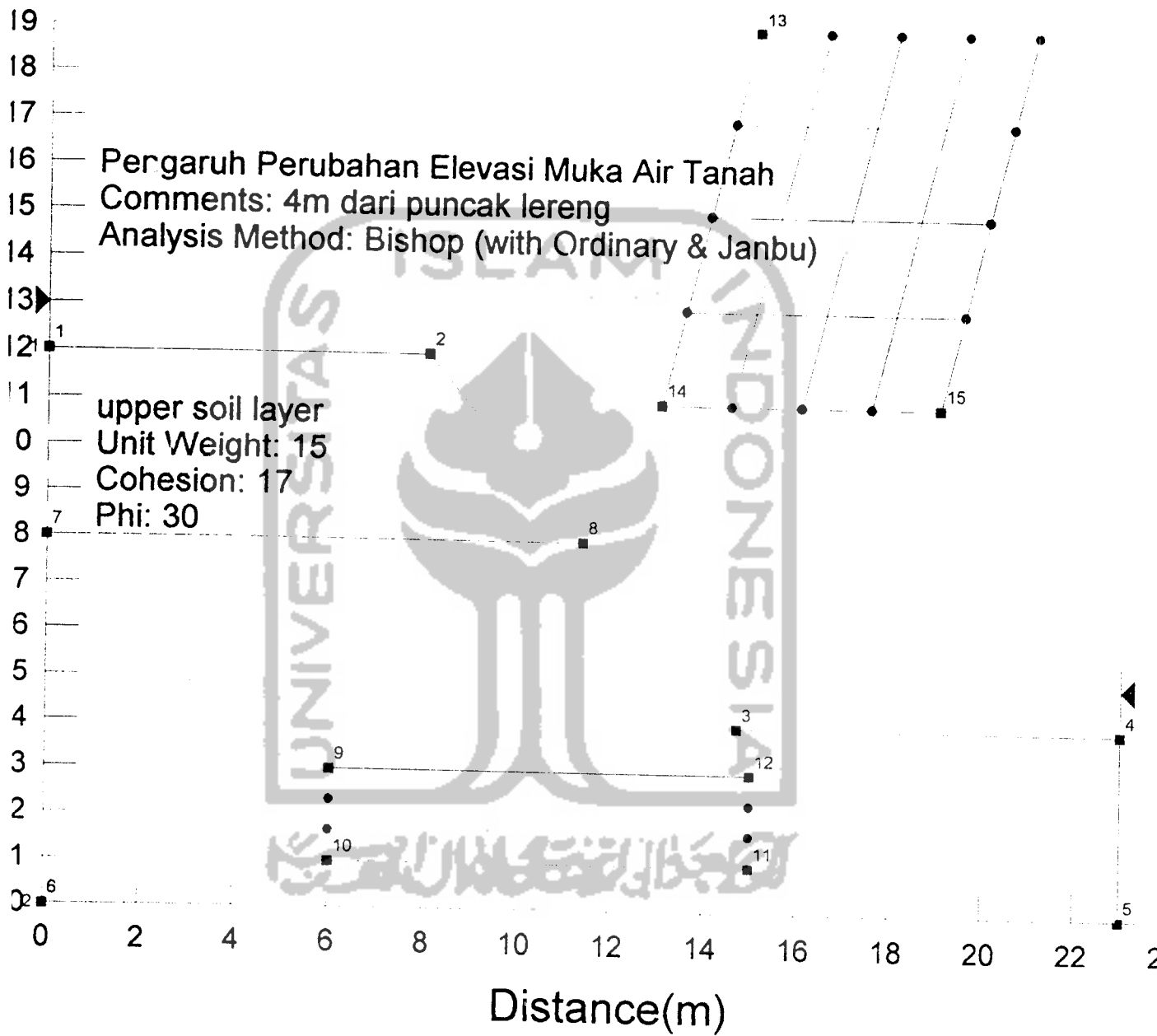
Factor of Safety	1.226
Phi Angle	30
C (Strength)	17
C (Force)	10.622
Pore Water Pressure	31.045
Pore Water Force	19.398
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.5368
Mid-Height	0.16522
Base Length	0.62483
Base Angle	30.783
Polygon Closure	0.00882
Anisotropic Strength Modifier	1
Weight	1.3303
Base Shear Force	0.3605
Base Normal Force	1.7631
Left Side Normal Force	1.1987

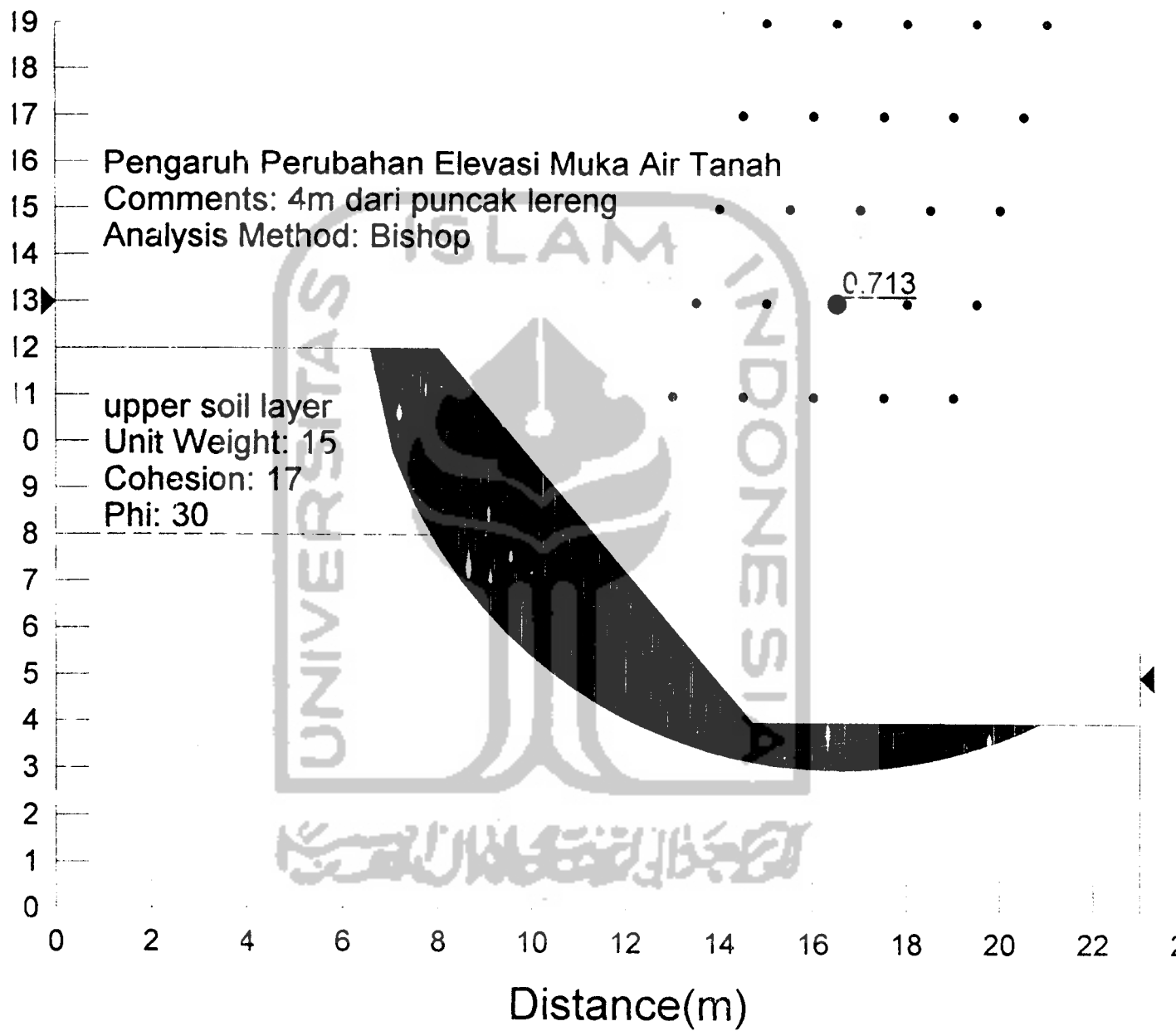
Slice 31 - Bishop Method



Shear Resistance vs. Slice #





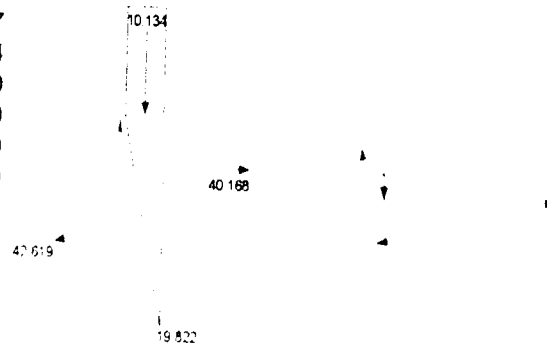


OUT PUT ANALISIS STABILITAS LERENG DENGAN ELEVASI MUKA AIR TANAH -4M

Slice 1 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	38.664
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.48329
Mid-Height	1.398
Base Length	2.2743
Base Angle	77.731
Polygon Closure	5.5405
Anisotropic Strength Modifier	1
Weight	10.134
Base Shear Force	19.822
Base Normal Force	42.619
Right Side Normal Force	40.168

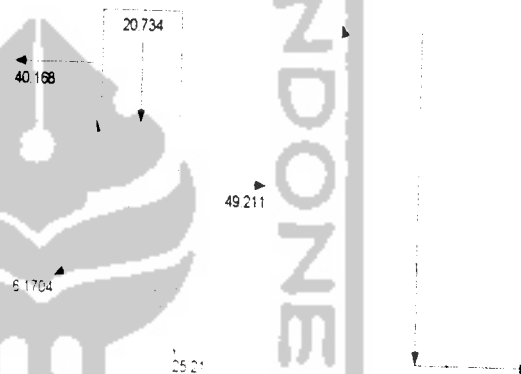
Slice 1 - Bishop Method



Slice 2 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	21.533
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.48329
Mid-Height	2.8601
Base Length	1.2667
Base Angle	67.57
Polygon Closure	6.1764
Anisotropic Strength Modifier	1
Weight	20.734
Base Shear Force	25.21
Base Normal Force	6.1704
Left Side Normal Force	40.168
Right Side Normal Force	49.211

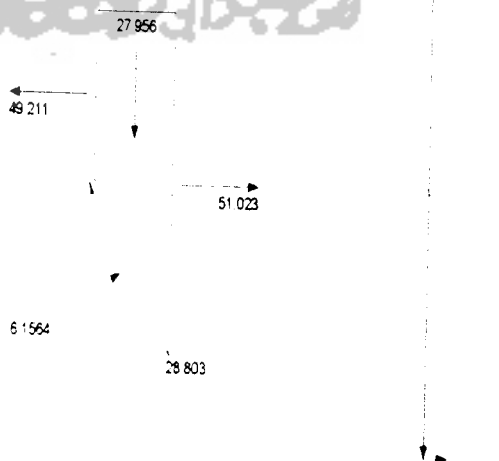
Slice 2 - Bishop Method



Slice 3 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	16.987
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.48329
Mid-Height	3.8563
Base Length	0.99924
Base Angle	61.075
Polygon Closure	6.9127
Anisotropic Strength Modifier	1
Weight	27.956
Base Shear Force	28.803
Base Normal Force	6.1564
Left Side Normal Force	49.211
Right Side Normal Force	51.023

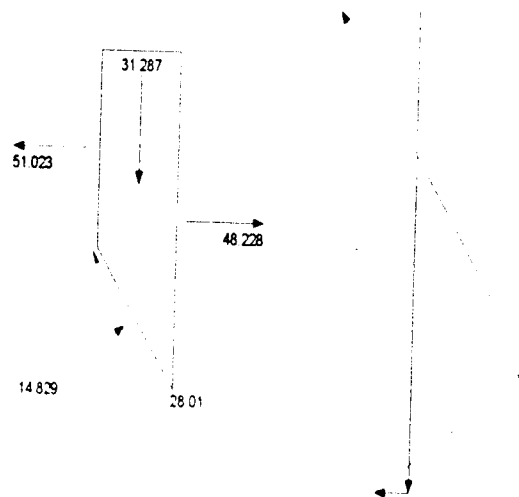
Slice 3 - Bishop Method



Slice 4 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	14.489
Pore Water Pressure	6.2419
Pore Water Force	5.3198
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47943
Mid-Height	4.3506
Base Length	0.85228
Base Angle	55.769
Polygon Closure	6.2574
Anisotropic Strength Modifier	1
Weight	31.287
Base Shear Force	28.01
Base Normal Force	14.829
Left Side Normal Force	51.023
Right Side Normal Force	48.228

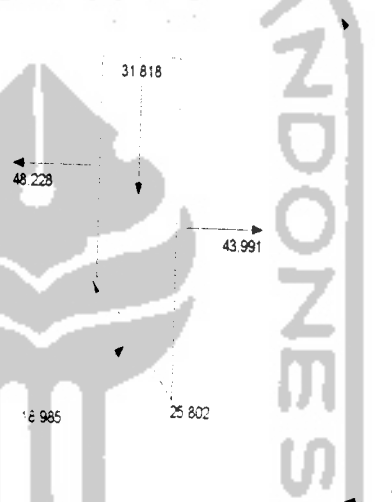
Slice 4 - Bishop Method



Slice 5 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	12.989
Pore Water Pressure	12.571
Pore Water Force	9.6057
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47943
Mid-Height	4.4244
Base Length	0.76409
Base Angle	51.138
Polygon Closure	5.5682
Anisotropic Strength Modifier	1
Weight	31.818
Base Shear Force	25.802
Base Normal Force	18.985
Left Side Normal Force	48.228
Right Side Normal Force	43.991

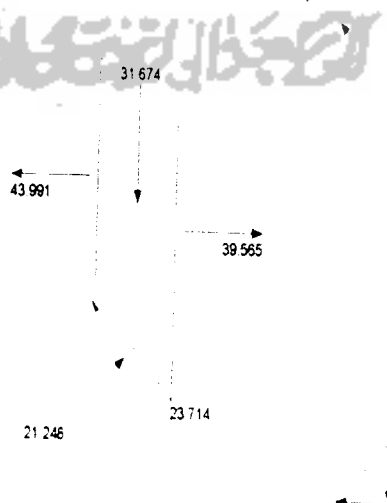
Slice 5 - Bishop Method



Slice 6 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	11.936
Pore Water Pressure	17.979
Pore Water Force	12.624
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47943
Mid-Height	4.4044
Base Length	0.70214
Base Angle	46.936
Polygon Closure	4.9095
Anisotropic Strength Modifier	1
Weight	31.674
Base Shear Force	23.714
Base Normal Force	21.248
Left Side Normal Force	43.991
Right Side Normal Force	39.565

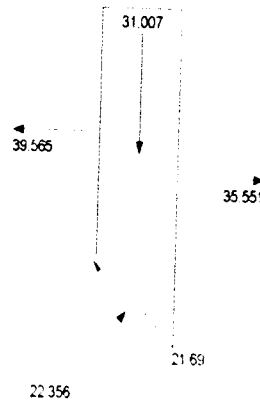
Slice 6 - Bishop Method



Slice 7 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	11.152
Pore Water Pressure	22.675
Pore Water Force	14.875
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47943
Mid-Height	4.3117
Base Length	0.65601
Base Angle	43.045
Polygon Closure	4.341
Anisotropic Strength Modifier	1
Weight	31.007
Base Shear Force	21.69
Base Normal Force	22.356
Left Side Normal Force	39.565
Right Side Normal Force	35.551

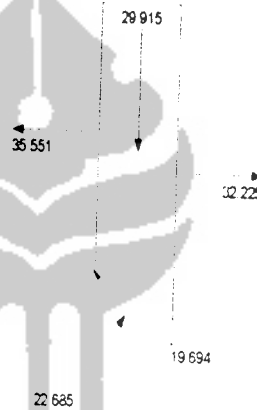
Slice 7 - Bishop Method



Slice 8 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	10.545
Pore Water Pressure	26.789
Pore Water Force	16.618
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47943
Mid-Height	4.1598
Base Length	0.62032
Base Angle	39.388
Polygon Closure	4.1881
Anisotropic Strength Modifier	1
Weight	29.915
Base Shear Force	19.694
Base Normal Force	22.685
Left Side Normal Force	35.551
Right Side Normal Force	32.225

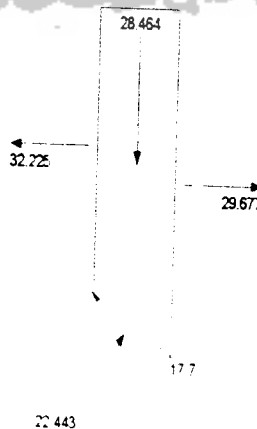
Slice 8 - Bishop Method



Slice 9 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	10.063
Pore Water Pressure	30.414
Pore Water Force	18.004
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47943
Mid-Height	3.958
Base Length	0.59196
Base Angle	35.914
Polygon Closure	3.558
Anisotropic Strength Modifier	1
Weight	28.464
Base Shear Force	17.7
Base Normal Force	22.443
Left Side Normal Force	32.225
Right Side Normal Force	29.677

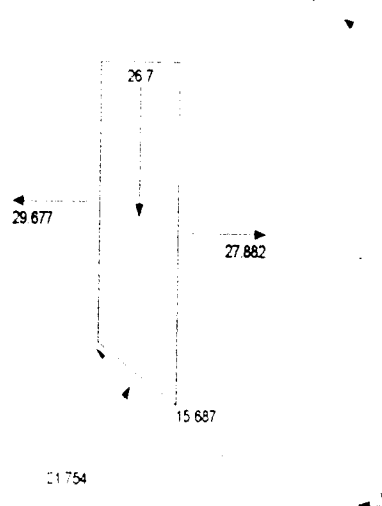
Slice 9 - Bishop Method



Slice 10 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	9.6732
Pore Water Pressure	33.615
Pore Water Force	19.127
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47943
Mid-Height	3.7128
Base Length	0.56901
Base Angle	32.588
Polygon Closure	3.204
Anisotropic Strength Modifier	1
Weight	26.7
Base Shear Force	15.687
Base Normal Force	21.754
Left Side Normal Force	29.677
Right Side Normal Force	27.882

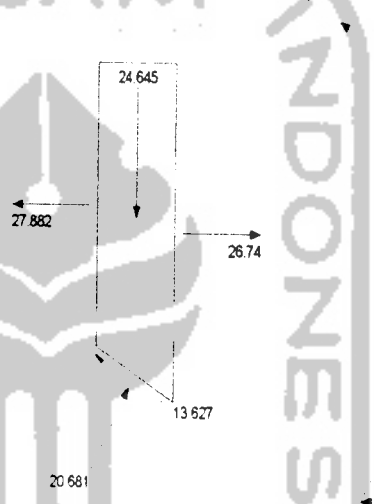
Slice 10 - Bishop Method



Slice 11 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	9.3478
Pore Water Pressure	36.438
Pore Water Force	20.035
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47914
Mid-Height	3.429
Base Length	0.54987
Base Angle	29.382
Polygon Closure	2.8342
Anisotropic Strength Modifier	1
Weight	24.645
Base Shear Force	13.627
Base Normal Force	20.681
Left Side Normal Force	27.882
Right Side Normal Force	26.74

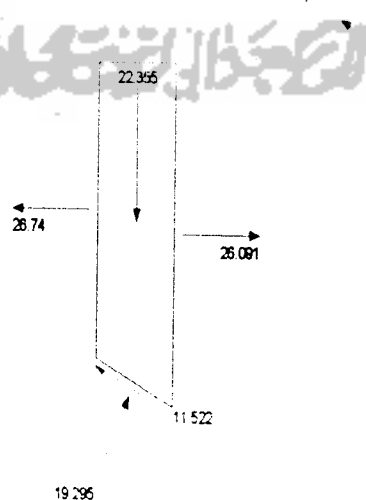
Slice 11 - Bishop Method



Slice 12 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	9.0841
Pore Water Pressure	38.914
Pore Water Force	20.794
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47915
Mid-Height	3.1104
Base Length	0.53436
Base Angle	26.275
Polygon Closure	2.3473
Anisotropic Strength Modifier	1
Weight	22.355
Base Shear Force	11.522
Base Normal Force	19.295
Left Side Normal Force	26.74
Right Side Normal Force	26.091

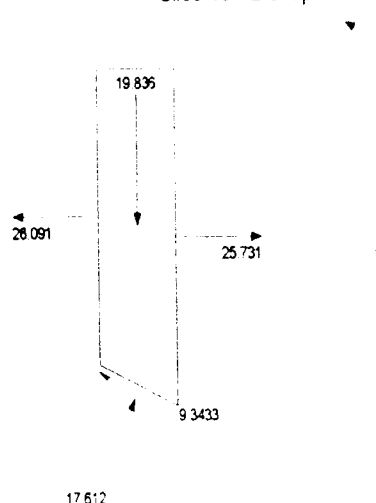
Slice 12 - Bishop Method



Slice 13 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.8654
Pore Water Pressure	41.08
Pore Water Force	21.423
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47914
Mid-Height	2.7599
Base Length	0.52149
Base Angle	23.25
Polygon Closure	1.9836
Anisotropic Strength Modifier	1
Weight	19.836
Base Shear Force	9.3433
Base Normal Force	17.612
Left Side Normal Force	26.091
Right Side Normal Force	25.731

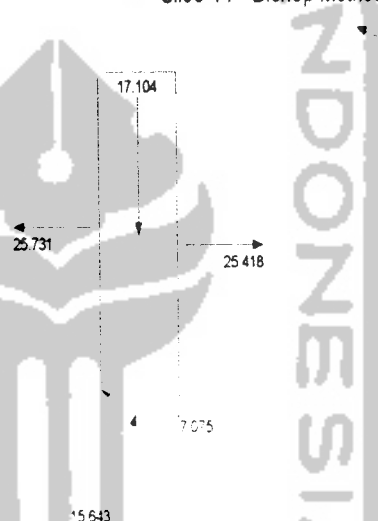
Slice 13 - Bishop Method



Slice 14 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.6844
Pore Water Pressure	42.958
Pore Water Force	21.945
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47914
Mid-Height	2.3798
Base Length	0.51085
Base Angle	20.293
Polygon Closure	1.3683
Anisotropic Strength Modifier	1
Weight	17.104
Base Shear Force	7.075
Base Normal Force	15.643
Left Side Normal Force	25.731
Right Side Normal Force	25.418

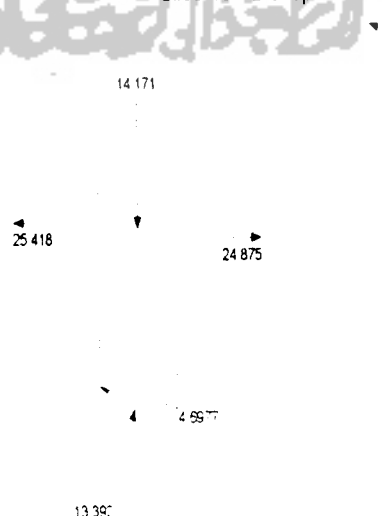
Slice 14 - Bishop Method



Slice 15 - Bishop Method

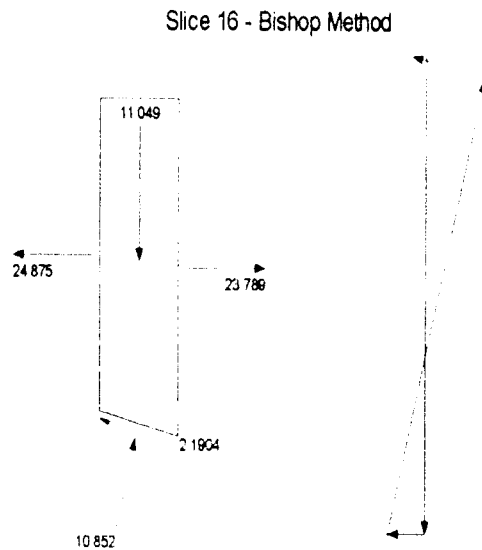
Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.5355
Pore Water Pressure	44.56
Pore Water Force	22.373
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47914
Mid-Height	1.9718
Base Length	0.50209
Base Angle	17.39
Polygon Closure	0.92111
Anisotropic Strength Modifier	1
Weight	14.171
Base Shear Force	4.6977
Base Normal Force	13.392
Left Side Normal Force	25.418
Right Side Normal Force	24.875

Slice 15 - Bishop Method



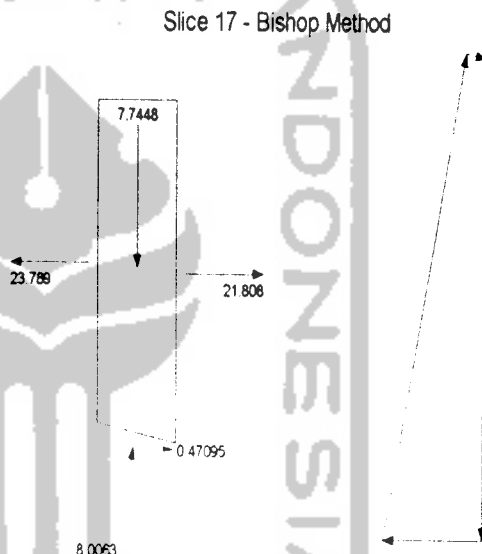
Slice 16 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.4148
Pore Water Pressure	45.902
Pore Water Force	22.721
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47915
Mid-Height	1.5373
Base Length	0.49499
Base Angle	14.533
Polygon Closure	0.38671
Anisotropic Strength Modifier	1
Weight	11.049
Base Shear Force	2.1904
Base Normal Force	10.852
Left Side Normal Force	24.875
Right Side Normal Force	23.789



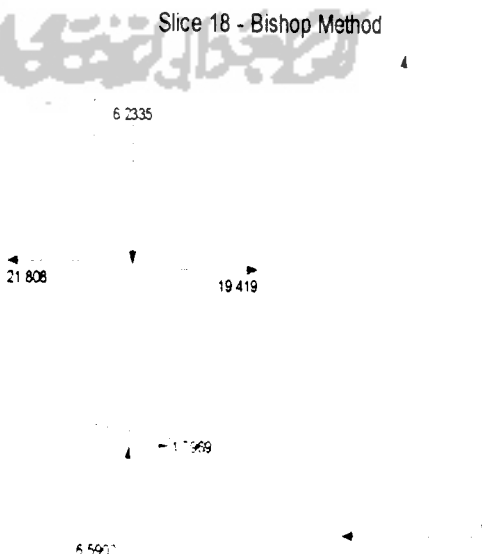
Slice 17 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.3186
Pore Water Pressure	46.999
Pore Water Force	22.998
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47914
Mid-Height	1.0776
Base Length	0.48933
Base Angle	11.714
Polygon Closure	0.04003
Anisotropic Strength Modifier	1
Weight	7.7448
Base Shear Force	0.47095
Base Normal Force	8.0063
Left Side Normal Force	23.789
Right Side Normal Force	21.808



Slice 18 - Bishop Method

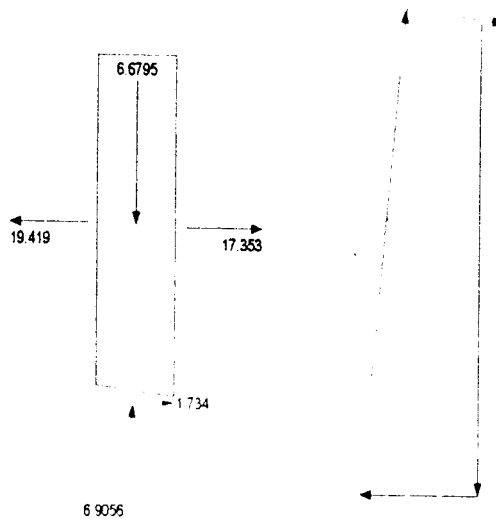
Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.1397
Pore Water Pressure	47.848
Pore Water Force	22.91
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47299
Mid-Height	0.87859
Base Length	0.47881
Base Angle	8.9397
Polygon Closure	0.39541
Anisotropic Strength Modifier	1
Weight	6.2335
Base Shear Force	1.7969
Base Normal Force	6.5902
Left Side Normal Force	21.808
Right Side Normal Force	19.419



Slice 19 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.0882
Pore Water Pressure	48.466
Pore Water Force	23.059
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47299
Mid-Height	0.94145
Base Length	0.47578
Base Angle	6.2048
Polygon Closure	0.37981
Anisotropic Strength Modifier	1
Weight	6.6795
Base Shear Force	1.734
Base Normal Force	6.9056
Left Side Normal Force	19.419
Right Side Normal Force	17.353

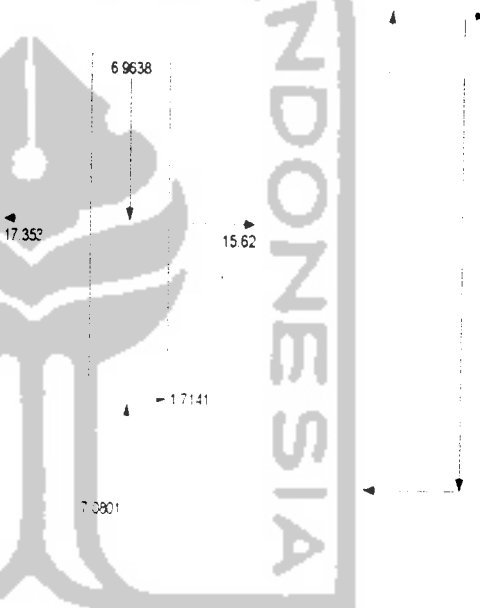
Slice 19 - Bishop Method



Slice 20 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.0559
Pore Water Pressure	48.857
Pore Water Force	23.152
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.473
Mid-Height	0.98153
Base Length	0.47388
Base Angle	3.4839
Polygon Closure	0.38941
Anisotropic Strength Modifier	1
Weight	6.9638
Base Shear Force	1.7141
Base Normal Force	7.0801
Left Side Normal Force	17.353
Right Side Normal Force	15.62

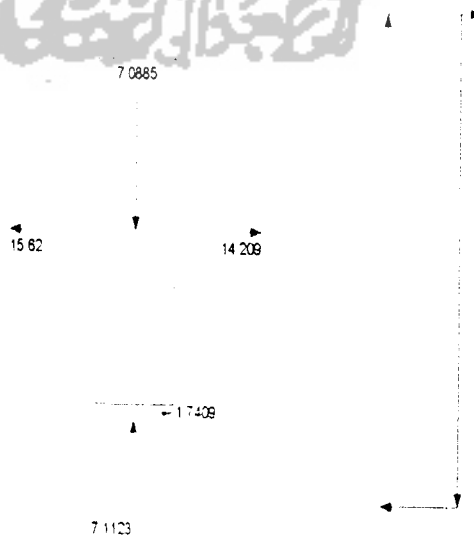
Slice 20 - Bishop Method



Slice 21 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.0416
Pore Water Pressure	49.03
Pore Water Force	23.193
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47299
Mid-Height	0.9991
Base Length	0.47303
Base Angle	0.771
Polygon Closure	0.35561
Anisotropic Strength Modifier	1
Weight	7.0885
Base Shear Force	1.7409
Base Normal Force	7.1123
Left Side Normal Force	15.62
Right Side Normal Force	14.209

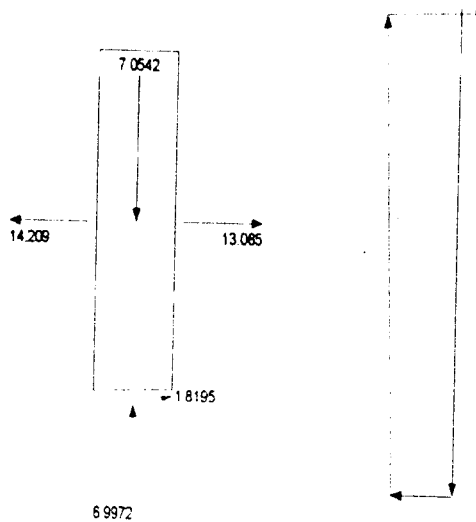
Slice 21 - Bishop Method



Slice 22 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.0454
Pore Water Pressure	48.984
Pore Water Force	23.182
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47299
Mid-Height	0.99427
Base Length	0.47326
Base Angle	1.9402
Polygon Closure	0.45852
Anisotropic Strength Modifier	1
Weight	7.0542
Base Shear Force	1.8195
Base Normal Force	6.9972
Left Side Normal Force	14.209
Right Side Normal Force	13.085

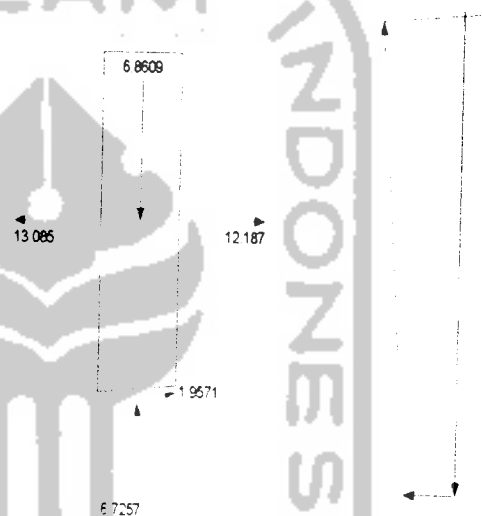
Slice 22 - Bishop Method



Slice 23 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.0675
Pore Water Pressure	48.717
Pore Water Force	23.119
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47299
Mid-Height	0.96702
Base Length	0.47456
Base Angle	4.6558
Polygon Closure	0.51457
Anisotropic Strength Modifier	1
Weight	6.8609
Base Shear Force	1.9571
Base Normal Force	6.7257
Left Side Normal Force	13.085
Right Side Normal Force	12.187

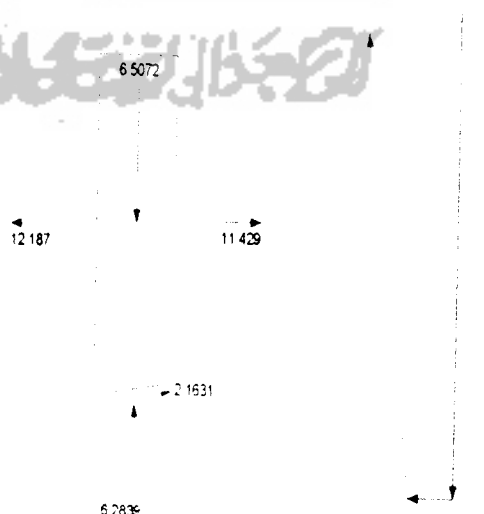
Slice 23 - Bishop Method



Slice 24 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.1082
Pore Water Pressure	48.227
Pore Water Force	23.002
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.473
Mid-Height	0.91717
Base Length	0.47695
Base Angle	7.3818
Polygon Closure	0.58585
Anisotropic Strength Modifier	1
Weight	6.5072
Base Shear Force	2.1631
Base Normal Force	6.2836
Left Side Normal Force	12.187
Right Side Normal Force	11.429

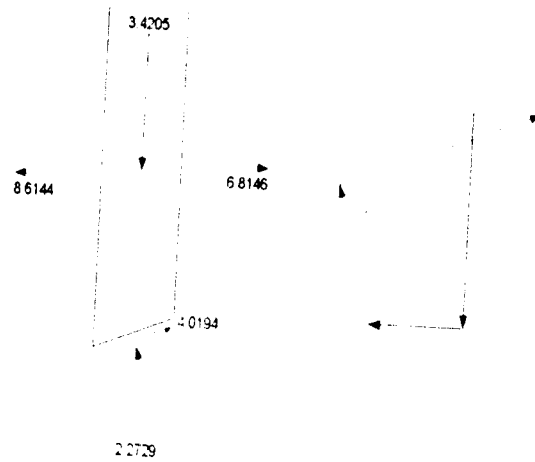
Slice 24 - Bishop Method



Slice 28 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.4803
Pore Water Pressure	43.96
Pore Water Force	21.929
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47299
Mid-Height	0.48211
Base Length	0.49884
Base Angle	18.526
Polygon Closure	1.3063
Anisotropic Strength Modifier	1
Weight	3.4205
Base Shear Force	4.0194
Base Normal Force	2.2729
Left Side Normal Force	8.6144
Right Side Normal Force	6.8146

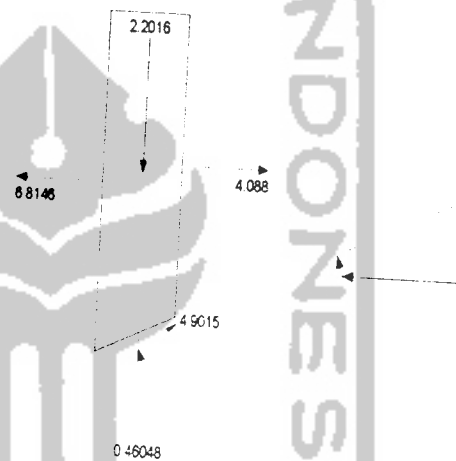
Slice 28 - Bishop Method



Slice 29 - Bishop Method

Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.6371
Pore Water Pressure	42.274
Pore Water Force	21.478
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.473
Mid-Height	0.31031
Base Length	0.50806
Base Angle	21.411
Polygon Closure	1.891
Anisotropic Strength Modifier	1
Weight	2.2016
Base Shear Force	4.9015
Base Normal Force	0.46048
Left Side Normal Force	6.8146
Right Side Normal Force	4.088

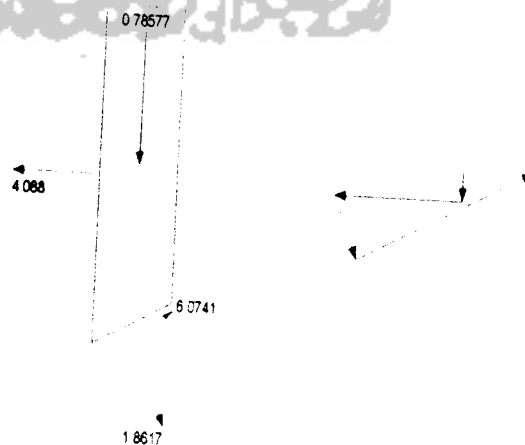
Slice 29 - Bishop Method



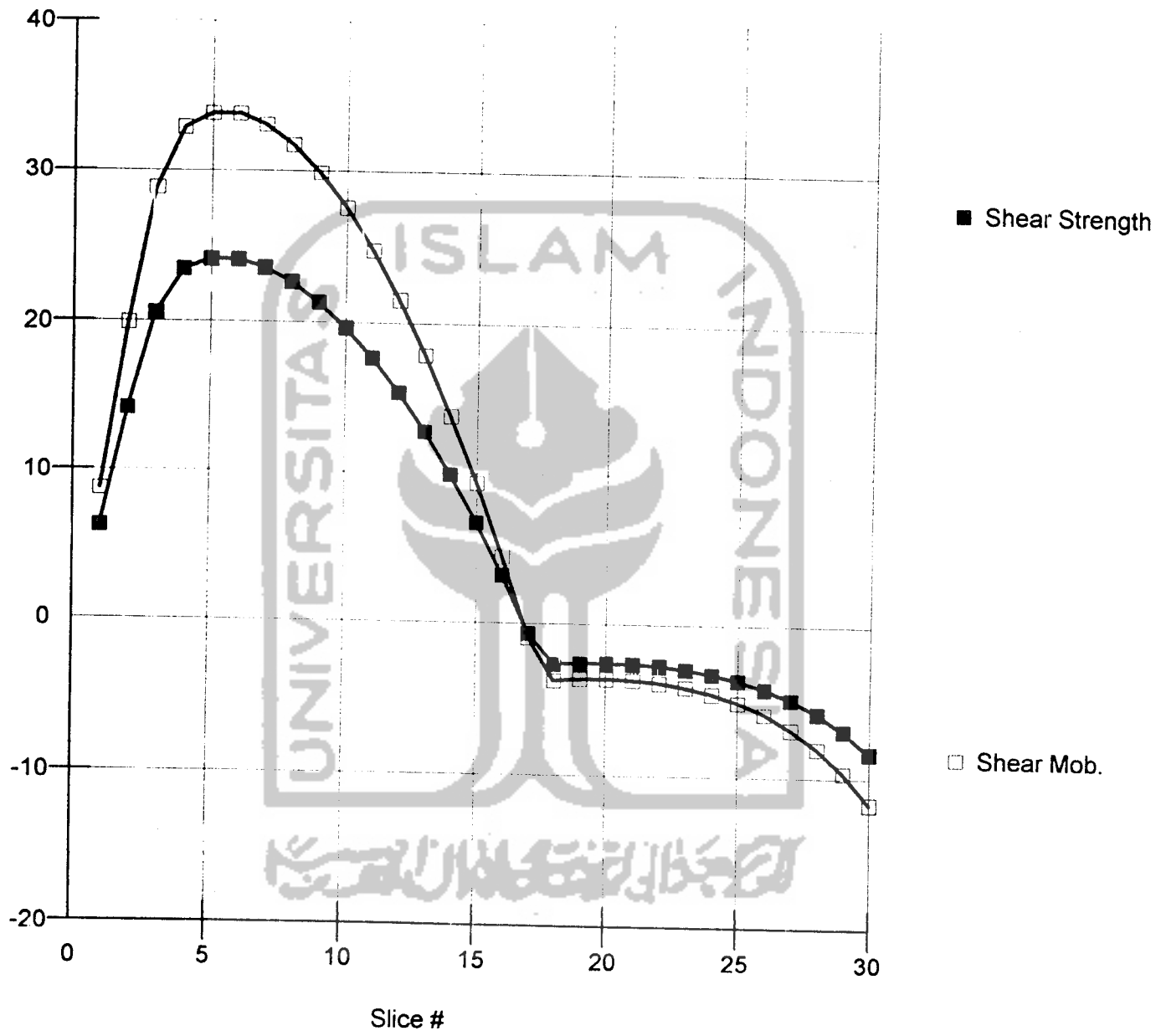
Slice 30 - Bishop Method

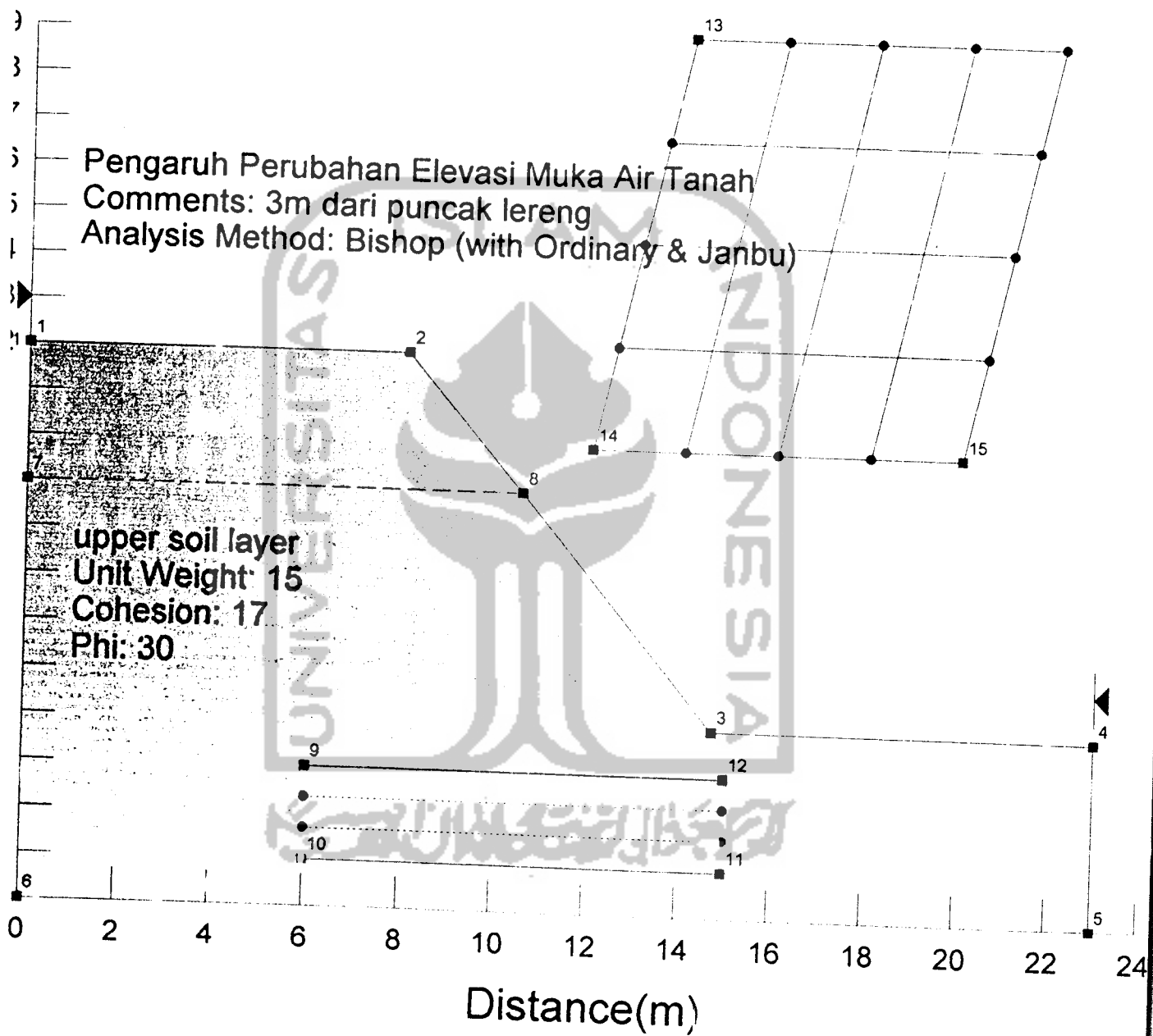
Factor of Safety	0.71342
Phi Angle	30
C (Strength)	17
C (Force)	8.8263
Pore Water Pressure	40.318
Pore Water Force	20.933
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.47299
Mid-Height	0.11075
Base Length	0.51919
Base Angle	24.354
Polygon Closure	2.217
Anisotropic Strength Modifier	1
Weight	0.78577
Base Shear Force	6.0741
Base Normal Force	1.8617
Left Side Normal Force	4.088

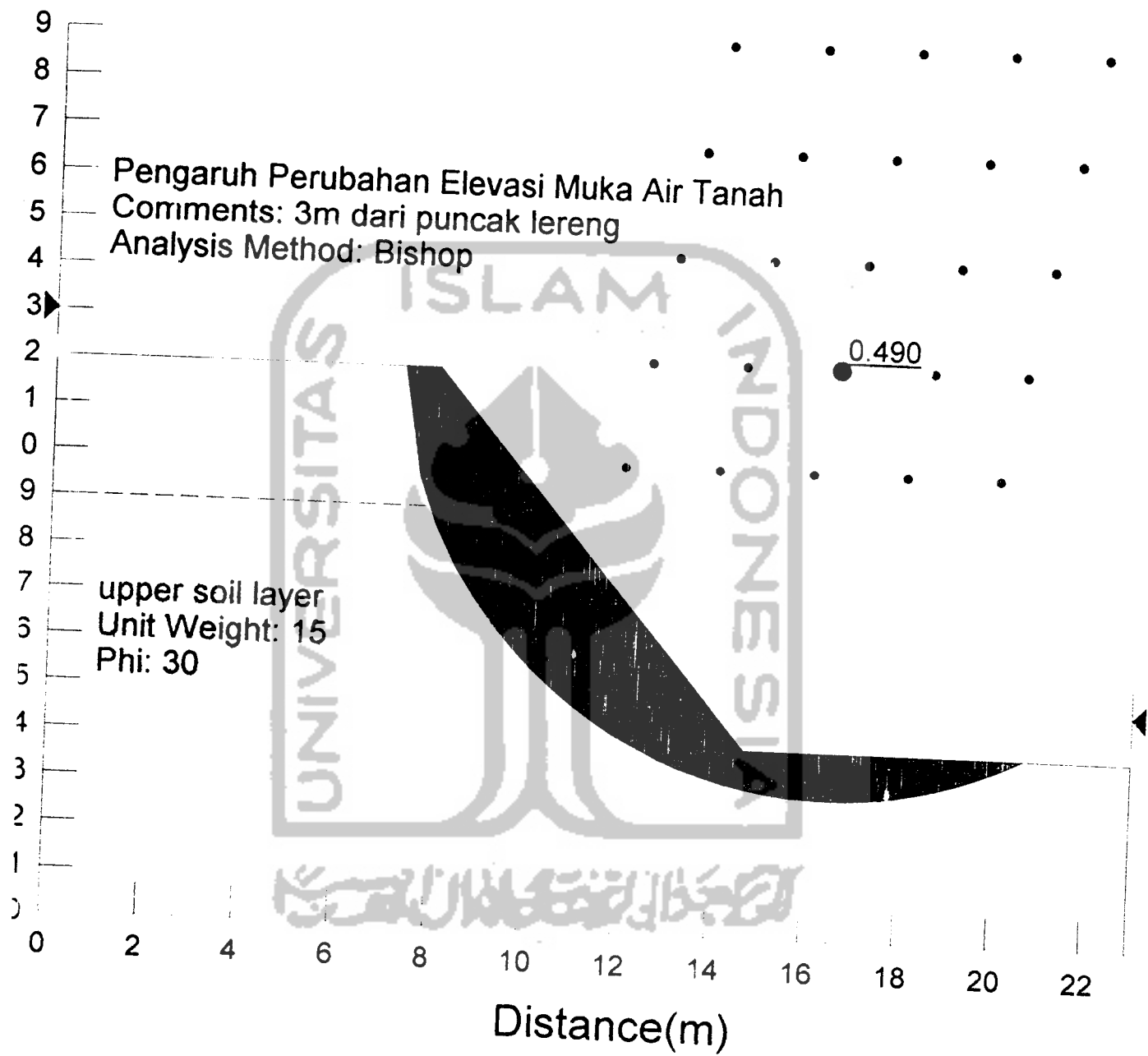
Slice 30 - Bishop Method



Shear Resistance vs. Slice #





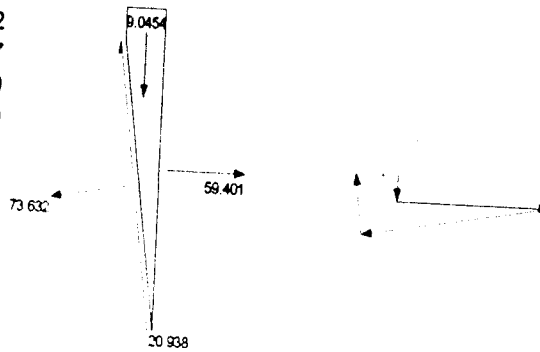


OUT PUT ANALISIS STABILITAS LERENG DENGAN ELEVASI MUKA AIR TANAH -3M

Slice 1 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	52.627
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.37331
Mid-Height	1.6153
Base Length	2.3921
Base Angle	81.022
Polygon Closure	16.199
Anisotropic Strength Modifier	1
Weight	9.0454
Base Shear Force	20.938
Base Normal Force	73.632
Right Side Normal Force	59.401

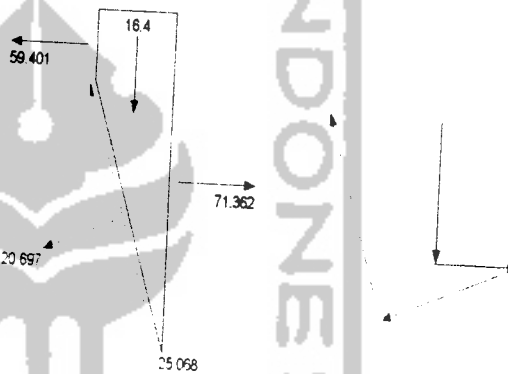
Slice 1 - Bishop Method



Slice 2 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	24.222
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.37331
Mid-Height	2.9288
Base Length	1.101
Base Angle	70.18
Polygon Closure	15.918
Anisotropic Strength Modifier	1
Weight	16.4
Base Shear Force	25.068
Base Normal Force	20.697
Left Side Normal Force	59.401
Right Side Normal Force	71.362

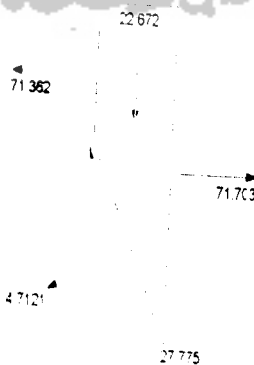
Slice 2 - Bishop Method



Slice 3 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	20.92
Pore Water Pressure	8.3688
Pore Water Force	7.9578
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.4195
Mid-Height	3.603
Base Length	0.95091
Base Angle	63.822
Polygon Closure	15.971
Anisotropic Strength Modifier	1
Weight	22.672
Base Shear Force	27.775
Base Normal Force	4.7121
Left Side Normal Force	71.362
Right Side Normal Force	71.703

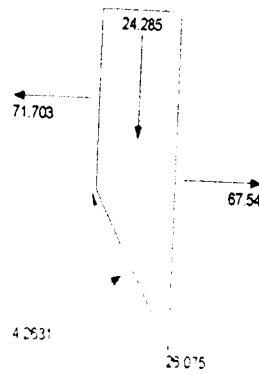
Slice 3 - Bishop Method



Slice 4 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	17.611
Pore Water Pressure	15.789
Pore Water Force	12.639
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.4195
Mid-Height	3.8594
Base Length	0.8005
Base Angle	58.396
Polygon Closure	14.08
Anisotropic Strength Modifier	1
Weight	24.285
Base Shear Force	26.075
Base Normal Force	4.2631
Left Side Normal Force	71.703
Right Side Normal Force	67.54

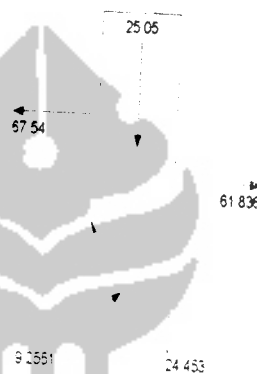
Slice 4 - Bishop Method



Slice 5 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	15.597
Pore Water Pressure	21.885
Pore Water Force	15.515
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.4195
Mid-Height	3.981
Base Length	0.70893
Base Angle	53.72
Polygon Closure	12.775
Anisotropic Strength Modifier	1
Weight	25.05
Base Shear Force	24.453
Base Normal Force	9.2551
Left Side Normal Force	67.54
Right Side Normal Force	61.836

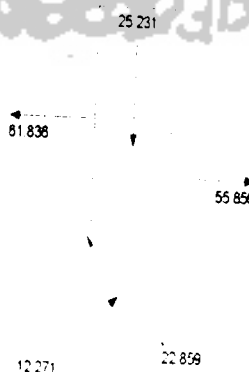
Slice 5 - Bishop Method



Slice 6 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	14.217
Pore Water Pressure	27.07
Pore Water Force	17.493
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.4195
Mid-Height	4.0097
Base Length	0.64622
Base Angle	49.522
Polygon Closure	11.48
Anisotropic Strength Modifier	1
Weight	25.231
Base Shear Force	22.859
Base Normal Force	12.271
Left Side Normal Force	61.836
Right Side Normal Force	55.856

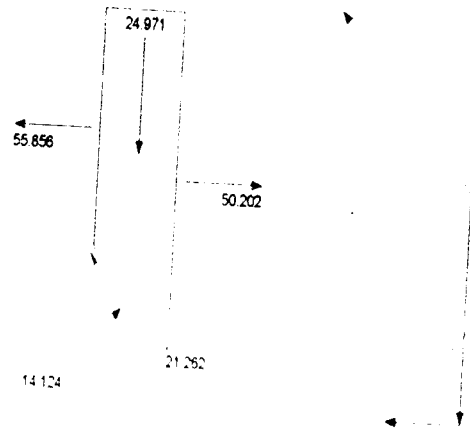
Slice 6 - Bishop Method



Slice 7 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	13.205
Pore Water Pressure	31.568
Pore Water Force	18.948
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.4195
Mid-Height	3.9684
Base Length	0.60022
Base Angle	45.661
Polygon Closure	10.363
Anisotropic Strength Modifier	1
Weight	24.971
Base Shear Force	21.262
Base Normal Force	14.124
Left Side Normal Force	55.856
Right Side Normal Force	50.202

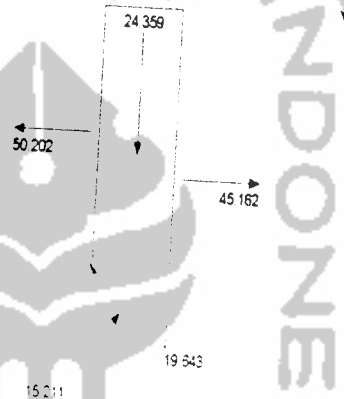
Slice 7 - Bishop Method



Slice 8 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	12.429
Pore Water Pressure	35.518
Pore Water Force	20.066
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.4195
Mid-Height	3.8711
Base Length	0.56495
Base Angle	42.051
Polygon Closure	9.3782
Anisotropic Strength Modifier	1
Weight	24.359
Base Shear Force	19.643
Base Normal Force	15.211
Left Side Normal Force	50.202
Right Side Normal Force	45.162

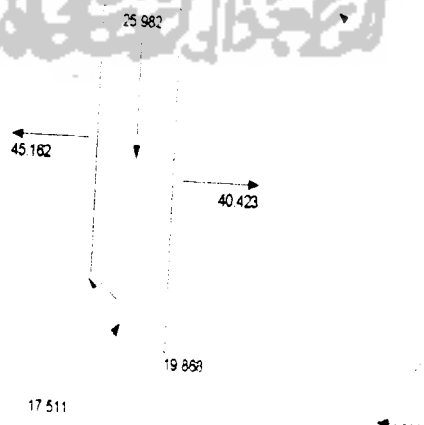
Slice 8 - Bishop Method



Slice 9 - Bishop Method

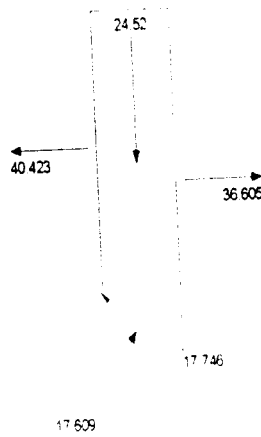
Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	13.089
Pore Water Pressure	39.192
Pore Water Force	23.318
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46589
Mid-Height	3.7179
Base Length	0.59496
Base Angle	38.459
Polygon Closure	9.3535
Anisotropic Strength Modifier	1
Weight	25.982
Base Shear Force	19.868
Base Normal Force	17.511
Left Side Normal Force	45.182
Right Side Normal Force	40.423

Slice 9 - Bishop Method



Slice 10 - Bishop Method

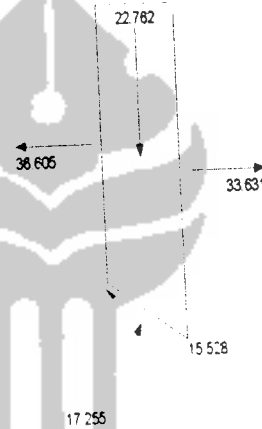
Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	12.491
Pore Water Pressure	42.59
Pore Water Force	24.181
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46589
Mid-Height	3.5088
Base Length	0.56776
Base Angle	34.857
Polygon Closure	8.3368
Anisotropic Strength Modifier	1
Weight	24.52
Base Shear Force	17.746
Base Normal Force	17.609
Left Side Normal Force	40.423
Right Side Normal Force	36.605



Slice 10 - Bishop Method

Slice 11 - Bishop Method

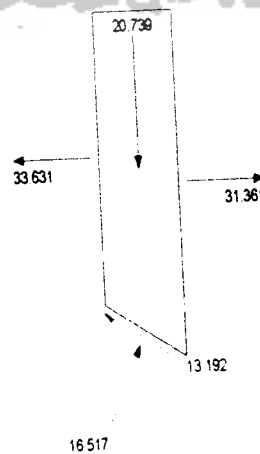
Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	12.009
Pore Water Pressure	45.57
Pore Water Force	24.875
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46589
Mid-Height	3.2571
Base Length	0.54587
Base Angle	31.407
Polygon Closure	7.2838
Anisotropic Strength Modifier	1
Weight	22.762
Base Shear Force	15.528
Base Normal Force	17.255
Left Side Normal Force	36.605
Right Side Normal Force	33.631



Slice 11 - Bishop Method

Slice 12 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	11.617
Pore Water Pressure	48.179
Pore Water Force	25.441
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46589
Mid-Height	2.9676
Base Length	0.52805
Base Angle	28.081
Polygon Closure	6.118
Anisotropic Strength Modifier	1
Weight	20.739
Base Shear Force	13.192
Base Normal Force	16.517
Left Side Normal Force	33.631
Right Side Normal Force	31.361

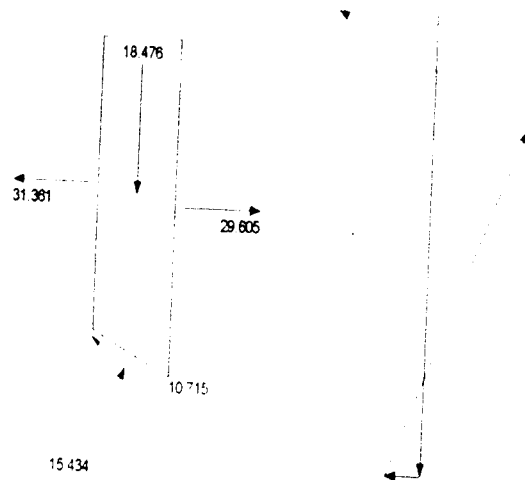


Slice 12 - Bishop Method

Slice 13 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	11.296
Pore Water Pressure	50.454
Pore Water Force	25.905
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46588
Mid-Height	2.6439
Base Length	0.51344
Base Angle	24.855
Polygon Closure	4.8961
Anisotropic Strength Modifier	1
Weight	18.476
Base Shear Force	10.715
Base Normal Force	15.434
Left Side Normal Force	31.361
Right Side Normal Force	29.605

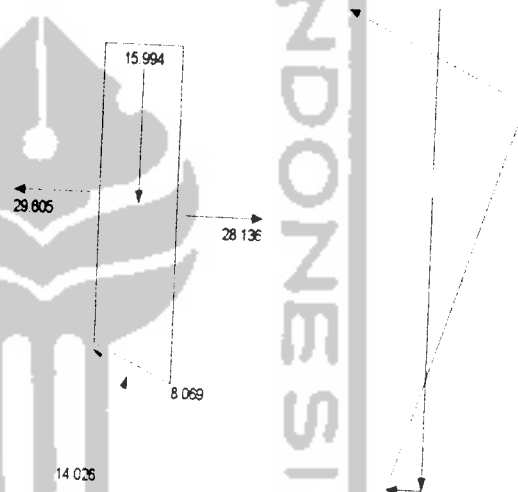
Slice 13 - Bishop Method



Slice 14 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	11.032
Pore Water Pressure	52.419
Pore Water Force	26.286
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46589
Mid-Height	2.2887
Base Length	0.50146
Base Angle	21.711
Polygon Closure	3.6786
Anisotropic Strength Modifier	1
Weight	15.994
Base Shear Force	8.069
Base Normal Force	14.026
Left Side Normal Force	29.605
Right Side Normal Force	28.136

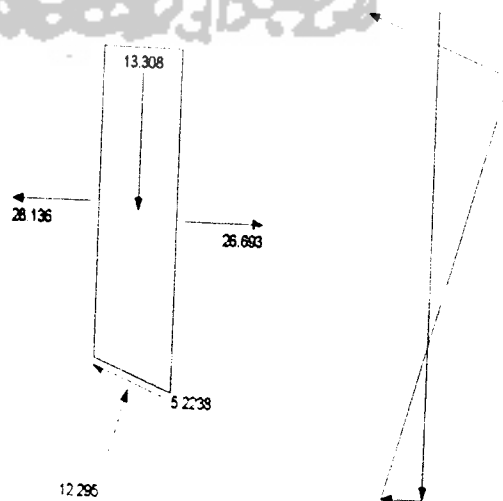
Slice 14 - Bishop Method



Slice 15 - Bishop Method

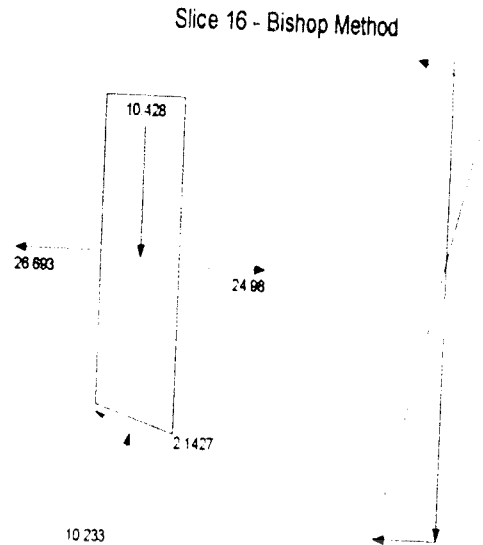
Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.817
Pore Water Pressure	54.096
Pore Water Force	26.597
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46589
Mid-Height	1.9043
Base Length	0.49167
Base Angle	18.635
Polygon Closure	2.3954
Anisotropic Strength Modifier	1
Weight	13.308
Base Shear Force	5.2238
Base Normal Force	12.295
Left Side Normal Force	28.136
Right Side Normal Force	26.693

Slice 15 - Bishop Method



Slice 16 - Bishop Method

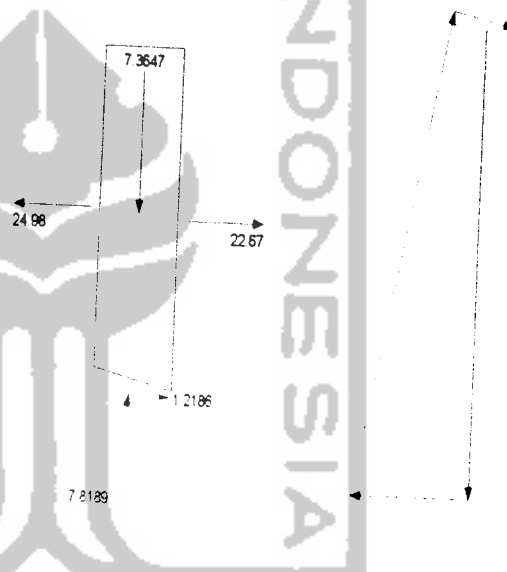
Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.642
Pore Water Pressure	55.503
Pore Water Force	26.849
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46589
Mid-Height	1.4922
Base Length	0.48374
Base Angle	15.614
Polygon Closure	0.99066
Anisotropic Strength Modifier	1
Weight	10.428
Base Shear Force	2.1427
Base Normal Force	10.233
Left Side Normal Force	26.693
Right Side Normal Force	24.98



Slice 17 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.504
Pore Water Pressure	56.652
Pore Water Force	27.049
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46589
Mid-Height	1.0539
Base Length	0.47746
Base Angle	12.637
Polygon Closure	0.54732
Anisotropic Strength Modifier	1
Weight	7.3647
Base Shear Force	1.2188
Base Normal Force	7.8189
Left Side Normal Force	24.98
Right Side Normal Force	22.67

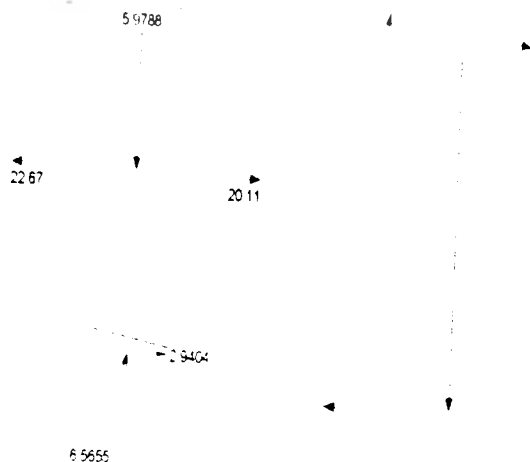
Slice 17 - Bishop Method



Slice 18 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.256
Pore Water Pressure	57.548
Pore Water Force	26.827
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.45948
Mid-Height	0.86746
Base Length	0.46616
Base Angle	9.7141
Polygon Closure	1.4116
Anisotropic Strength Modifier	1
Weight	5.9788
Base Shear Force	2.9404
Base Normal Force	6.5655
Left Side Normal Force	22.67
Right Side Normal Force	20.11

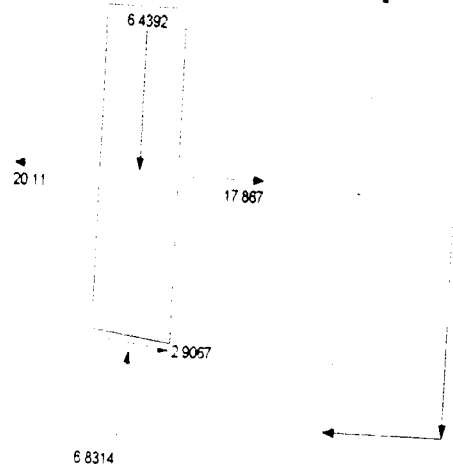
Slice 18 - Bishop Method



Slice 19 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.181
Pore Water Pressure	58.203
Pore Water Force	26.935
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.45949
Mid-Height	0.93427
Base Length	0.46278
Base Angle	6.8365
Polygon Closure	1.4346
Anisotropic Strength Modifier	1
Weight	6.4392
Base Shear Force	2.9067
Base Normal Force	6.8314
Left Side Normal Force	20.11
Right Side Normal Force	17.867

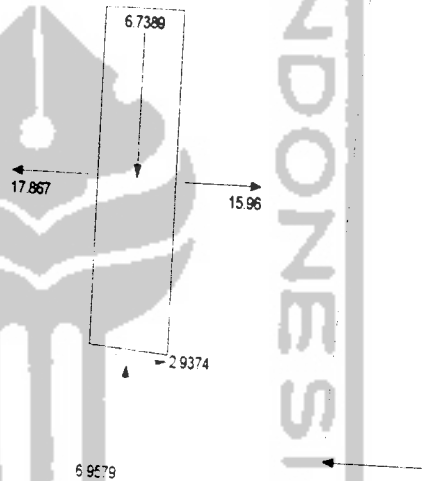
Slice 19 - Bishop Method



Slice 20 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.133
Pore Water Pressure	58.632
Pore Water Force	27.005
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.45948
Mid-Height	0.97774
Base Length	0.46059
Base Angle	3.9767
Polygon Closure	1.4612
Anisotropic Strength Modifier	1
Weight	6.7389
Base Shear Force	2.9374
Base Normal Force	6.9579
Left Side Normal Force	17.867
Right Side Normal Force	15.96

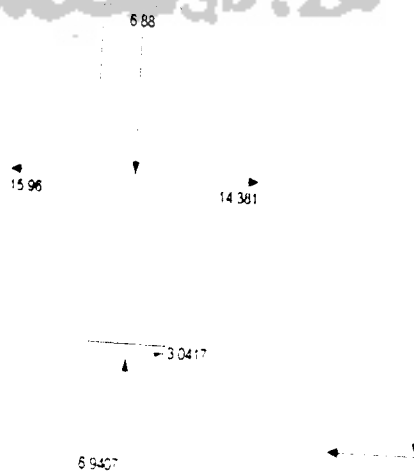
Slice 20 - Bishop Method



Slice 21 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.111
Pore Water Pressure	58.83
Pore Water Force	27.037
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.45949
Mid-Height	0.99821
Base Length	0.45958
Base Angle	1.1266
Polygon Closure	1.527
Anisotropic Strength Modifier	1
Weight	6.88
Base Shear Force	3.0417
Base Normal Force	6.9407
Left Side Normal Force	15.96
Right Side Normal Force	14.381

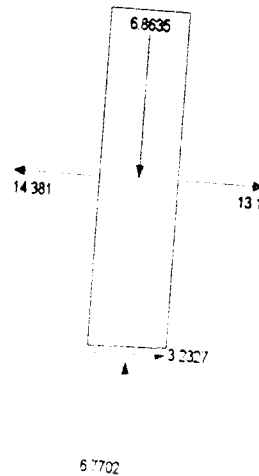
Slice 21 - Bishop Method



Slice 22 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.113
Pore Water Pressure	58.807
Pore Water Force	27.033
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.45948
Mid-Height	0.99583
Base Length	0.45969
Base Angle	1.7208
Polygon Closure	1.7502
Anisotropic Strength Modifier	1
Weight	6.8635
Base Shear Force	3.2327
Base Normal Force	6.7702
Left Side Normal Force	14.381
Right Side Normal Force	13.1

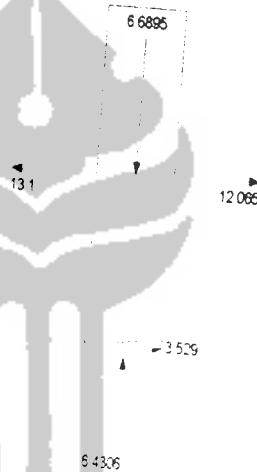
Slice 22 - Bishop Method



Slice 23 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.141
Pore Water Pressure	58.559
Pore Water Force	26.993
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.45949
Mid-Height	0.97058
Base Length	0.46096
Base Angle	4.5724
Polygon Closure	1.9734
Anisotropic Strength Modifier	1
Weight	6.6895
Base Shear Force	3.529
Base Normal Force	6.4306
Left Side Normal Force	13.1
Right Side Normal Force	12.065

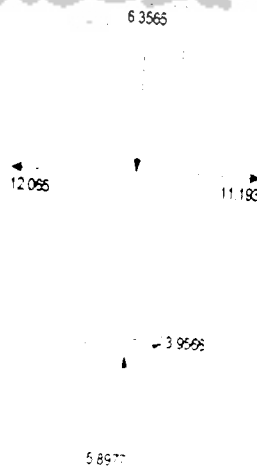
Slice 23 - Bishop Method



Slice 24 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.194
Pore Water Pressure	58.087
Pore Water Force	26.916
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.45948
Mid-Height	0.92227
Base Length	0.46338
Base Angle	7.4354
Polygon Closure	2.2883
Anisotropic Strength Modifier	1
Weight	6.3565
Base Shear Force	3.9566
Base Normal Force	5.8977
Left Side Normal Force	12.065
Right Side Normal Force	11.193

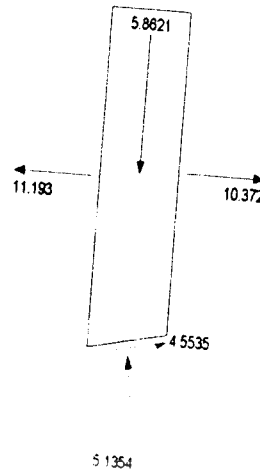
Slice 24 - Bishop Method



Slice 25 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.275
Pore Water Pressure	57.383
Pore Water Force	26.8
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.45949
Mid-Height	0.85053
Base Length	0.46704
Base Angle	10.317
Polygon Closure	2.7259
Anisotropic Strength Modifier	1
Weight	5.8621
Base Shear Force	4.5535
Base Normal Force	5.1354
Left Side Normal Force	11.193
Right Side Normal Force	10.372

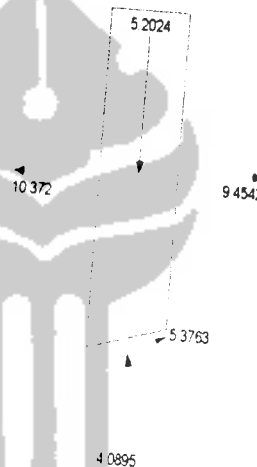
Slice 25 - Bishop Method



Slice 26 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.384
Pore Water Pressure	56.445
Pore Water Force	26.642
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.45948
Mid-Height	0.75481
Base Length	0.472
Base Angle	13.226
Polygon Closure	3.3871
Anisotropic Strength Modifier	1
Weight	5.2024
Base Shear Force	5.3763
Base Normal Force	4.0895
Left Side Normal Force	10.372
Right Side Normal Force	9.4542

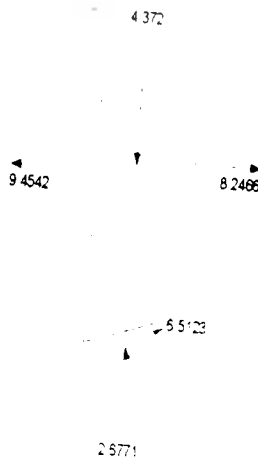
Slice 26 - Bishop Method



Slice 27 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.525
Pore Water Pressure	55.262
Pore Water Force	26.438
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.45949
Mid-Height	0.63433
Base Length	0.47841
Base Angle	16.17
Polygon Closure	4.3307
Anisotropic Strength Modifier	1
Weight	4.372
Base Shear Force	6.5123
Base Normal Force	2.6771
Left Side Normal Force	9.4542
Right Side Normal Force	8.2466

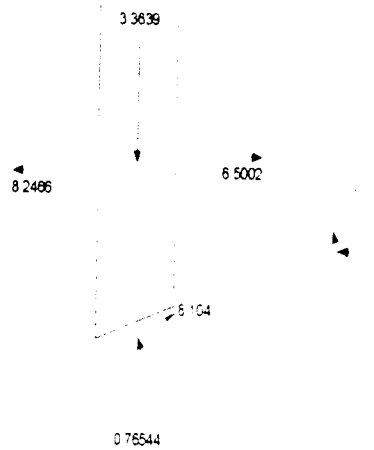
Slice 27 - Bishop Method



Slice 28 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.701
Pore Water Pressure	53.828
Pore Water Force	26.183
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.45948
Mid-Height	0.48806
Base Length	0.48642
Base Angle	19.158
Polygon Closure	5.6728
Anisotropic Strength Modifier	1
Weight	3.3639
Base Shear Force	8.104
Base Normal Force	0.76544
Left Side Normal Force	8.2466
Right Side Normal Force	6.5002

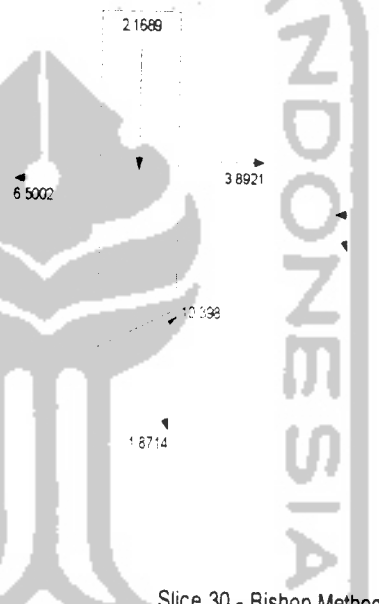
Slice 28 - Bishop Method



Slice 29 - Bishop Method

Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	10.918
Pore Water Pressure	52.127
Pore Water Force	25.87
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.45949
Mid-Height	0.31469
Base Length	0.49628
Base Angle	22.202
Polygon Closure	7.6945
Anisotropic Strength Modifier	1
Weight	2.1689
Base Shear Force	10.398
Base Normal Force	1.8714
Left Side Normal Force	6.5002
Right Side Normal Force	3.8921

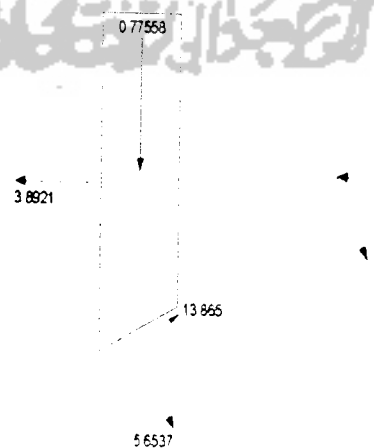
Slice 29 - Bishop Method



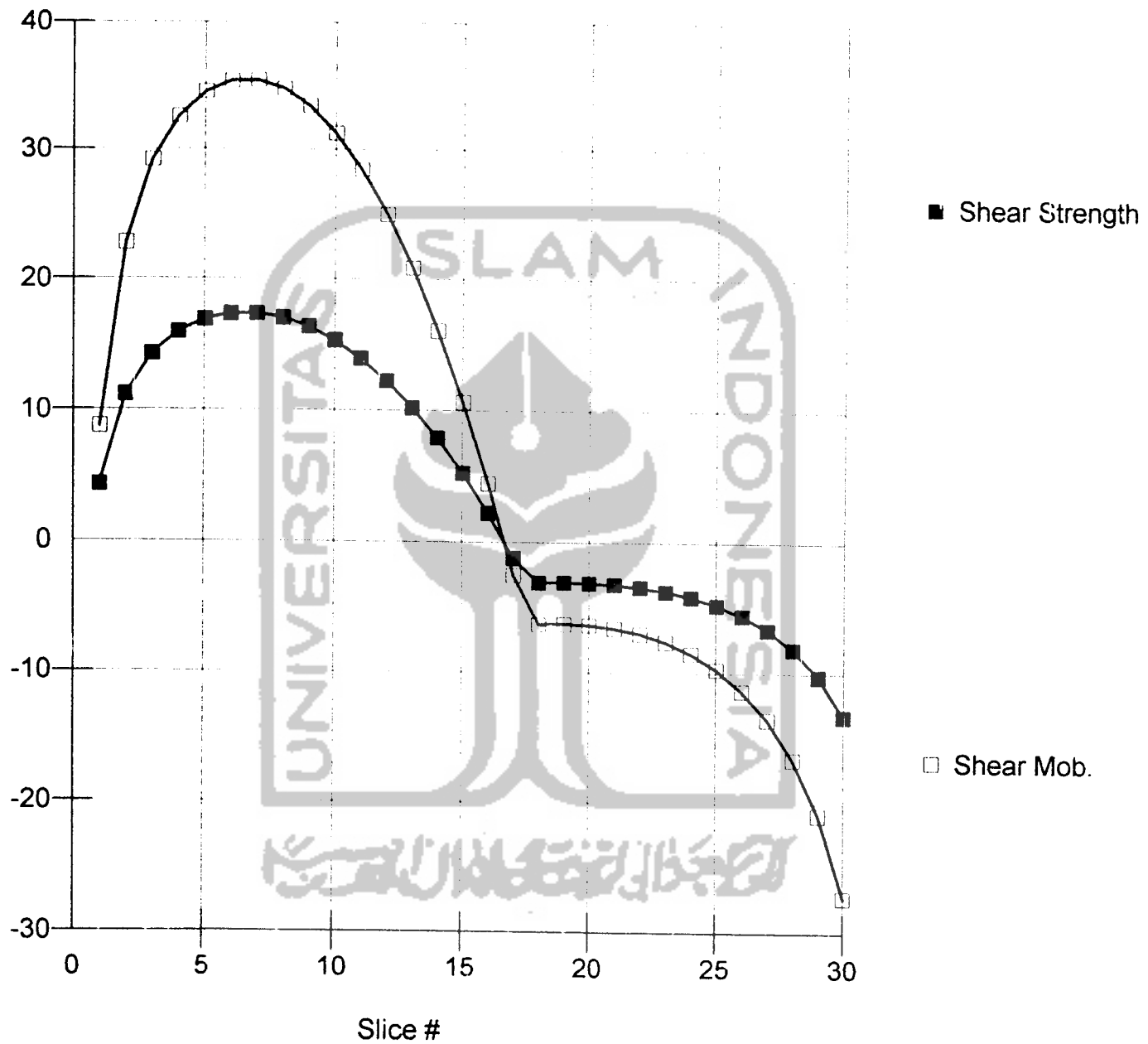
Slice 30 - Bishop Method

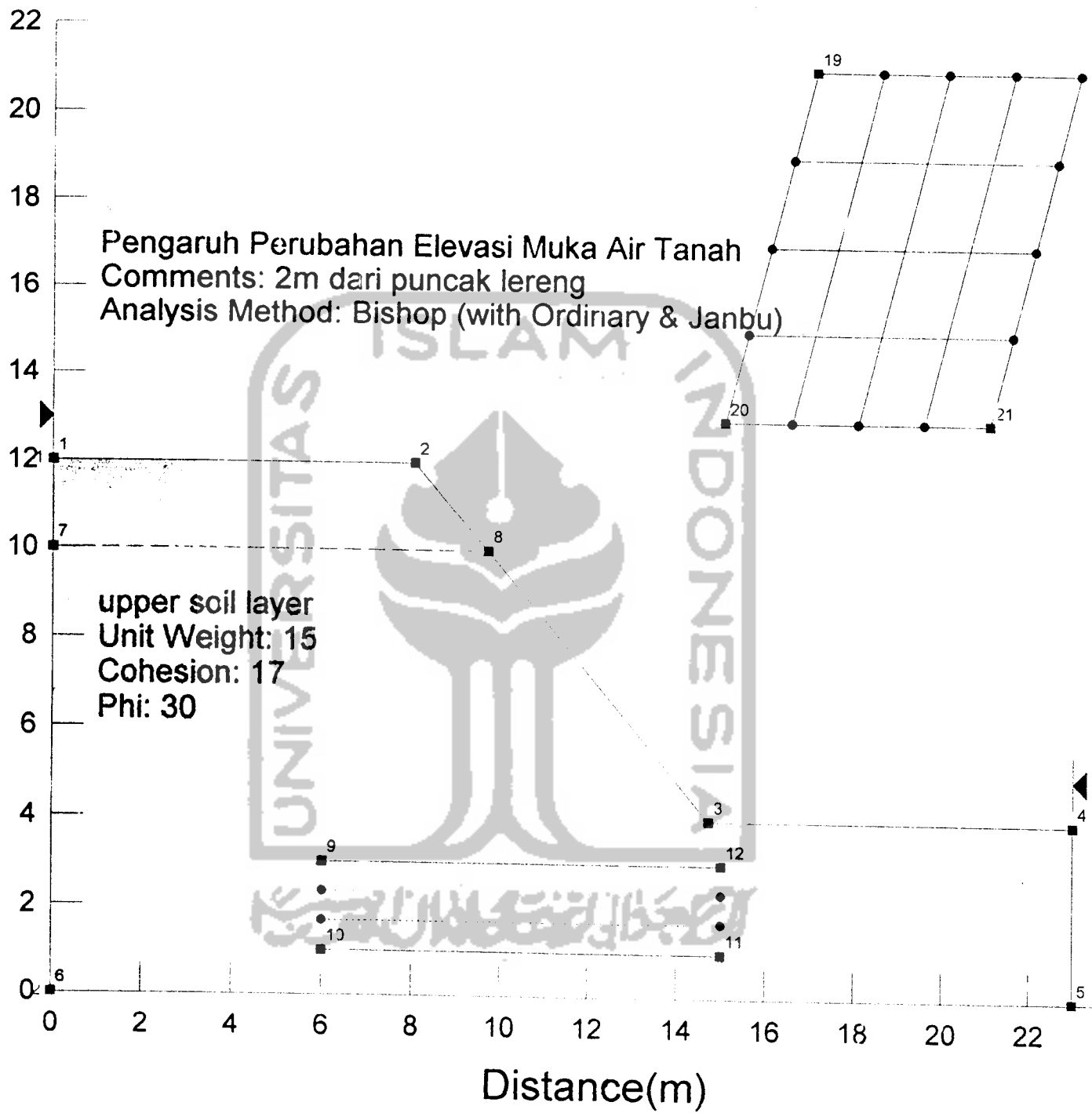
Factor of Safety	0.49017
Phi Angle	30
C (Strength)	22
C (Force)	11.182
Pore Water Pressure	50.145
Pore Water Force	25.488
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.45948
Mid-Height	0.11253
Base Length	0.50829
Base Angle	25.314
Polygon Closure	10.953
Anisotropic Strength Modifier	1
Weight	0.77558
Base Shear Force	13.865
Base Normal Force	5.6537
Left Side Normal Force	3.8921

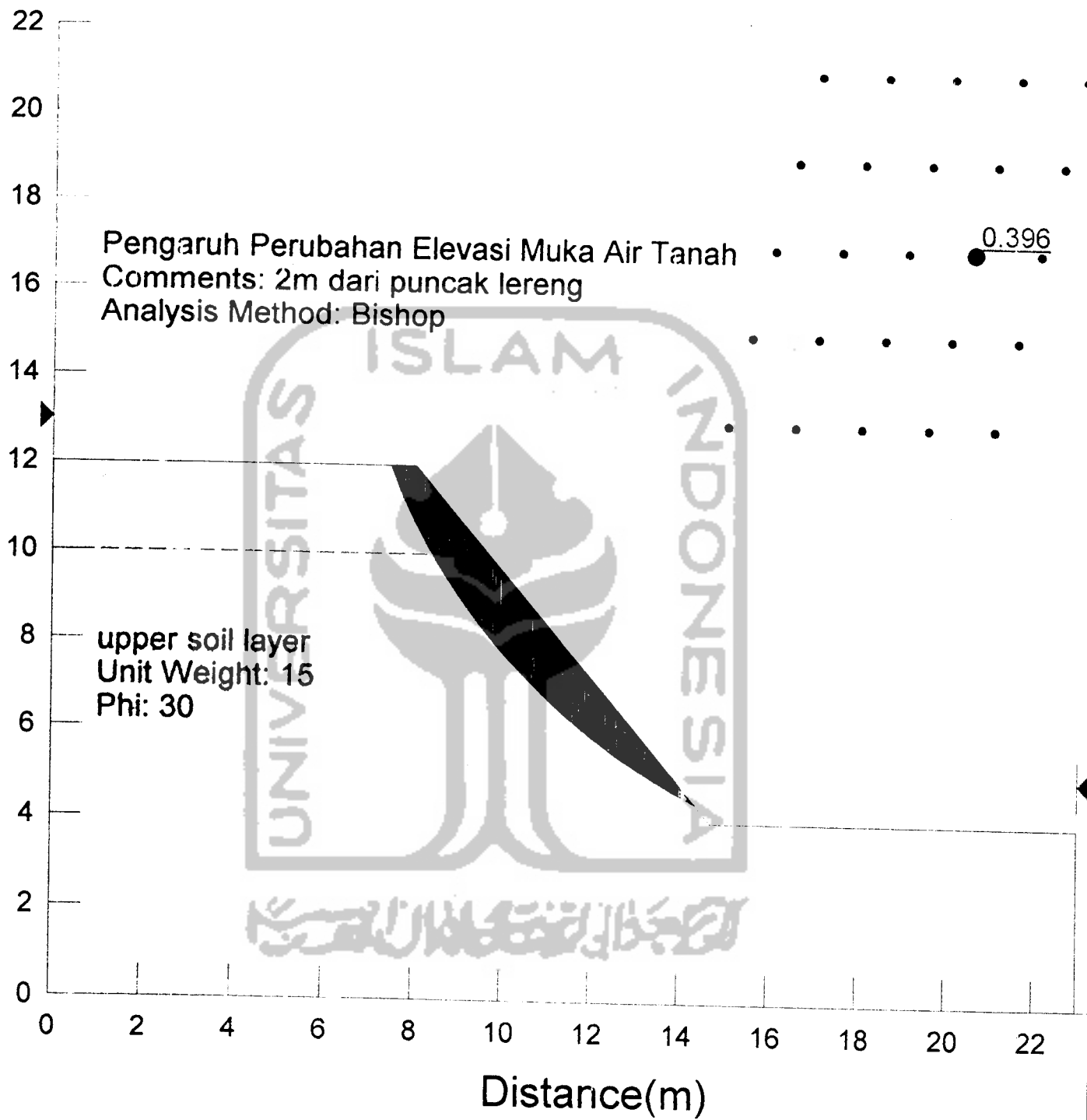
Slice 30 - Bishop Method



Shear Resistance vs. Slice #





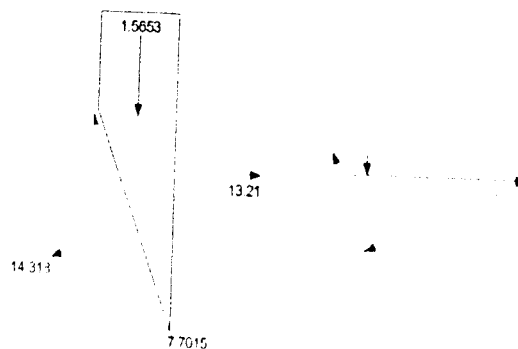


OUT PUT ANALISIS STABILITAS LERENG DENGAN ELEVASI MUKA AIR TANAH -2M

Slice 1 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	11.317
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.28835
Mid-Height	0.36189
Base Length	0.75448
Base Angle	67.531
Polygon Closure	2.8636
Anisotropic Strength Modifier	1
Weight	1.5653
Base Shear Force	7.7015
Base Normal Force	14.318
Right Side Normal Force	13.21

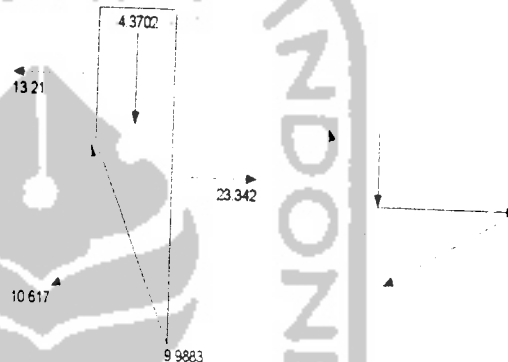
Slice 1 - Bishop Method



Slice 2 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	10.088
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.28835
Mid-Height	1.0104
Base Length	0.67251
Base Angle	64.611
Polygon Closure	3.7159
Anisotropic Strength Modifier	1
Weight	4.3702
Base Shear Force	9.9883
Base Normal Force	10.617
Left Side Normal Force	13.21
Right Side Normal Force	23.342

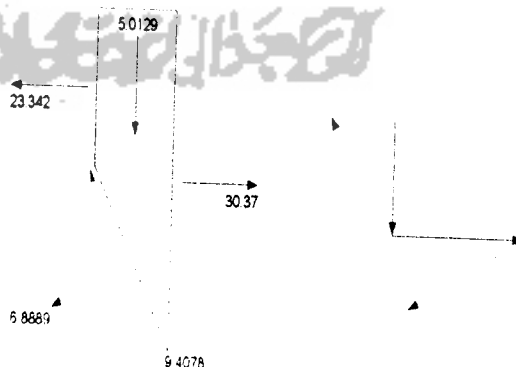
Slice 2 - Bishop Method



Slice 3 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	7.7055
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23971
Mid-Height	1.3941
Base Length	0.5137
Base Angle	62.183
Polygon Closure	3.4338
Anisotropic Strength Modifier	1
Weight	5.0129
Base Shear Force	9.4078
Base Normal Force	6.8889
Left Side Normal Force	23.342
Right Side Normal Force	30.37

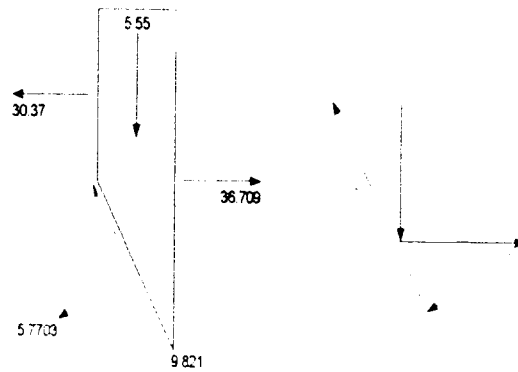
Slice 3 - Bishop Method



Slice 4 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	7.2234
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23972
Mid-Height	1.5435
Base Length	0.48156
Base Angle	60.146
Polygon Closure	3.4865
Anisotropic Strength Modifier	1
Weight	5.55
Base Shear Force	9.821
Base Normal Force	5.7703
Left Side Normal Force	30.37
Right Side Normal Force	36.709

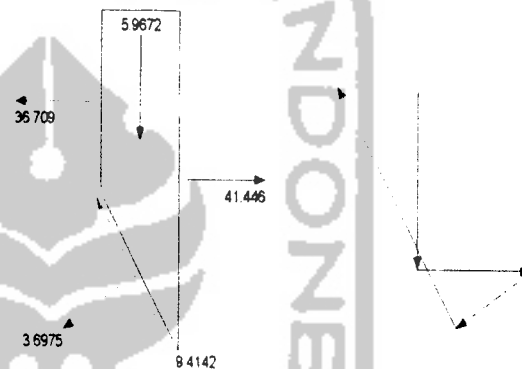
Slice 4 - Bishop Method



Slice 5 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	6.8292
Pore Water Pressure	3.6661
Pore Water Force	1.6691
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23971
Mid-Height	1.6595
Base Length	0.45528
Base Angle	58.23
Polygon Closure	3.342
Anisotropic Strength Modifier	1
Weight	5.9672
Base Shear Force	9.4142
Base Normal Force	3.6975
Left Side Normal Force	36.709
Right Side Normal Force	41.446

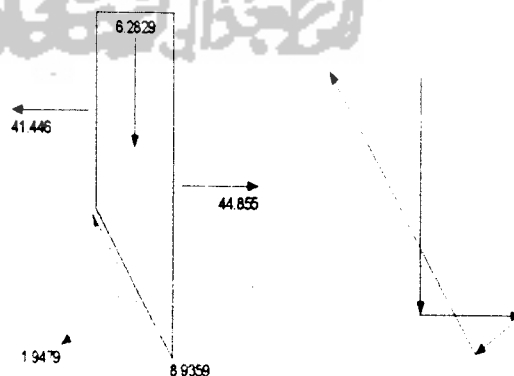
Slice 5 - Bishop Method



Slice 6 - Bishop Method

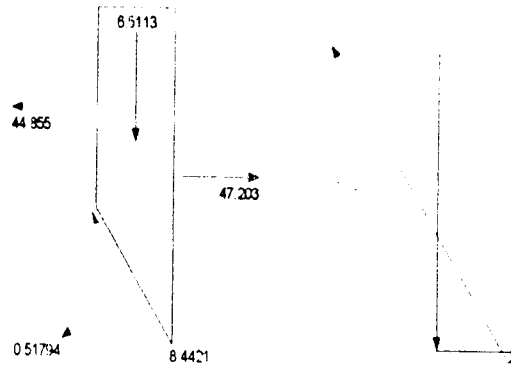
Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	6.4995
Pore Water Pressure	7.3293
Pore Water Force	3.1758
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23971
Mid-Height	1.7473
Base Length	0.4333
Base Angle	56.411
Polygon Closure	3.0829
Anisotropic Strength Modifier	1
Weight	6.2829
Base Shear Force	8.9359
Base Normal Force	1.9479
Left Side Normal Force	41.446
Right Side Normal Force	44.855

Slice 6 - Bishop Method



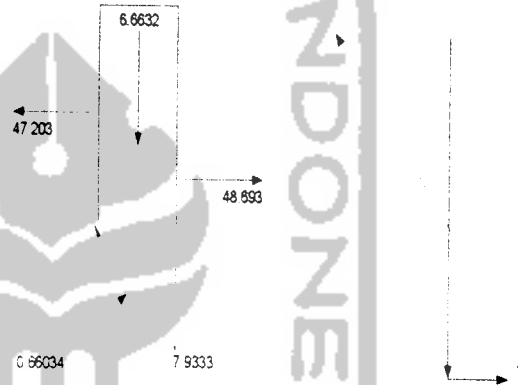
Slice 7 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	6.2188
Pore Water Pressure	10.754
Pore Water Force	4.4586
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23971
Mid-Height	1.8108
Base Length	0.41459
Base Angle	54.676
Polygon Closure	2.9125
Anisotropic Strength Modifier	1
Weight	6.5113
Base Shear Force	8.4421
Base Normal Force	0.51794
Left Side Normal Force	44.855
Right Side Normal Force	47.203



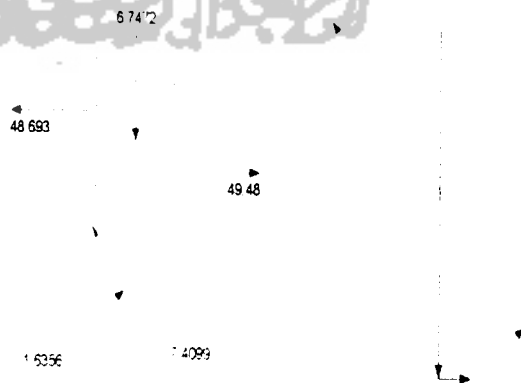
Slice 8 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	5.9765
Pore Water Pressure	13.971
Pore Water Force	5.5664
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23971
Mid-Height	1.8531
Base Length	0.39843
Base Angle	53.012
Polygon Closure	2.8163
Anisotropic Strength Modifier	1
Weight	6.6632
Base Shear Force	7.9333
Base Normal Force	0.66034
Left Side Normal Force	47.203
Right Side Normal Force	48.693



Slice 9 - Bishop Method

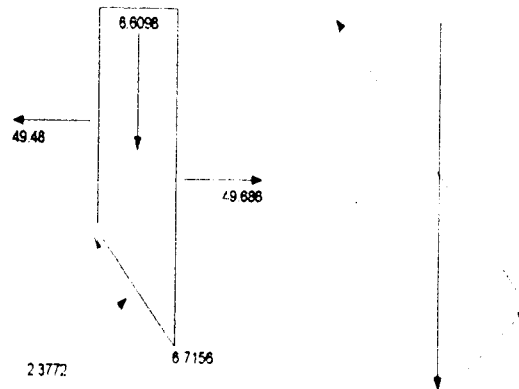
Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	5.7648
Pore Water Pressure	17.002
Pore Water Force	6.5342
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23971
Mid-Height	1.8765
Base Length	0.38432
Base Angle	51.41
Polygon Closure	2.5564
Anisotropic Strength Modifier	1
Weight	6.7472
Base Shear Force	7.4099
Base Normal Force	1.6356
Left Side Normal Force	48.693
Right Side Normal Force	49.48



Slice 10 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	5.4479
Pore Water Pressure	19.834
Pore Water Force	7.2036
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23403
Mid-Height	1.8829
Base Length	0.36319
Base Angle	49.881
Polygon Closure	2.3169
Anisotropic Strength Modifier	1
Weight	6.6098
Base Shear Force	6.7156
Base Normal Force	2.3772
Left Side Normal Force	49.48
Right Side Normal Force	49.686

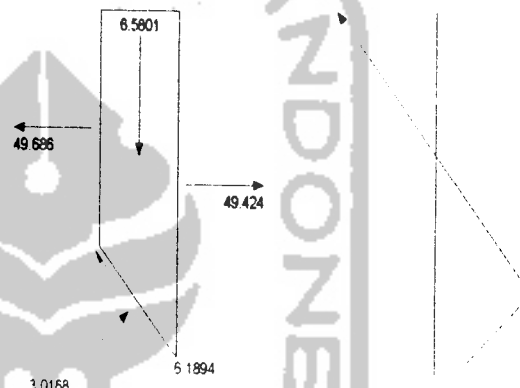
Slice 10 - Bishop Method



Slice 11 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	5.2892
Pore Water Pressure	22.488
Pore Water Force	7.9294
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23403
Mid-Height	1.8744
Base Length	0.35261
Base Angle	48.416
Polygon Closure	2.0727
Anisotropic Strength Modifier	1
Weight	6.5801
Base Shear Force	6.1894
Base Normal Force	3.0168
Left Side Normal Force	49.686
Right Side Normal Force	49.424

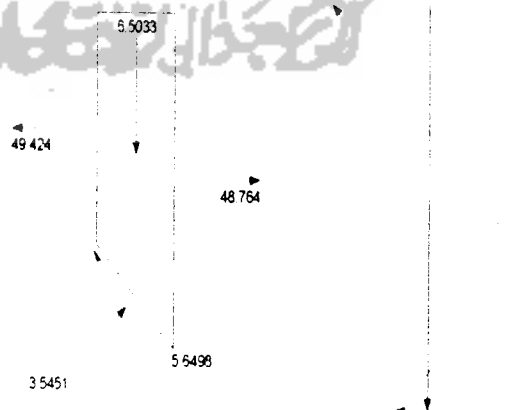
Slice 11 - Bishop Method



Slice 12 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	5.1466
Pore Water Pressure	25.01
Pore Water Force	8.5812
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23403
Mid-Height	1.8525
Base Length	0.34311
Base Angle	46.993
Polygon Closure	1.9185
Anisotropic Strength Modifier	1
Weight	6.5033
Base Shear Force	5.6498
Base Normal Force	3.5451
Left Side Normal Force	49.424
Right Side Normal Force	48.764

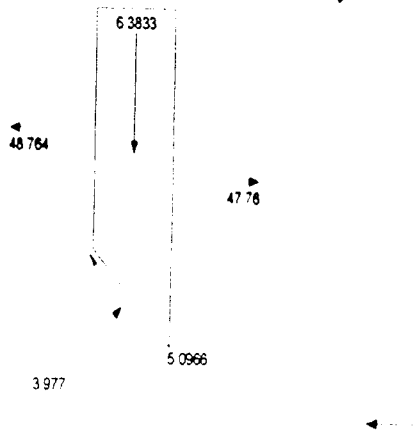
Slice 12 - Bishop Method



Slice 13 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	5.018
Pore Water Pressure	27.411
Pore Water Force	9.1699
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23404
Mid-Height	1.8183
Base Length	0.33453
Base Angle	45.605
Polygon Closure	1.7235
Anisotropic Strength Modifier	1
Weight	6.3833
Base Shear Force	5.0966
Base Normal Force	3.977
Left Side Normal Force	48.764
Right Side Normal Force	47.76

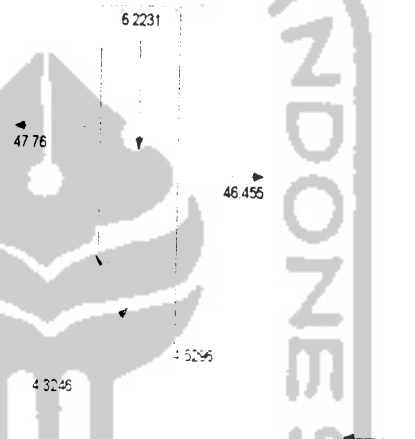
Slice 13 - Bishop Method



Slice 14 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	4.9011
Pore Water Pressure	29.701
Pore Water Force	9.7044
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23403
Mid-Height	1.7727
Base Length	0.32674
Base Angle	44.253
Polygon Closure	1.4935
Anisotropic Strength Modifier	1
Weight	6.2231
Base Shear Force	4.5296
Base Normal Force	4.3246
Left Side Normal Force	47.76
Right Side Normal Force	46.455

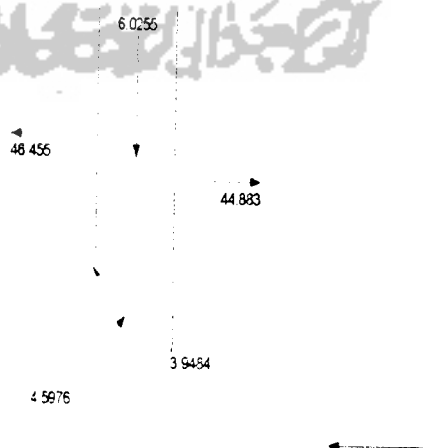
Slice 14 - Bishop Method



Slice 15 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	4.7946
Pore Water Pressure	31.886
Pore Water Force	10.192
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23404
Mid-Height	1.7164
Base Length	0.31964
Base Angle	42.929
Polygon Closure	1.3256
Anisotropic Strength Modifier	1
Weight	6.0255
Base Shear Force	3.9484
Base Normal Force	4.5976
Left Side Normal Force	46.455
Right Side Normal Force	44.883

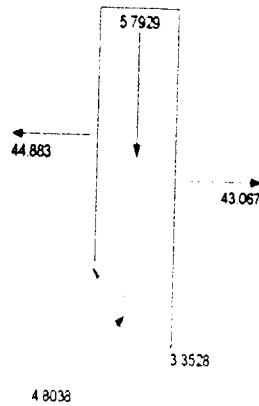
Slice 15 - Bishop Method



Slice 16 - Bishop Method

Factor of Safety 0.39633
 Phi Angle 30
 C (Strength) 15
 C (Force) 4.697
 Pore Water Pressure 33.973
 Pore Water Force 10.638
 Pore Air Pressure 0
 Pore Air Force 0
 Slice Width 0.23403
 Mid-Height 1.6502
 Base Length 0.31313
 Base Angle 41.636
 Polygon Closure 1.1007
 Anisotropic Strength Modifier 1
 Weight 5.7929
 Base Shear Force 3.3528
 Base Normal Force 4.8038
 Left Side Normal Force 44.883
 Right Side Normal Force 43.067

Slice 16 - Bishop Method



Slice 17 - Bishop Method

Factor of Safety 0.39633
 Phi Angle 30
 C (Strength) 15
 C (Force) 4.6075
 Pore Water Pressure 35.968
 Pore Water Force 11.048
 Pore Air Pressure 0
 Pore Air Force 0
 Slice Width 0.23404
 Mid-Height 1.5745
 Base Length 0.30716
 Base Angle 40.365
 Polygon Closure 0.91202
 Anisotropic Strength Modifier 1
 Weight 5.5274
 Base Shear Force 2.7421
 Base Normal Force 4.9497
 Left Side Normal Force 43.067
 Right Side Normal Force 41.027

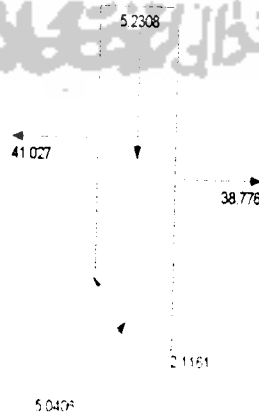
Slice 17 - Bishop Method



Slice 18 - Bishop Method

Factor of Safety 0.39633
 Phi Angle 30
 C (Strength) 15
 C (Force) 4.5248
 Pore Water Pressure 37.874
 Pore Water Force 11.425
 Pore Air Pressure 0
 Pore Air Force 0
 Slice Width 0.23403
 Mid-Height 1.49
 Base Length 0.30165
 Base Angle 39.12
 Polygon Closure 0.70616
 Anisotropic Strength Modifier 1
 Weight 5.2308
 Base Shear Force 2.1161
 Base Normal Force 5.0406
 Left Side Normal Force 41.027
 Right Side Normal Force 38.776

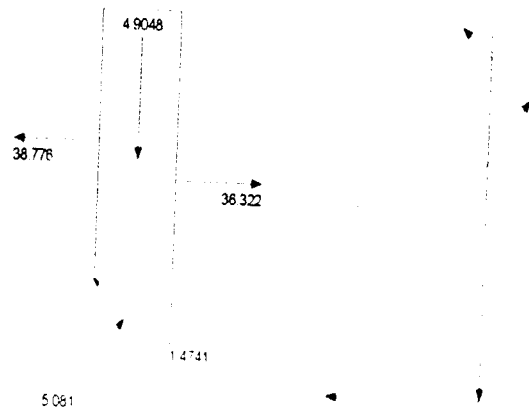
Slice 18 - Bishop Method



Slice 19 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	4.4486
Pore Water Pressure	39.7
Pore Water Force	11.774
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23404
Mid-Height	1.3972
Base Length	0.29658
Base Angle	37.895
Polygon Closure	0.48269
Anisotropic Strength Modifier	1
Weight	4.9048
Base Shear Force	1.4741
Base Normal Force	5.081
Left Side Normal Force	38.776
Right Side Normal Force	36.322

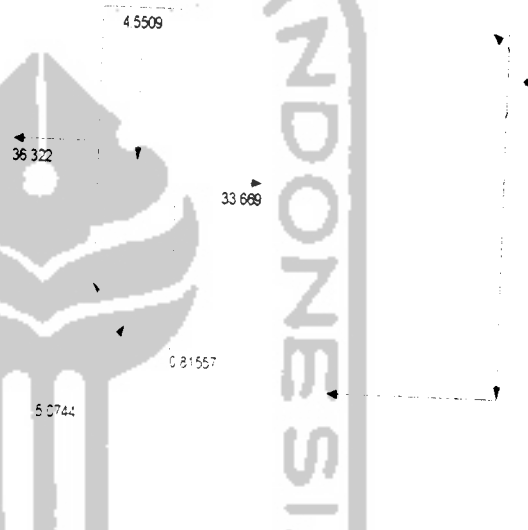
Slice 19 - Bishop Method



Slice 20 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	4.3779
Pore Water Pressure	41.451
Pore Water Force	12.098
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23403
Mid-Height	1.2964
Base Length	0.29186
Base Angle	36.692
Polygon Closure	0.25372
Anisotropic Strength Modifier	1
Weight	4.5509
Base Shear Force	0.81557
Base Normal Force	5.0744
Left Side Normal Force	36.322
Right Side Normal Force	33.669

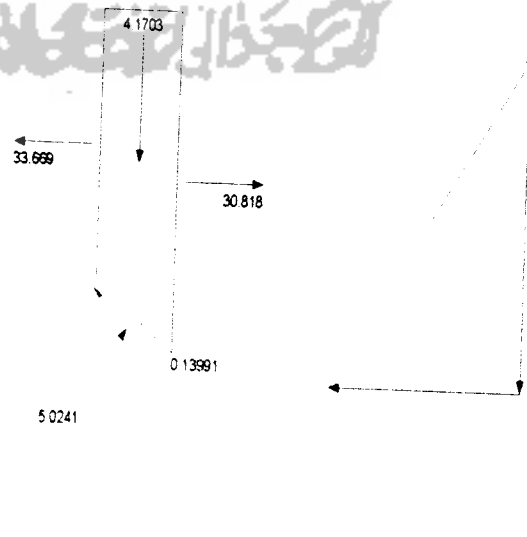
Slice 20 - Bishop Method



Slice 21 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	4.3123
Pore Water Pressure	43.122
Pore Water Force	12.397
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23403
Mid-Height	1.1879
Base Length	0.28749
Base Angle	35.507
Polygon Closure	0.05024
Anisotropic Strength Modifier	1
Weight	4.1703
Base Shear Force	0.13991
Base Normal Force	5.0241
Left Side Normal Force	33.669
Right Side Normal Force	30.818

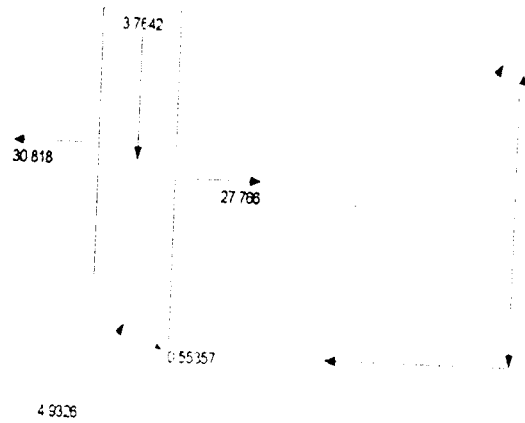
Slice 21 - Bishop Method



Slice 22 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	4.2515
Pore Water Pressure	44.723
Pore Water Force	12.676
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23404
Mid-Height	1.0723
Base Length	0.28343
Base Angle	34.337
Polygon Closure	0.17264
Anisotropic Strength Modifier	1
Weight	3.7842
Base Shear Force	0.55357
Base Normal Force	4.9326
Left Side Normal Force	30.818
Right Side Normal Force	27.766

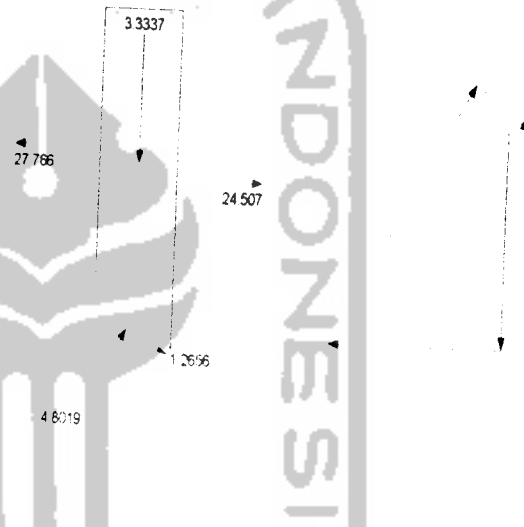
Slice 22 - Bishop Method



Slice 23 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	4.1946
Pore Water Pressure	46.26
Pore Water Force	12.936
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23403
Mid-Height	0.94984
Base Length	0.27964
Base Angle	33.186
Polygon Closure	0.40816
Anisotropic Strength Modifier	1
Weight	3.3337
Base Shear Force	1.2656
Base Normal Force	4.8019
Left Side Normal Force	27.766
Right Side Normal Force	24.507

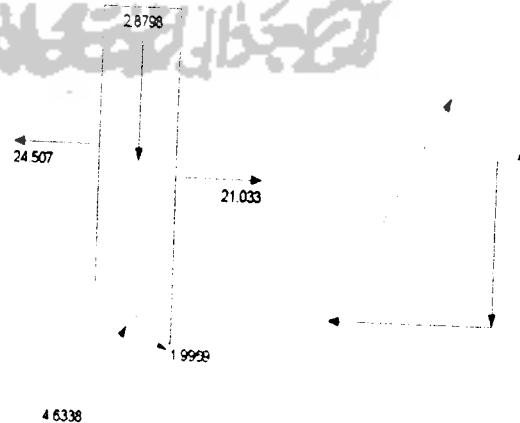
Slice 23 - Bishop Method



Slice 24 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	4.1418
Pore Water Pressure	47.726
Pore Water Force	13.178
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23404
Mid-Height	0.82035
Base Length	0.27612
Base Angle	32.048
Polygon Closure	0.6719
Anisotropic Strength Modifier	1
Weight	2.8798
Base Shear Force	1.9969
Base Normal Force	4.6338
Left Side Normal Force	24.507
Right Side Normal Force	21.033

Slice 24 - Bishop Method



Slice 25 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	4.0922
Pore Water Pressure	49.136
Pore Water Force	13.405
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23403
Mid-Height	0.68462
Base Length	0.27281
Base Angle	30.925
Polygon Closure	0.90809
Anisotropic Strength Modifier	1
Weight	2.4034
Base Shear Force	2.7484
Base Normal Force	4.4297
Left Side Normal Force	21.033
Right Side Normal Force	17.333

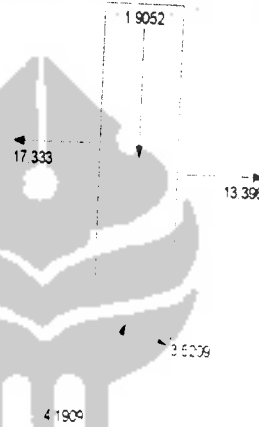
Slice 25 - Bishop Method



Slice 26 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	4.0461
Pore Water Pressure	50.478
Pore Water Force	13.616
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23404
Mid-Height	0.5427
Base Length	0.26974
Base Angle	29.814
Polygon Closure	1.1944
Anisotropic Strength Modifier	1
Weight	1.9052
Base Shear Force	3.5209
Base Normal Force	4.1909
Left Side Normal Force	17.333
Right Side Normal Force	13.396

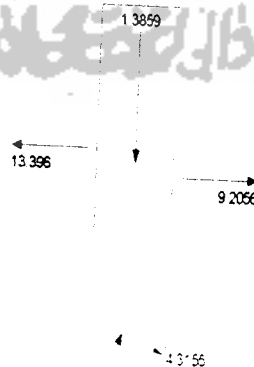
Slice 26 - Bishop Method



Slice 27 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	4.0028
Pore Water Pressure	51.766
Pore Water Force	13.814
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23403
Mid-Height	0.39479
Base Length	0.26685
Base Angle	28.717
Polygon Closure	1.4457
Anisotropic Strength Modifier	1
Weight	1.3859
Base Shear Force	4.3155
Base Normal Force	3.9181
Left Side Normal Force	13.396
Right Side Normal Force	9.2056

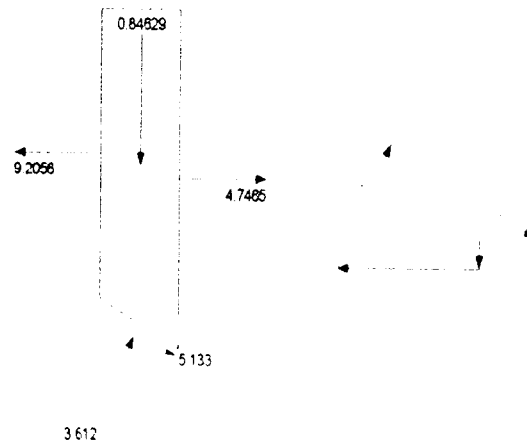
Slice 27 - Bishop Method



Slice 28 - Bishop Method

Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	3.9624
Pore Water Pressure	52.994
Pore Water Force	13.999
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23404
Mid-Height	0.24107
Base Length	0.26416
Base Angle	27.629
Polygon Closure	1.7452
Anisotropic Strength Modifier	1
Weight	0.84629
Base Shear Force	5.133
Base Normal Force	3.612
Left Side Normal Force	9.2056
Right Side Normal Force	4.7465

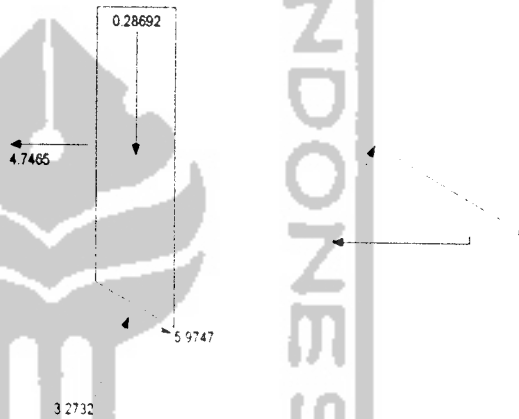
Slice 28 - Bishop Method



Slice 29 - Bishop Method

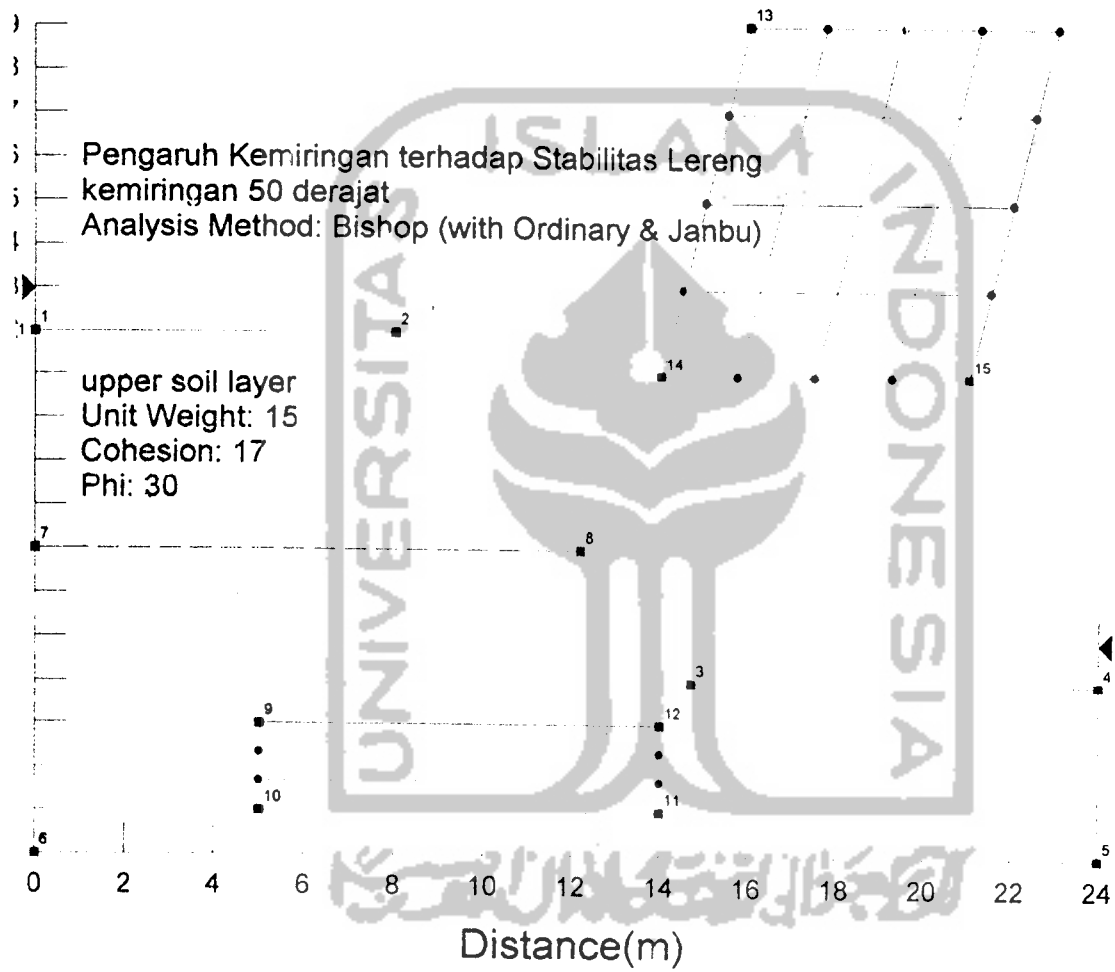
Factor of Safety	0.39633
Phi Angle	30
C (Strength)	15
C (Force)	3.9245
Pore Water Pressure	54.168
Pore Water Force	14.172
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23403
Mid-Height	0.08173
Base Length	0.26163
Base Angle	26.555
Polygon Closure	2.0314
Anisotropic Strength Modifier	1
Weight	0.28692
Base Shear Force	5.9747
Base Normal Force	3.2732
Left Side Normal Force	4.7465

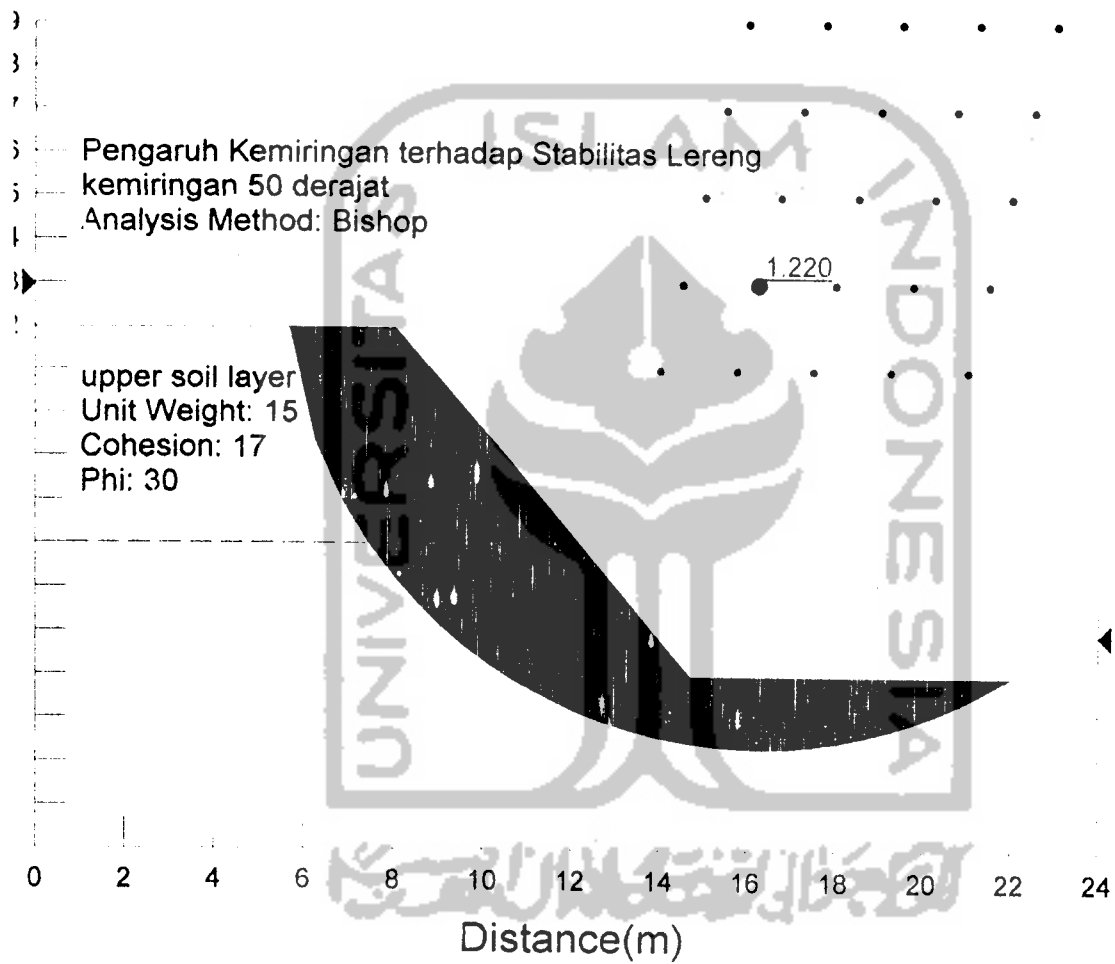
Slice 29 - Bishop Method





LAMPIRAN II

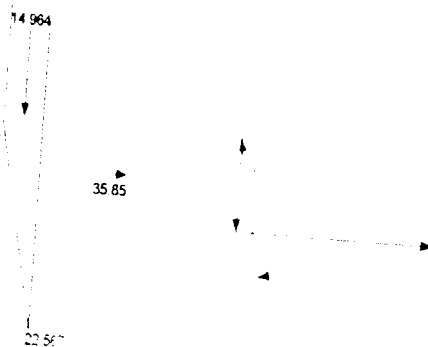




OUT PUT ANALISIS STABILITAS LERENG DENGAN KEMIRINGAN 50

Slice 1 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	45.955
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.59242
Mid-Height	1.684
Base Length	2.7033
Base Angle	77.341
Polygon Closure	0.17925
Anisotropic Strength Modifier	1
Weight	14.964
Base Shear Force	22.567
Base Normal Force	32.131
Right Side Normal Force	35.85



Slice 2 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	24.884
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.59242
Mid-Height	3.3686
Base Length	1.4638
Base Angle	66.127
Polygon Closure	0.59868
Anisotropic Strength Modifier	1
Weight	29.934
Base Shear Force	26.789
Base Normal Force	13.468
Left Side Normal Force	35.85
Right Side Normal Force	33.877

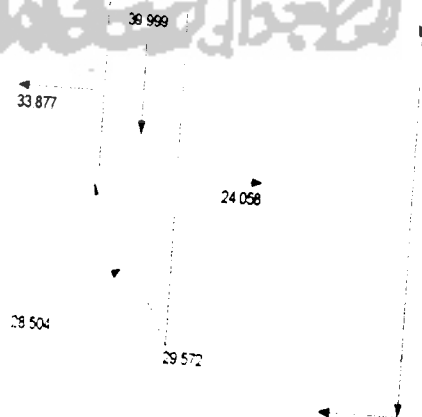
Slice 2 - Bishop Method



Slice 3 - Bishop Method

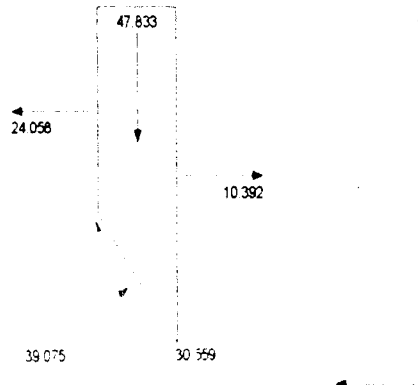
Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	19.607
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.59242
Mid-Height	4.5012
Base Length	1.1534
Base Angle	59.093
Polygon Closure	0.59999
Anisotropic Strength Modifier	1
Weight	39.999
Base Shear Force	29.572
Base Normal Force	28.504
Left Side Normal Force	33.877
Right Side Normal Force	24.058

Slice 3 - Bishop Method



Slice 4 - Bishop Method

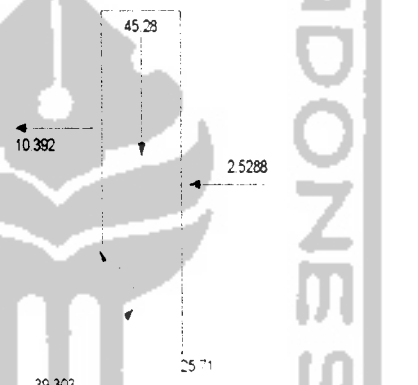
Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	16.863
Pore Water Pressure	3.7554
Pore Water Force	3.7252
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.59242
Mid-Height	5.3828
Base Length	0.99196
Base Angle	53.329
Polygon Closure	0.47833
Anisotropic Strength Modifier	1
Weight	47.833
Base Shear Force	30.559
Base Normal Force	39.075
Left Side Normal Force	24.058
Right Side Normal Force	10.392



Slice 4 - Bishop Method

Slice 5 - Bishop Method

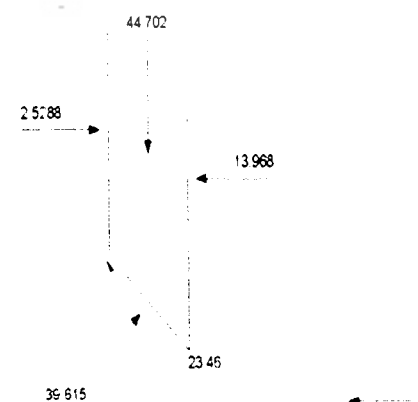
Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	13.463
Pore Water Pressure	10.487
Pore Water Force	8.3053
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	5.7566
Base Length	0.79193
Base Angle	48.536
Polygon Closure	0.4528
Anisotropic Strength Modifier	1
Weight	45.28
Base Shear Force	25.71
Base Normal Force	39.303
Left Side Normal Force	10.392
Right Side Normal Force	2.5288



Slice 5 - Bishop Method

Slice 6 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	12.485
Pore Water Pressure	15.898
Pore Water Force	11.675
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	5.6832
Base Length	0.73439
Base Angle	44.436
Polygon Closure	0.44702
Anisotropic Strength Modifier	1
Weight	44.702
Base Shear Force	23.46
Base Normal Force	39.615
Left Side Normal Force	2.5288
Right Side Normal Force	13.968

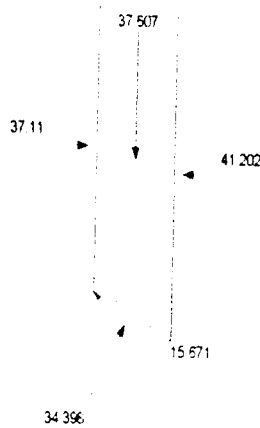


Slice 6 - Bishop Method

Slice 10 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	10.316
Pore Water Pressure	31.589
Pore Water Force	19.157
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52438
Mid-Height	4.7812
Base Length	0.60682
Base Angle	30.216
Polygon Closure	0.37607
Anisotropic Strength Modifier	1
Weight	37.607
Base Shear Force	15.671
Base Normal Force	34.398
Left Side Normal Force	37.11
Right Side Normal Force	41.202

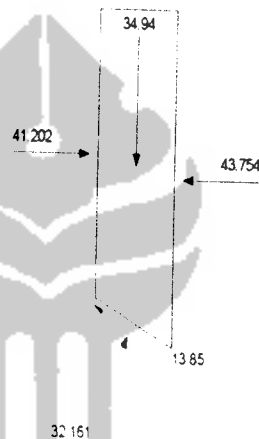
Slice 10 - Bishop Method



Slice 11 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	10.005
Pore Water Pressure	34.375
Pore Water Force	20.231
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	4.4421
Base Length	0.58854
Base Angle	27.005
Polygon Closure	0.3494
Anisotropic Strength Modifier	1
Weight	34.94
Base Shear Force	13.85
Base Normal Force	32.161
Left Side Normal Force	41.202
Right Side Normal Force	43.754

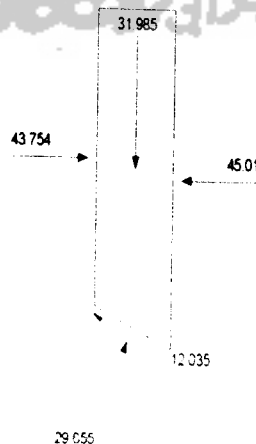
Slice 11 - Bishop Method



Slice 12 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	9.7493
Pore Water Pressure	36.819
Pore Water Force	21.115
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52433
Mid-Height	4.0665
Base Length	0.57349
Base Angle	23.884
Polygon Closure	0.15992
Anisotropic Strength Modifier	1
Weight	31.985
Base Shear Force	12.035
Base Normal Force	29.655
Left Side Normal Force	43.754
Right Side Normal Force	45.01

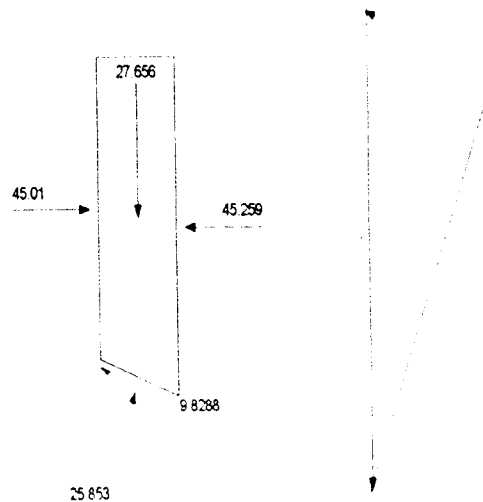
Slice 12 - Bishop Method



Slice 13 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	9.1531
Pore Water Pressure	38.894
Pore Water Force	20.941
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	3.6655
Base Length	0.53842
Base Angle	20.897
Polygon Closure	0.27656
Anisotropic Strength Modifier	1
Weight	27.656
Base Shear Force	9.8288
Base Normal Force	25.853
Left Side Normal Force	45.01
Right Side Normal Force	45.259

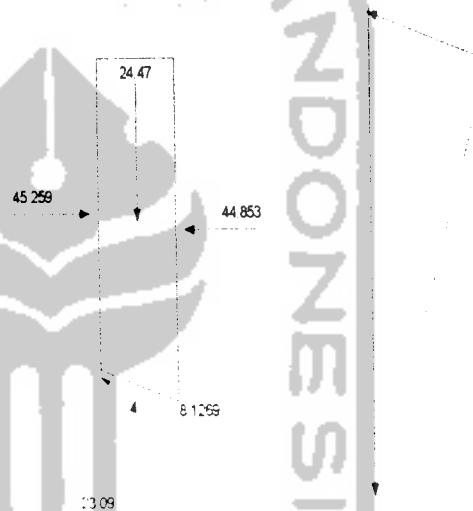
Slice 13 - Bishop Method



Slice 14 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	8.9926
Pore Water Pressure	40.637
Pore Water Force	21.496
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	3.2432
Base Length	0.52898
Base Angle	18.03
Polygon Closure	0.2447
Anisotropic Strength Modifier	1
Weight	24.47
Base Shear Force	8.1269
Base Normal Force	23.09
Left Side Normal Force	45.259
Right Side Normal Force	44.853

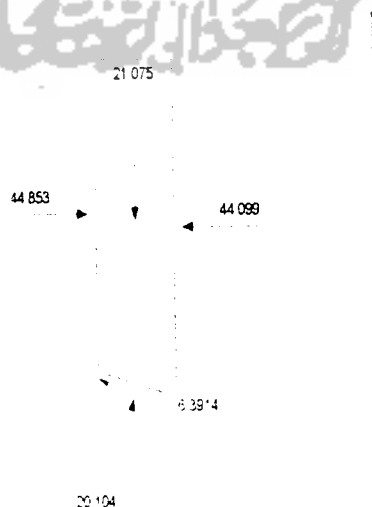
Slice 14 - Bishop Method



Slice 15 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	8.8614
Pore Water Pressure	42.108
Pore Water Force	21.949
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.7933
Base Length	0.52126
Base Angle	15.209
Polygon Closure	0.21075
Anisotropic Strength Modifier	1
Weight	21.075
Base Shear Force	6.3914
Base Normal Force	20.104
Left Side Normal Force	44.853
Right Side Normal Force	44.099

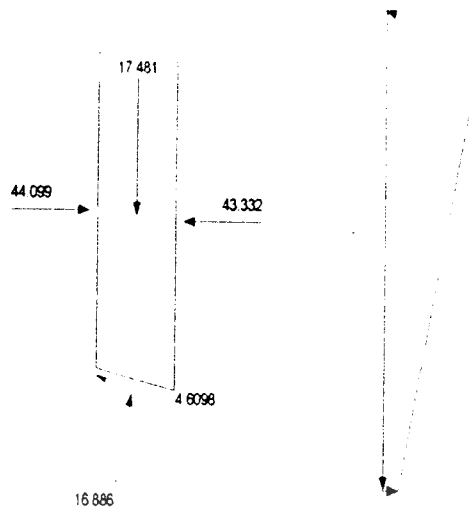
Slice 15 - Bishop Method



Slice 16 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	8.7561
Pore Water Pressure	43.321
Pore Water Force	22.313
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.317
Base Length	0.51506
Base Angle	12.426
Polygon Closure	0.08741
Anisotropic Strength Modifier	1
Weight	17.481
Base Shear Force	4.6098
Base Normal Force	16.886
Left Side Normal Force	44.099
Right Side Normal Force	43.332

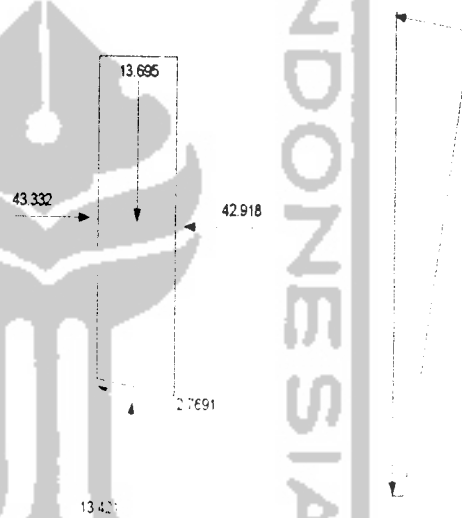
Slice 16 - Bishop Method



Slice 17 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	8.6743
Pore Water Pressure	44.284
Pore Water Force	22.596
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	1.8151
Base Length	0.51025
Base Angle	9.6716
Polygon Closure	0.13695
Anisotropic Strength Modifier	1
Weight	13.695
Base Shear Force	2.7691
Base Normal Force	13.421
Left Side Normal Force	43.332
Right Side Normal Force	42.918

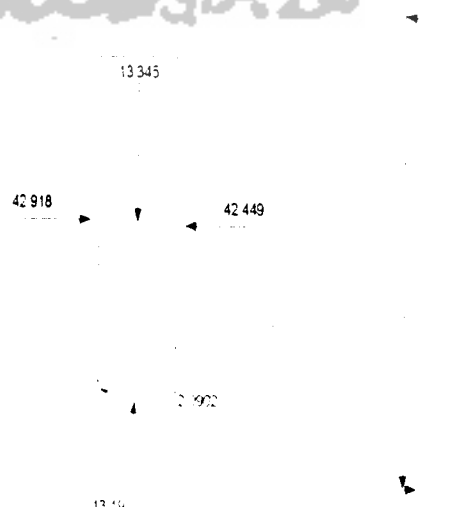
Slice 17 - Bishop Method



Slice 18 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	9.5677
Pore Water Pressure	45.039
Pore Water Force	25.348
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.5919
Base Length	0.56281
Base Angle	6.7894
Polygon Closure	0.13345
Anisotropic Strength Modifier	1
Weight	13.345
Base Shear Force	2.0902
Base Normal Force	13.19
Left Side Normal Force	42.918
Right Side Normal Force	42.449

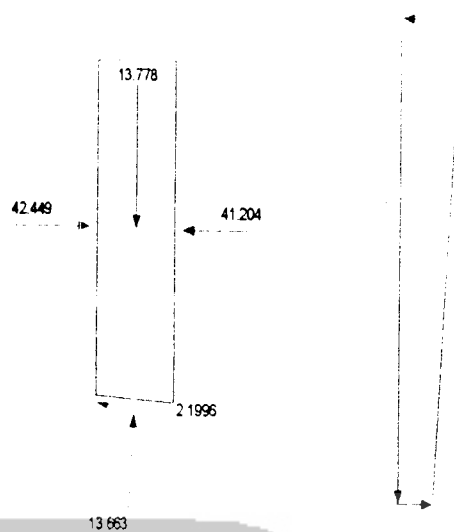
Slice 18 - Bishop Method



Slice 19 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	9.5213
Pore Water Pressure	45.544
Pore Water Force	25.508
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.6436
Base Length	0.56007
Base Angle	3.7733
Polygon Closure	0.06889
Anisotropic Strength Modifier	1
Weight	13.778
Base Shear Force	2.1996
Base Normal Force	13.663
Left Side Normal Force	42.449
Right Side Normal Force	41.204

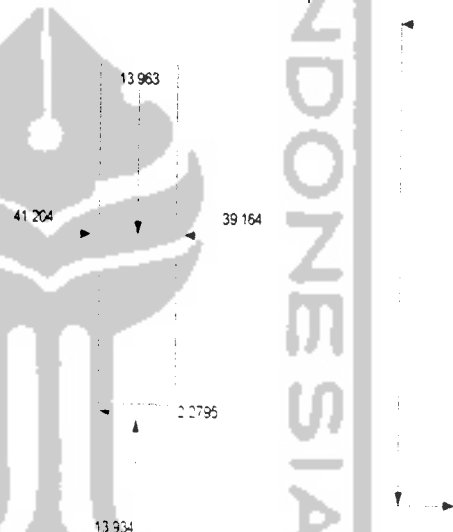
Slice 19 - Bishop Method



Slice 20 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	9.5015
Pore Water Pressure	45.762
Pore Water Force	25.577
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.6657
Base Length	0.55891
Base Angle	0.76755
Polygon Closure	0.13963
Anisotropic Strength Modifier	1
Weight	13.963
Base Shear Force	2.2795
Base Normal Force	13.934
Left Side Normal Force	41.204
Right Side Normal Force	39.164

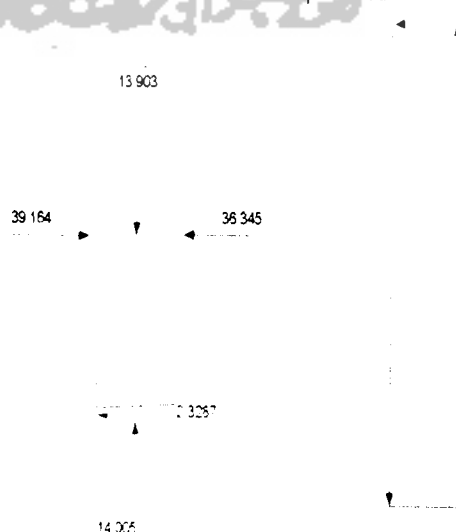
Slice 20 - Bishop Method



Slice 21 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	9.5079
Pore Water Pressure	45.692
Pore Water Force	25.555
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.6586
Base Length	0.55929
Base Angle	2.2359
Polygon Closure	0.07003
Anisotropic Strength Modifier	1
Weight	13.903
Base Shear Force	2.3287
Base Normal Force	14.005
Left Side Normal Force	39.164
Right Side Normal Force	36.345

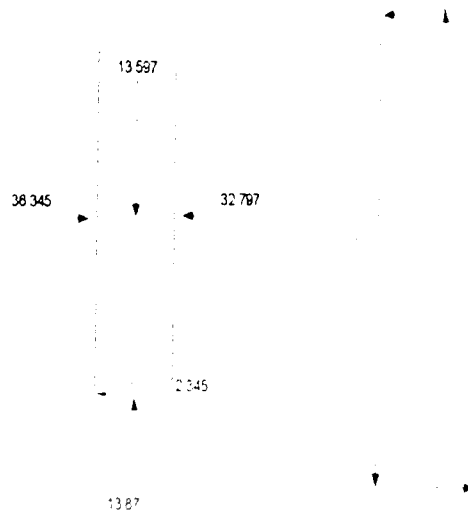
Slice 21 - Bishop Method



Slice 22 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	9.5406
Pore Water Pressure	45.334
Pore Water Force	25.442
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.622
Base Length	0.56121
Base Angle	5.2456
Polygon Closure	0.06935
Anisotropic Strength Modifier	1
Weight	13.597
Base Shear Force	2.345
Base Normal Force	13.87
Left Side Normal Force	36.345
Right Side Normal Force	32.797

Slice 22 - Bishop Method



Slice 23 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	9.6005
Pore Water Pressure	44.685
Pore Water Force	25.235
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.5558
Base Length	0.56473
Base Angle	8.27
Polygon Closure	0.06759
Anisotropic Strength Modifier	1
Weight	13.042
Base Shear Force	2.3252
Base Normal Force	13.517
Left Side Normal Force	32.797
Right Side Normal Force	28.607

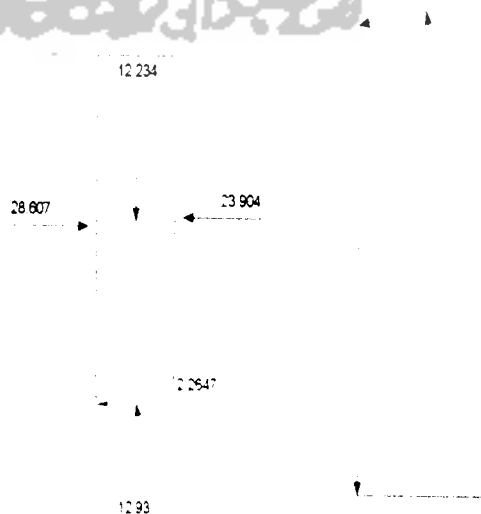
Slice 23 - Bishop Method



Slice 24 - Bishop Method

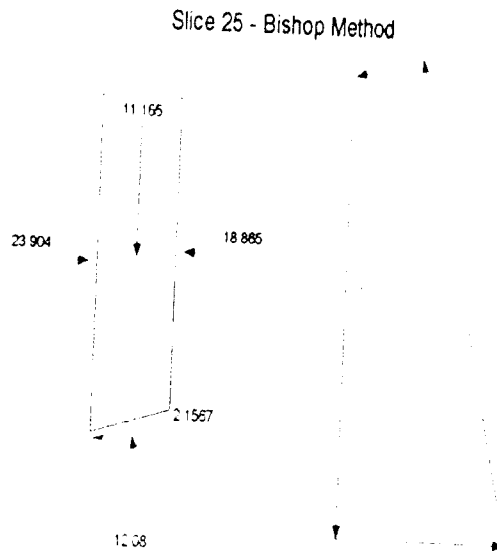
Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	9.689
Pore Water Pressure	43.738
Pore Water Force	24.928
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.4594
Base Length	0.56994
Base Angle	11.318
Polygon Closure	0.06465
Anisotropic Strength Modifier	1
Weight	12.234
Base Shear Force	2.2647
Base Normal Force	12.93
Left Side Normal Force	28.607
Right Side Normal Force	23.904

Slice 24 - Bishop Method



Slice 25 - Bishop Method

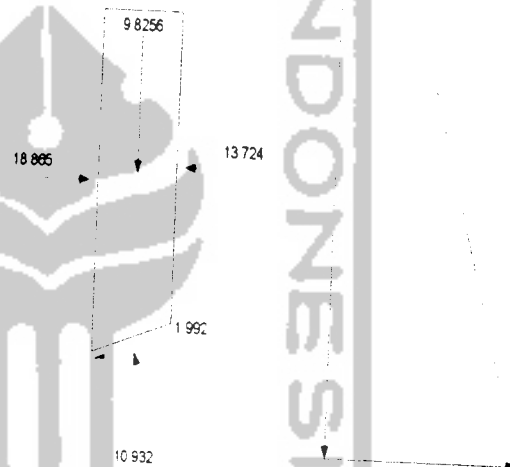
Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	9.8087
Pore Water Pressure	42.488
Pore Water Force	24.515
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.3319
Base Length	0.57698
Base Angle	14.399
Polygon Closure	0.0604
Anisotropic Strength Modifier	1
Weight	11.165
Base Shear Force	2.1567
Base Normal Force	12.08
Left Side Normal Force	23.904
Right Side Normal Force	18.865



Slice 26 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	9.9631
Pore Water Pressure	40.92
Pore Water Force	23.982
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55887
Mid-Height	1.1721
Base Length	0.58606
Base Angle	17.522
Polygon Closure	0.05466
Anisotropic Strength Modifier	1
Weight	9.8256
Base Shear Force	1.992
Base Normal Force	10.932
Left Side Normal Force	18.865
Right Side Normal Force	13.724

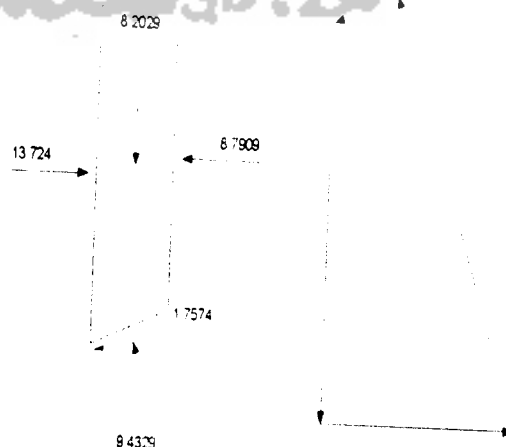
Slice 26 - Bishop Method



Slice 27 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	10.156
Pore Water Pressure	39.022
Pore Water Force	23.313
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	0.97853
Base Length	0.59743
Base Angle	20.701
Polygon Closure	0.04716
Anisotropic Strength Modifier	1
Weight	8.2029
Base Shear Force	1.7574
Base Normal Force	9.4329
Left Side Normal Force	13.724
Right Side Normal Force	8.7909

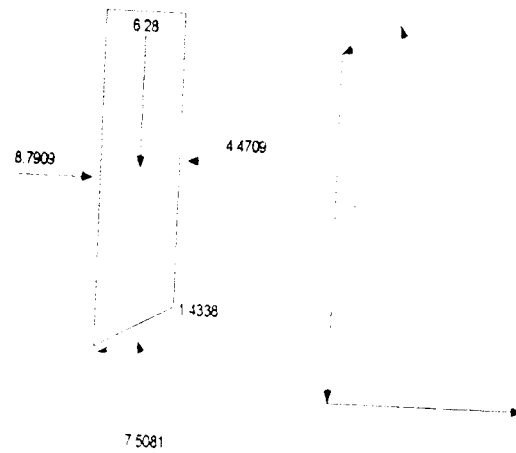
Slice 27 - Bishop Method



Slice 28 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	10.396
Pore Water Pressure	36.773
Pore Water Force	22.487
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	0.74915
Base Length	0.6115
Base Angle	23.949
Polygon Closure	0
Anisotropic Strength Modifier	1
Weight	6.28
Base Shear Force	1.4338
Base Normal Force	7.5081
Left Side Normal Force	8.7909
Right Side Normal Force	4.4709

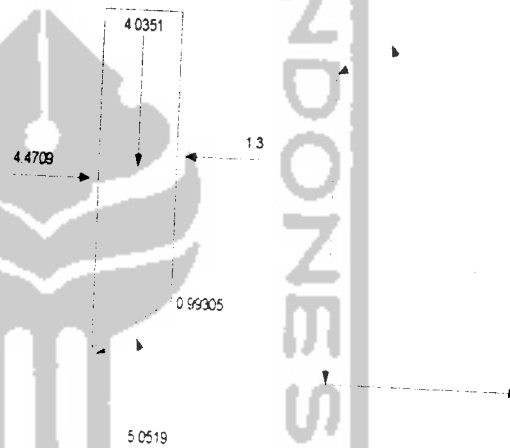
Slice 28 - Bishop Method



Slice 29 - Bishop Method

Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	10.69
Pore Water Pressure	34.146
Pore Water Force	21.471
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	0.48135
Base Length	0.6288
Base Angle	27.28
Polygon Closure	0.02528
Anisotropic Strength Modifier	1
Weight	4.0351
Base Shear Force	0.99305
Base Normal Force	5.0519
Left Side Normal Force	4.4709
Right Side Normal Force	1.3

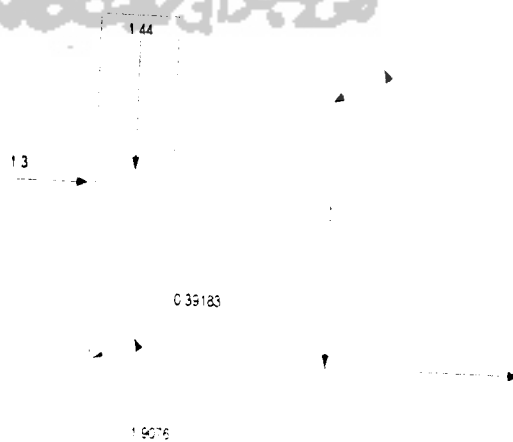
Slice 29 - Bishop Method



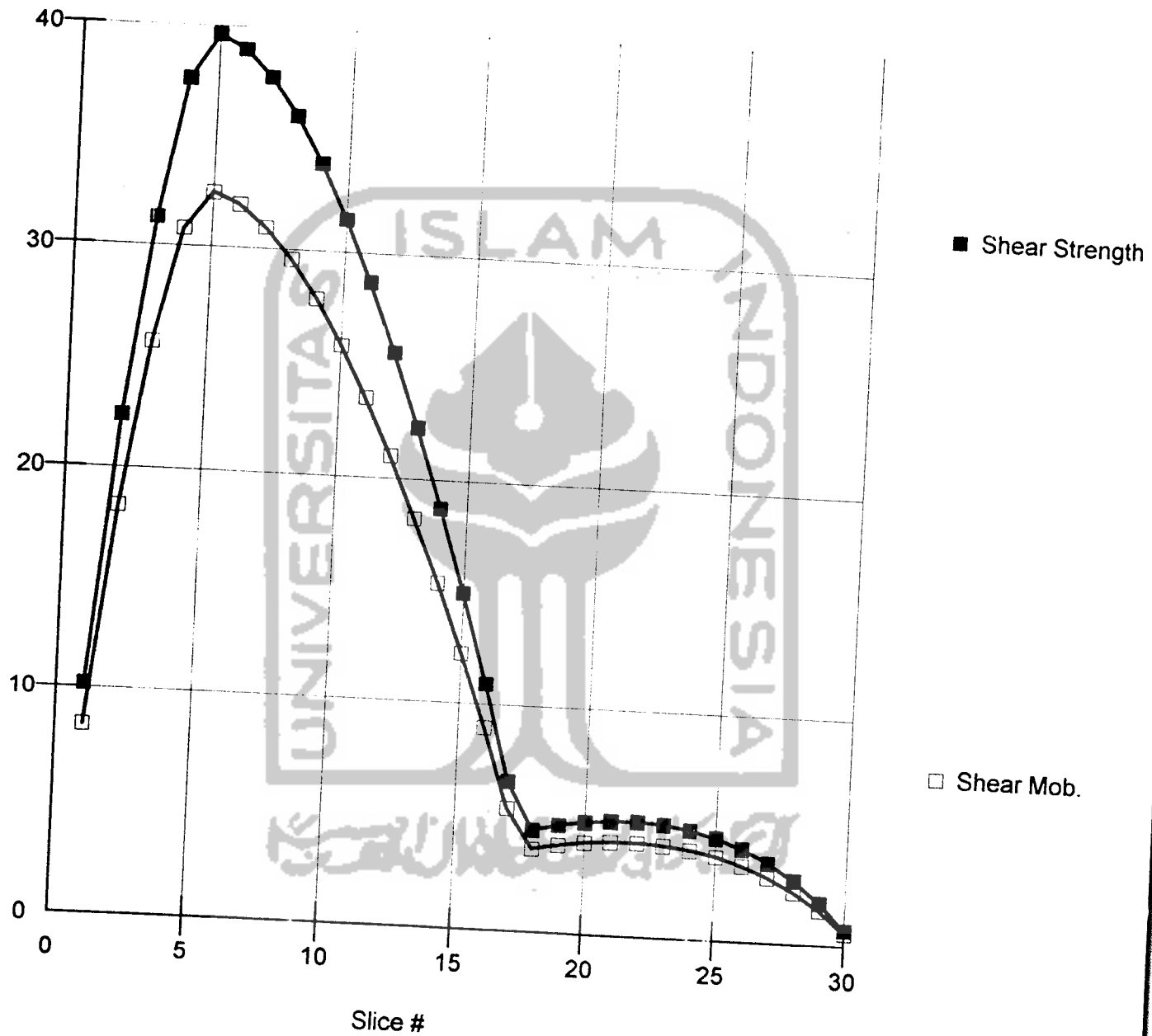
Slice 30 - Bishop Method

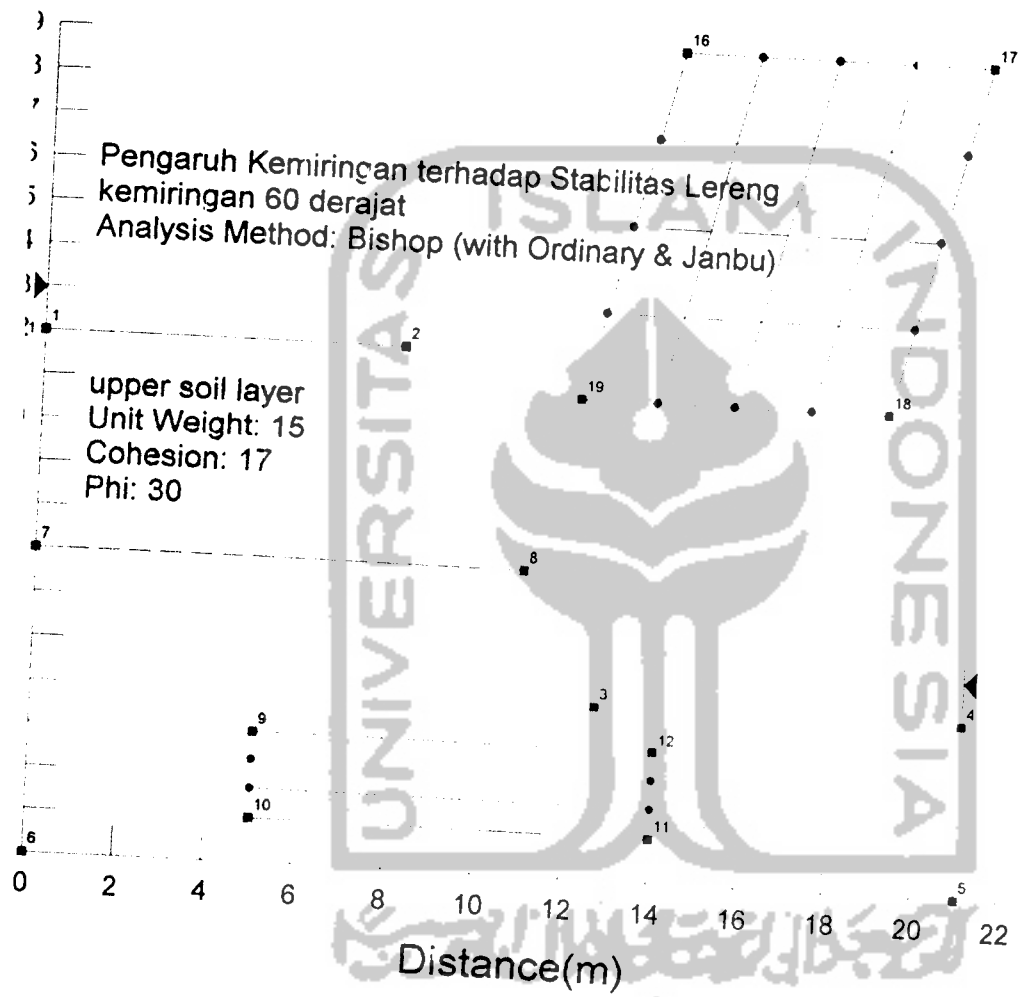
Factor of Safety	1.2199
Phi Angle	30
C (Strength)	17
C (Force)	11.051
Pore Water Pressure	31.11
Pore Water Force	20.223
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	0.17178
Base Length	0.65005
Base Angle	30.716
Polygon Closure	0.00954
Anisotropic Strength Modifier	1
Weight	1.44
Base Shear Force	0.39183
Base Normal Force	1.9076
Left Side Normal Force	1.3

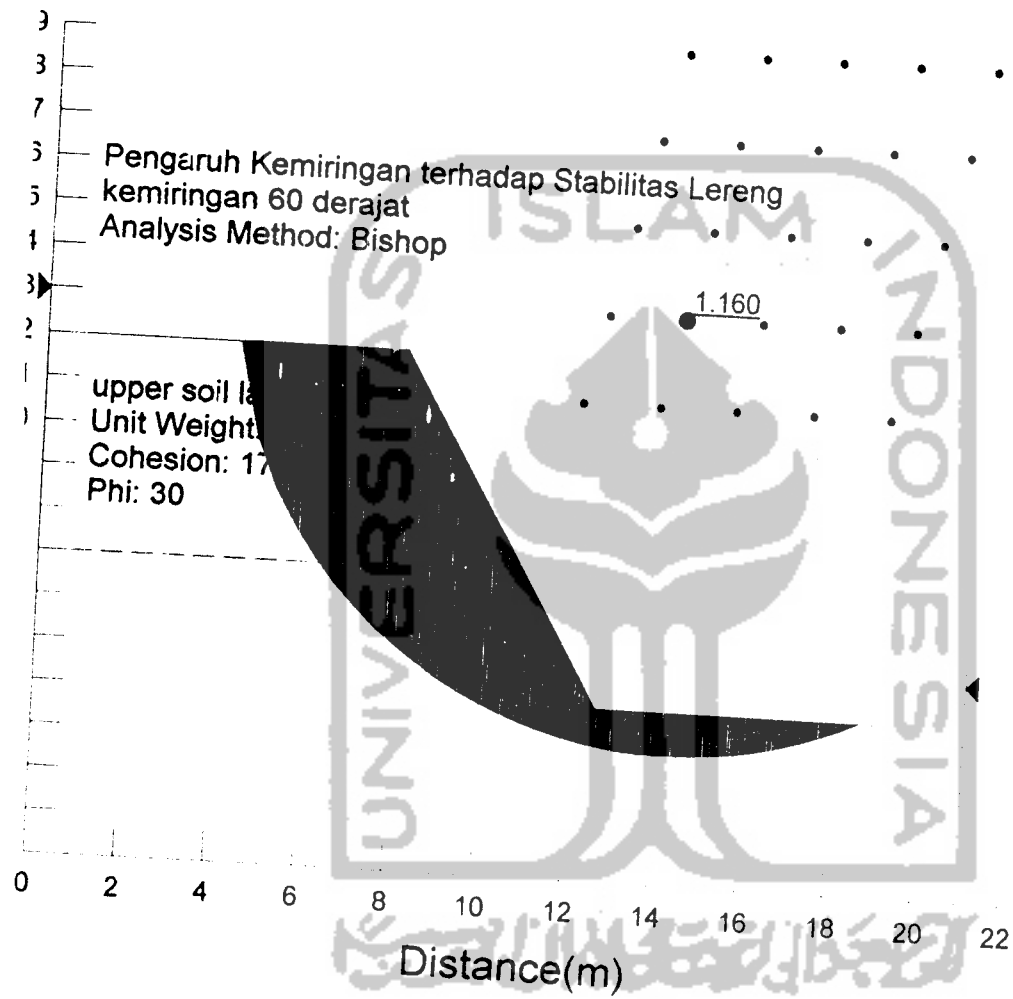
Slice 30 - Bishop Method



Shear Resistance vs. Slice #



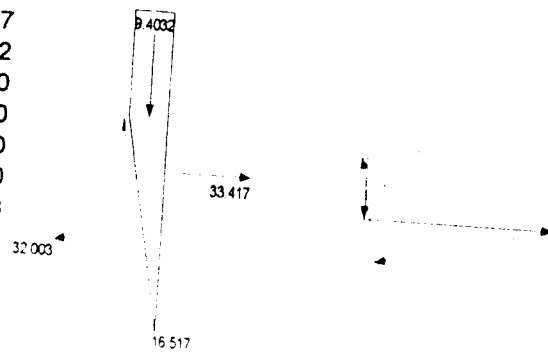




OUT PUT ANALISIS STABILITAS LERENG DENGAN KEMIRINGAN 60

Slice 1 - Bishop Method

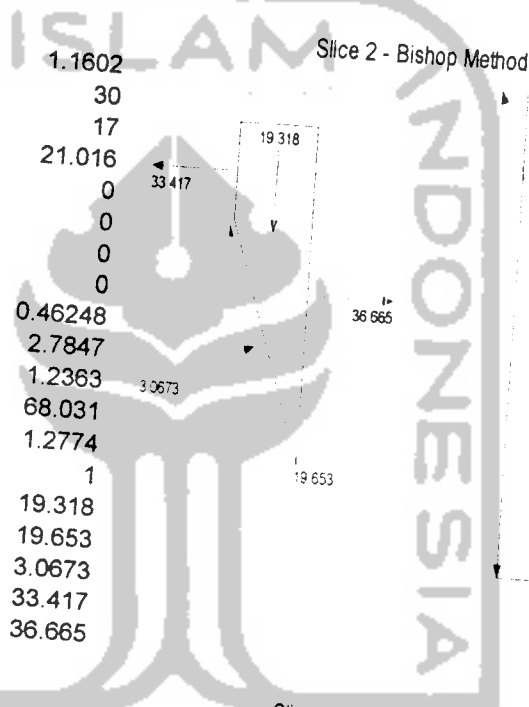
Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	37.562
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46248
Mid-Height	1.3555
Base Length	2.2096
Base Angle	77.918
Polygon Closure	1.0025
Anisotropic Strength Modifier	1
Weight	9.4032
Base Shear Force	16.517
Base Normal Force	32.003
Right Side Normal Force	33.417



Slice 1 - Bishop Method

Slice 2 - Bishop Method

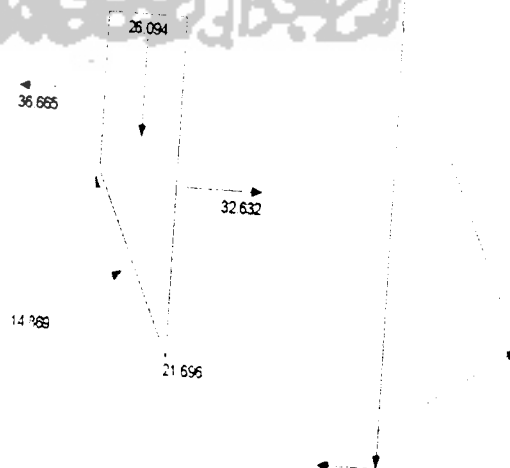
Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	21.016
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46248
Mid-Height	2.7847
Base Length	1.2363
Base Angle	68.031
Polygon Closure	1.2774
Anisotropic Strength Modifier	1
Weight	19.318
Base Shear Force	19.653
Base Normal Force	3.0673
Left Side Normal Force	33.417
Right Side Normal Force	36.665



Slice 2 - Bishop Method

Slice 3 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	16.58
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46249
Mid-Height	3.7615
Base Length	0.97528
Base Angle	61.692
Polygon Closure	1.1742
Anisotropic Strength Modifier	1
Weight	26.094
Base Shear Force	21.696
Base Normal Force	14.869
Left Side Normal Force	36.665
Right Side Normal Force	32.632

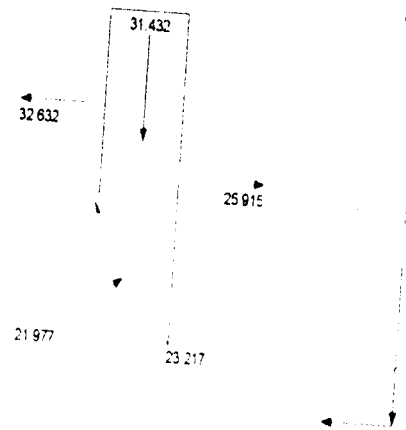


Slice 3 - Bishop Method

Slice 4 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	14.243
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46248
Mid-Height	4.531
Base Length	0.83785
Base Angle	56.496
Polygon Closure	1.2573
Anisotropic Strength Modifier	1
Weight	31.432
Base Shear Force	23.217
Base Normal Force	21.977
Left Side Normal Force	32.632
Right Side Normal Force	25.915

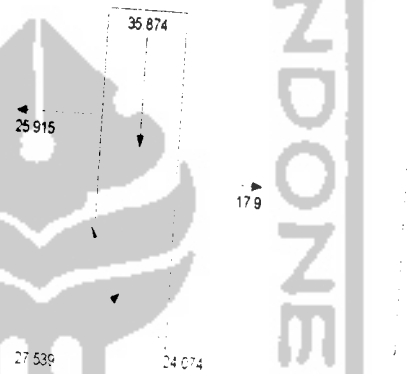
Slice 4 - Bishop Method



Slice 5 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	12.755
Pore Water Pressure	1.8792
Pore Water Force	1.2599
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46248
Mid-Height	5.1712
Base Length	0.75028
Base Angle	51.945
Polygon Closure	1.0762
Anisotropic Strength Modifier	1
Weight	35.874
Base Shear Force	24.074
Base Normal Force	27.539
Left Side Normal Force	25.915
Right Side Normal Force	17.9

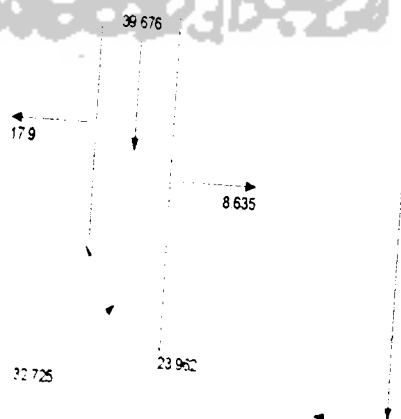
Slice 5 - Bishop Method



Slice 6 - Bishop Method

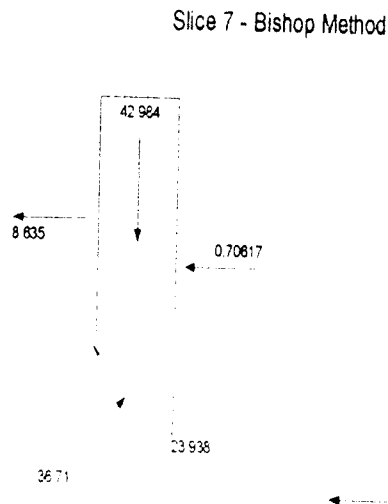
Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	11.71
Pore Water Pressure	7.0549
Pore Water Force	4.8594
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46248
Mid-Height	5.7192
Base Length	0.6888
Base Angle	47.822
Polygon Closure	0.9919
Anisotropic Strength Modifier	1
Weight	39.676
Base Shear Force	23.962
Base Normal Force	32.725
Left Side Normal Force	17.9
Right Side Normal Force	8.635

Slice 6 - Bishop Method



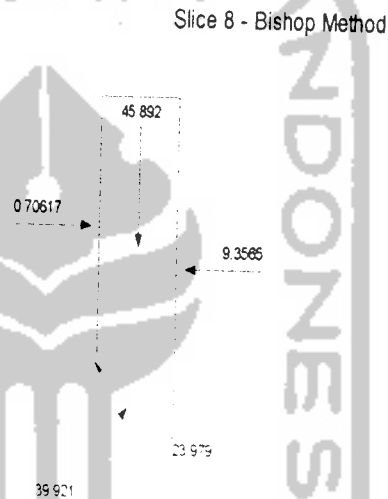
Slice 7 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	10.931
Pore Water Pressure	11.733
Pore Water Force	7.5441
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46249
Mid-Height	6.1962
Base Length	0.64299
Base Angle	44.006
Polygon Closure	0.85968
Anisotropic Strength Modifier	1
Weight	42.984
Base Shear Force	23.938
Base Normal Force	36.71
Left Side Normal Force	8.635
Right Side Normal Force	0.70617



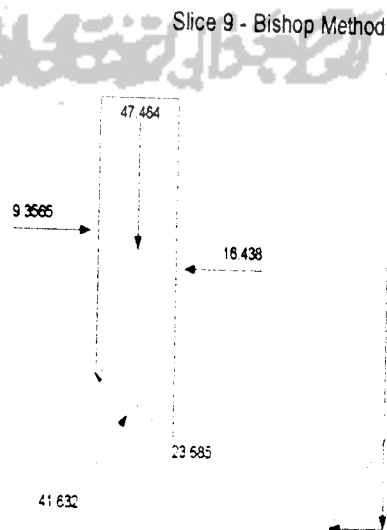
Slice 8 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	10.328
Pore Water Pressure	15.844
Pore Water Force	9.6255
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46248
Mid-Height	6.6153
Base Length	0.60751
Base Angle	40.423
Polygon Closure	0.91784
Anisotropic Strength Modifier	1
Weight	45.892
Base Shear Force	23.979
Base Normal Force	39.921
Left Side Normal Force	0.70617
Right Side Normal Force	9.3565



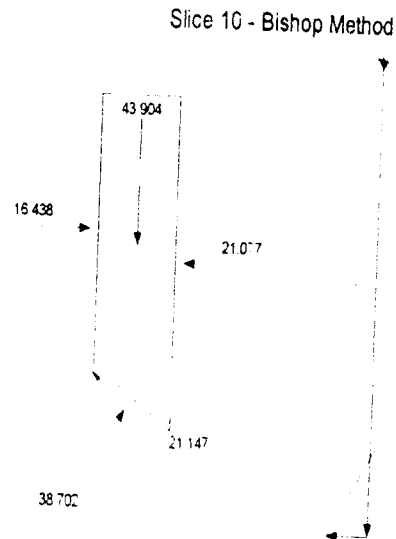
Slice 9 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	10.236
Pore Water Pressure	19.547
Pore Water Force	11.77
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.48117
Mid-Height	6.5763
Base Length	0.60215
Base Angle	36.957
Polygon Closure	0.71196
Anisotropic Strength Modifier	1
Weight	47.464
Base Shear Force	23.885
Base Normal Force	41.632
Left Side Normal Force	9.3565
Right Side Normal Force	16.438



Slice 10 - Bishop Method

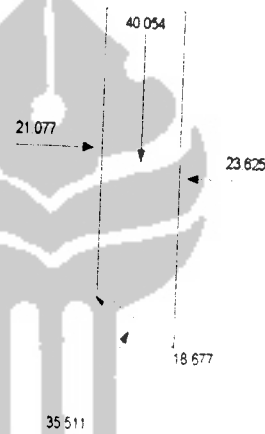
Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	9.818
Pore Water Pressure	22.882
Pore Water Force	13.215
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.48117
Mid-Height	6.083
Base Length	0.57753
Base Angle	33.577
Polygon Closure	0.65856
Anisotropic Strength Modifier	1
Weight	43.904
Base Shear Force	21.147
Base Normal Force	38.702
Left Side Normal Force	16.438
Right Side Normal Force	21.077



Slice 11 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	9.4765
Pore Water Pressure	25.823
Pore Water Force	14.395
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.48117
Mid-Height	5.5496
Base Length	0.55744
Base Angle	30.325
Polygon Closure	0.60081
Anisotropic Strength Modifier	1
Weight	40.054
Base Shear Force	18.677
Base Normal Force	35.511
Left Side Normal Force	21.077
Right Side Normal Force	23.625

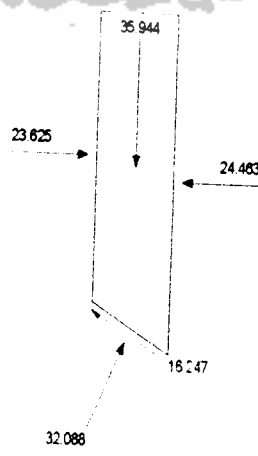
Slice 11 - Bishop Method



Slice 12 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	9.1951
Pore Water Pressure	28.413
Pore Water Force	15.368
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.48117
Mid-Height	4.9801
Base Length	0.54089
Base Angle	27.178
Polygon Closure	0.53916
Anisotropic Strength Modifier	1
Weight	35.944
Base Shear Force	16.247
Base Normal Force	32.088
Left Side Normal Force	23.625
Right Side Normal Force	24.463

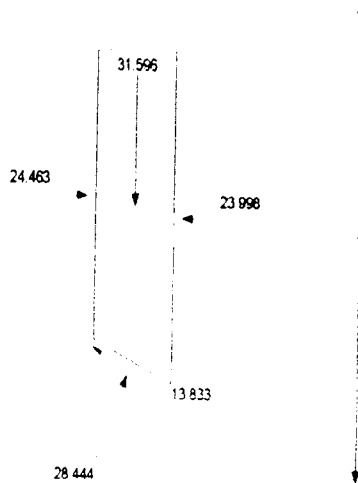
Slice 12 - Bishop Method



Slice 13 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	8.9621
Pore Water Pressure	30.676
Pore Water Force	16.172
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.48116
Mid-Height	4.3777
Base Length	0.52718
Base Angle	24.118
Polygon Closure	0.63192
Anisotropic Strength Modifier	1
Weight	31.596
Base Shear Force	13.833
Base Normal Force	28.444
Left Side Normal Force	24.463
Right Side Normal Force	23.998

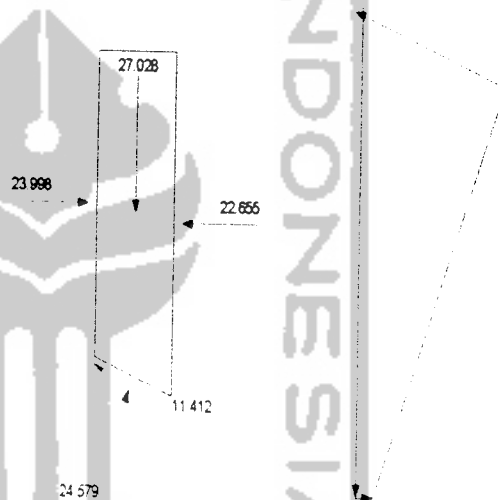
Slice 13 - Bishop Method



Slice 14 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	8.7695
Pore Water Pressure	32.643
Pore Water Force	16.839
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.48117
Mid-Height	3.7448
Base Length	0.51585
Base Angle	21.129
Polygon Closure	0.54056
Anisotropic Strength Modifier	1
Weight	27.028
Base Shear Force	11.412
Base Normal Force	24.579
Left Side Normal Force	23.998
Right Side Normal Force	22.655

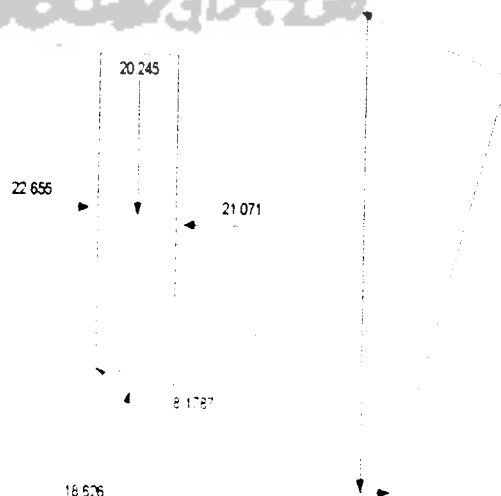
Slice 14 - Bishop Method



Slice 15 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	7.7551
Pore Water Pressure	34.249
Pore Water Force	15.624
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.433
Mid-Height	3.1171
Base Length	0.45618
Base Angle	18.345
Polygon Closure	0.30367
Anisotropic Strength Modifier	1
Weight	20.245
Base Shear Force	8.1787
Base Normal Force	18.626
Left Side Normal Force	22.655
Right Side Normal Force	21.071

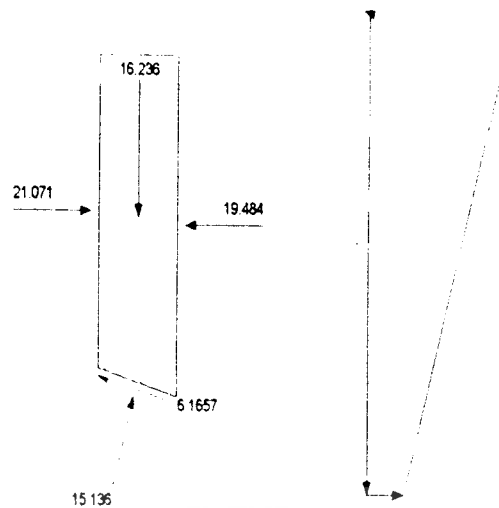
Slice 15 - Bishop Method



Slice 16 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	7.6481
Pore Water Pressure	35.551
Pore Water Force	15.994
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.433
Mid-Height	2.4998
Base Length	0.44989
Base Angle	15.749
Polygon Closure	0.24354
Anisotropic Strength Modifier	1
Weight	16.236
Base Shear Force	6.1657
Base Normal Force	15.136
Left Side Normal Force	21.071
Right Side Normal Force	19.484

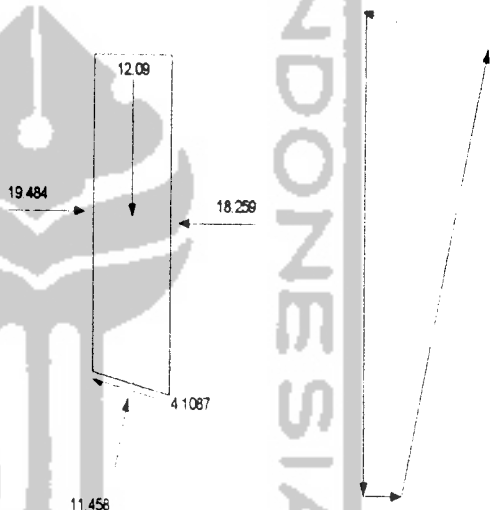
Slice 16 - Bishop Method



Slice 17 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	7.5603
Pore Water Pressure	38.847
Pore Water Force	16.298
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.433
Mid-Height	1.8615
Base Length	0.44472
Base Angle	13.186
Polygon Closure	0.1209
Anisotropic Strength Modifier	1
Weight	12.09
Base Shear Force	4.1087
Base Normal Force	11.458
Left Side Normal Force	19.484
Right Side Normal Force	18.259

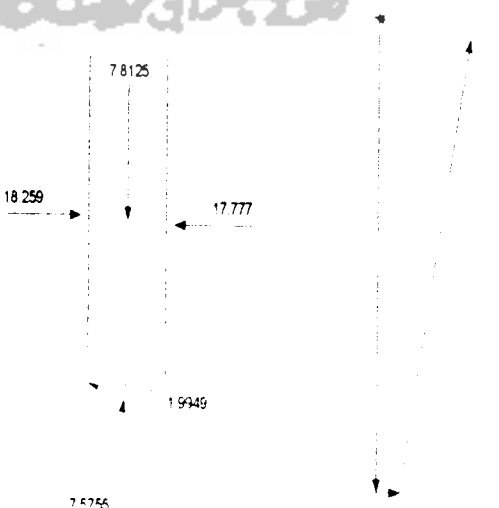
Slice 17 - Bishop Method



Slice 18 - Bishop Method

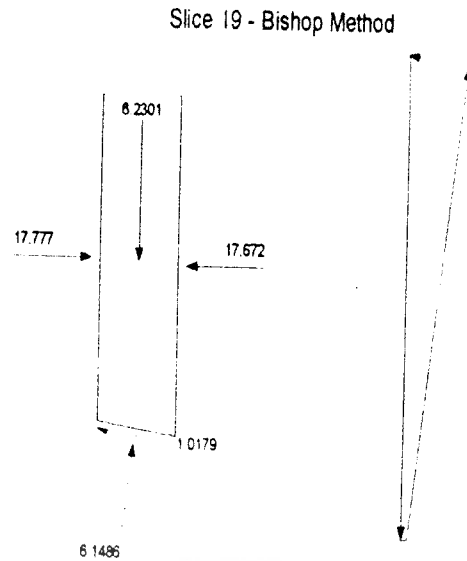
Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	7.49
Pore Water Pressure	37.543
Pore Water Force	16.541
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.433
Mid-Height	1.2029
Base Length	0.44059
Base Angle	10.649
Polygon Closure	0.11719
Anisotropic Strength Modifier	1
Weight	7.8125
Base Shear Force	1.9949
Base Normal Force	7.5755
Left Side Normal Force	18.259
Right Side Normal Force	17.777

Slice 18 - Bishop Method



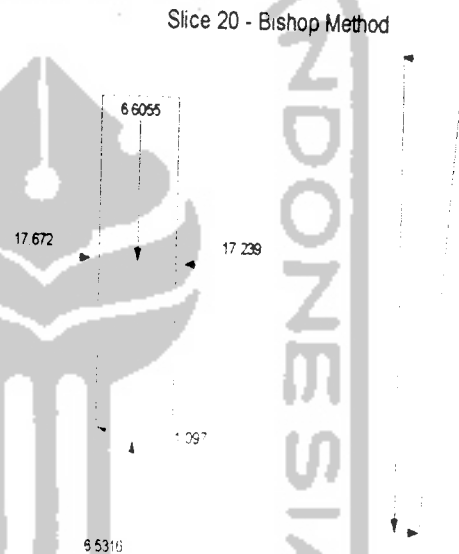
Slice 19 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	7.9109
Pore Water Pressure	38.266
Pore Water Force	17.807
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46076
Mid-Height	0.90143
Base Length	0.46535
Base Angle	8.0537
Polygon Closure	0.03115
Anisotropic Strength Modifier	1
Weight	6.2301
Base Shear Force	1.0179
Base Normal Force	6.1486
Left Side Normal Force	17.777
Right Side Normal Force	17.672



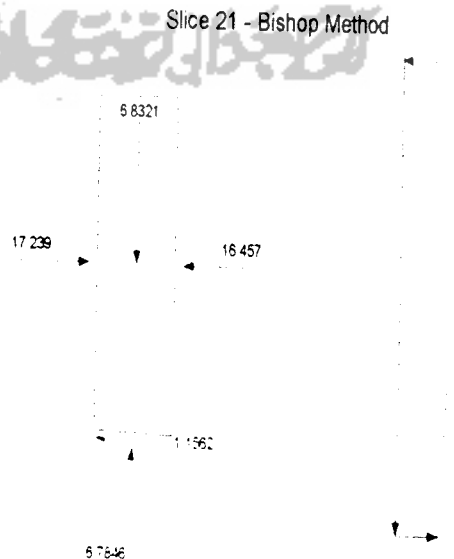
Slice 20 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	7.8678
Pore Water Pressure	38.798
Pore Water Force	17.956
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46076
Mid-Height	0.95574
Base Length	0.46281
Base Angle	5.3944
Polygon Closure	0.03303
Anisotropic Strength Modifier	1
Weight	6.6055
Base Shear Force	1.097
Base Normal Force	6.5316
Left Side Normal Force	17.672
Right Side Normal Force	17.239



Slice 21 - Bishop Method

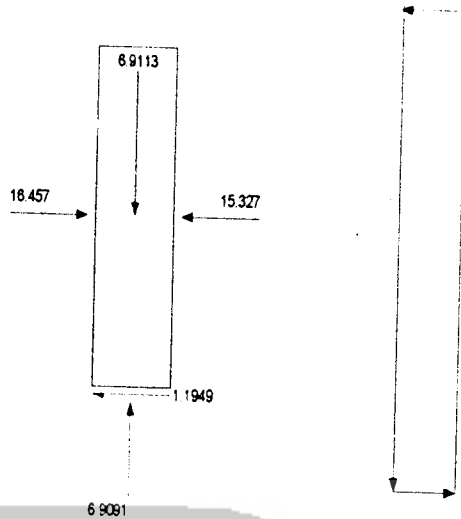
Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	7.8419
Pore Water Pressure	39.119
Pore Water Force	18.045
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46076
Mid-Height	0.98852
Base Length	0.46129
Base Angle	2.7469
Polygon Closure	0.06832
Anisotropic Strength Modifier	1
Weight	6.8321
Base Shear Force	1.1582
Base Normal Force	6.7846
Left Side Normal Force	17.239
Right Side Normal Force	16.457



Slice 22 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	7.8331
Pore Water Pressure	39.23
Pore Water Force	18.076
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46077
Mid-Height	0.99998
Base Length	0.46077
Base Angle	0.10507
Polygon Closure	0.06911
Anisotropic Strength Modifier	1
Weight	6.9113
Base Shear Force	1.1949
Base Normal Force	6.9091
Left Side Normal Force	18.457
Right Side Normal Force	15.327

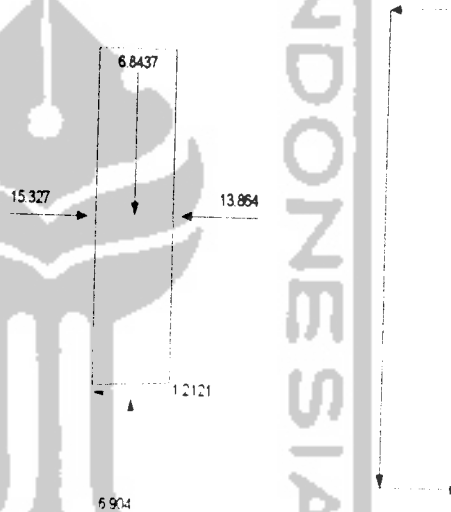
Slice 22 - Bishop Method



Slice 23 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	7.8406
Pore Water Pressure	39.138
Pore Water Force	18.05
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46076
Mid-Height	0.99021
Base Length	0.46121
Base Angle	2.5365
Polygon Closure	0
Anisotropic Strength Modifier	1
Weight	6.8437
Base Shear Force	1.2121
Base Normal Force	6.904
Left Side Normal Force	15.327
Right Side Normal Force	13.864

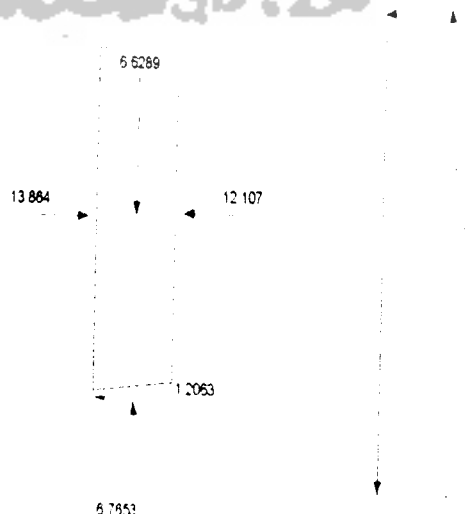
Slice 23 - Bishop Method



Slice 24 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	7.8651
Pore Water Pressure	38.83
Pore Water Force	17.965
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46076
Mid-Height	0.95913
Base Length	0.46265
Base Angle	5.1834
Polygon Closure	0.03383
Anisotropic Strength Modifier	1
Weight	6.6289
Base Shear Force	1.2063
Base Normal Force	6.7853
Left Side Normal Force	13.864
Right Side Normal Force	12.107

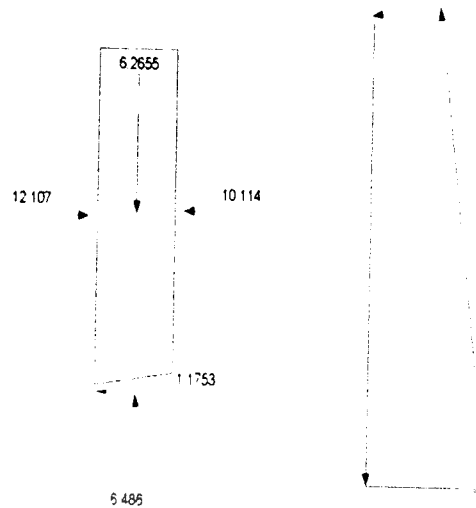
Slice 24 - Bishop Method



Slice 25 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	7.9069
Pore Water Pressure	38.316
Pore Water Force	17.821
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46076
Mid-Height	0.90655
Base Length	0.46511
Base Angle	7.8415
Polygon Closure	0.03243
Anisotropic Strength Modifier	1
Weight	6.2655
Base Shear Force	1.1753
Base Normal Force	6.486
Left Side Normal Force	12.107
Right Side Normal Force	10.114

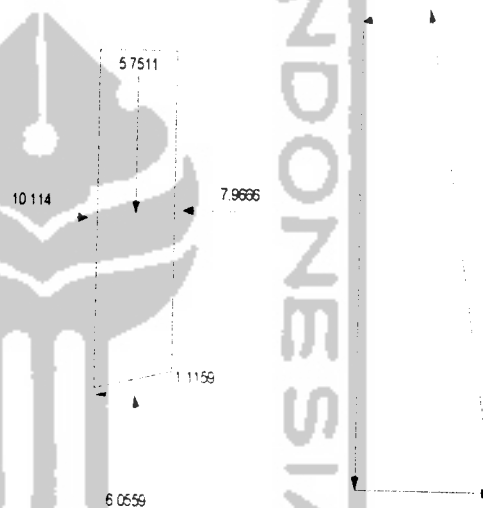
Slice 25 - Bishop Method



Slice 26 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	7.9667
Pore Water Pressure	37.586
Pore Water Force	17.614
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46076
Mid-Height	0.83211
Base Length	0.46863
Base Angle	10.517
Polygon Closure	0.03028
Anisotropic Strength Modifier	1
Weight	5.7511
Base Shear Force	1.1159
Base Normal Force	6.0559
Left Side Normal Force	10.114
Right Side Normal Force	7.9666

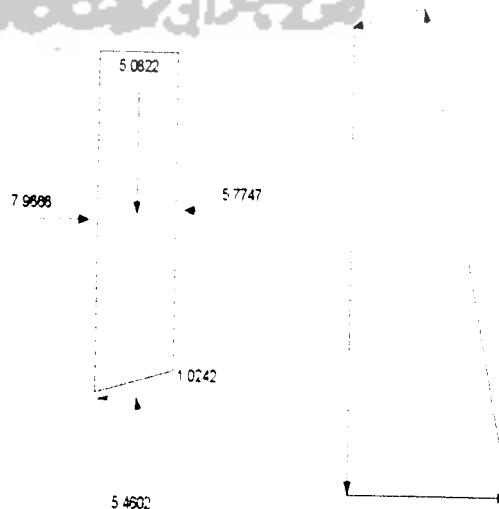
Slice 26 - Bishop Method



Slice 27 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	8.046
Pore Water Pressure	36.637
Pore Water Force	17.34
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46076
Mid-Height	0.73533
Base Length	0.47329
Base Angle	13.215
Polygon Closure	0.0273
Anisotropic Strength Modifier	1
Weight	5.0822
Base Shear Force	1.0242
Base Normal Force	5.4602
Left Side Normal Force	7.9666
Right Side Normal Force	5.7747

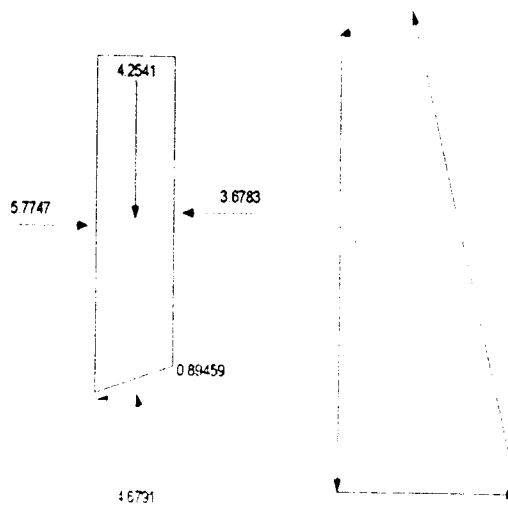
Slice 27 - Bishop Method



Slice 28 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	8.1463
Pore Water Pressure	35.462
Pore Water Force	16.993
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46076
Mid-Height	0.61552
Base Length	0.4792
Base Angle	15.944
Polygon Closure	0.0234
Anisotropic Strength Modifier	1
Weight	4.2541
Base Shear Force	0.89459
Base Normal Force	4.6791
Left Side Normal Force	5.7747
Right Side Normal Force	3.6783

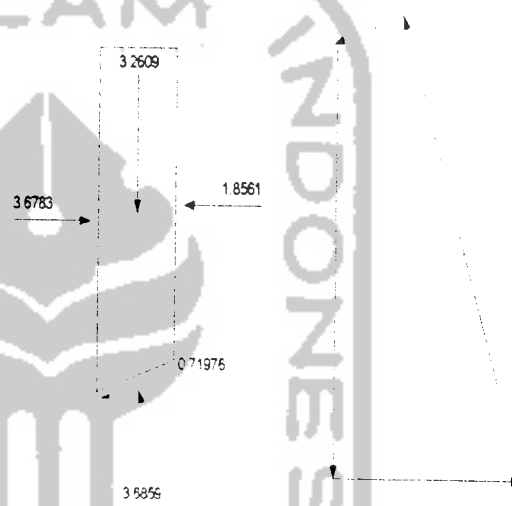
Slice 28 - Bishop Method



Slice 29 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	8.2702
Pore Water Pressure	34.051
Pore Water Force	16.565
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46077
Mid-Height	0.47181
Base Length	0.48648
Base Angle	18.711
Polygon Closure	0.03688
Anisotropic Strength Modifier	1
Weight	3.2609
Base Shear Force	0.71976
Base Normal Force	3.6859
Left Side Normal Force	3.6783
Right Side Normal Force	1.8561

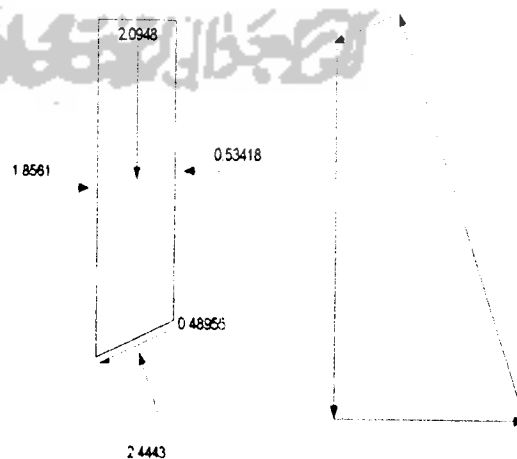
Slice 29 - Bishop Method



Slice 30 - Bishop Method

Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	8.4201
Pore Water Pressure	32.397
Pore Water Force	16.046
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46076
Mid-Height	0.30309
Base Length	0.4953
Base Angle	21.524
Polygon Closure	0.02444
Anisotropic Strength Modifier	1
Weight	2.0948
Base Shear Force	0.48955
Base Normal Force	2.4443
Left Side Normal Force	1.8561
Right Side Normal Force	0.53418

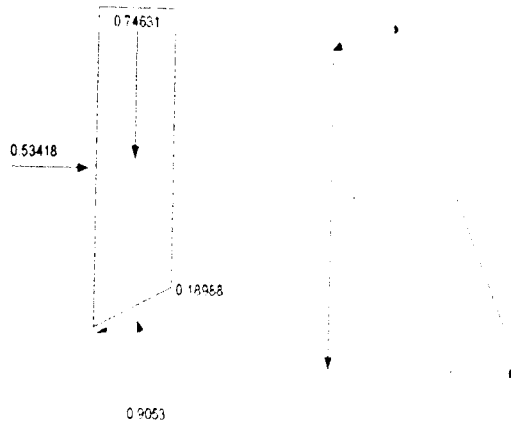
Slice 30 - Bishop Method



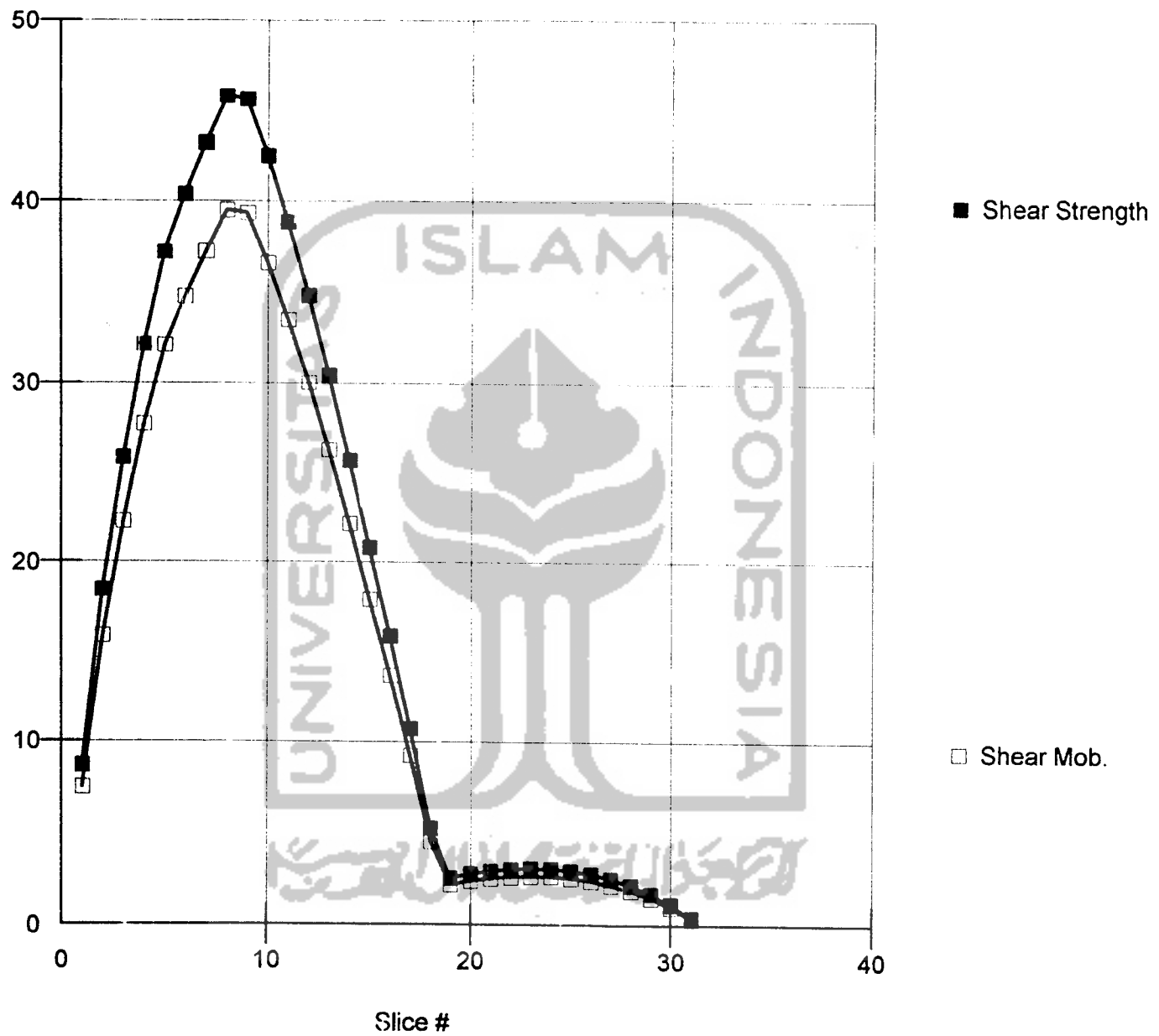
Slice 31 - Bishop Method

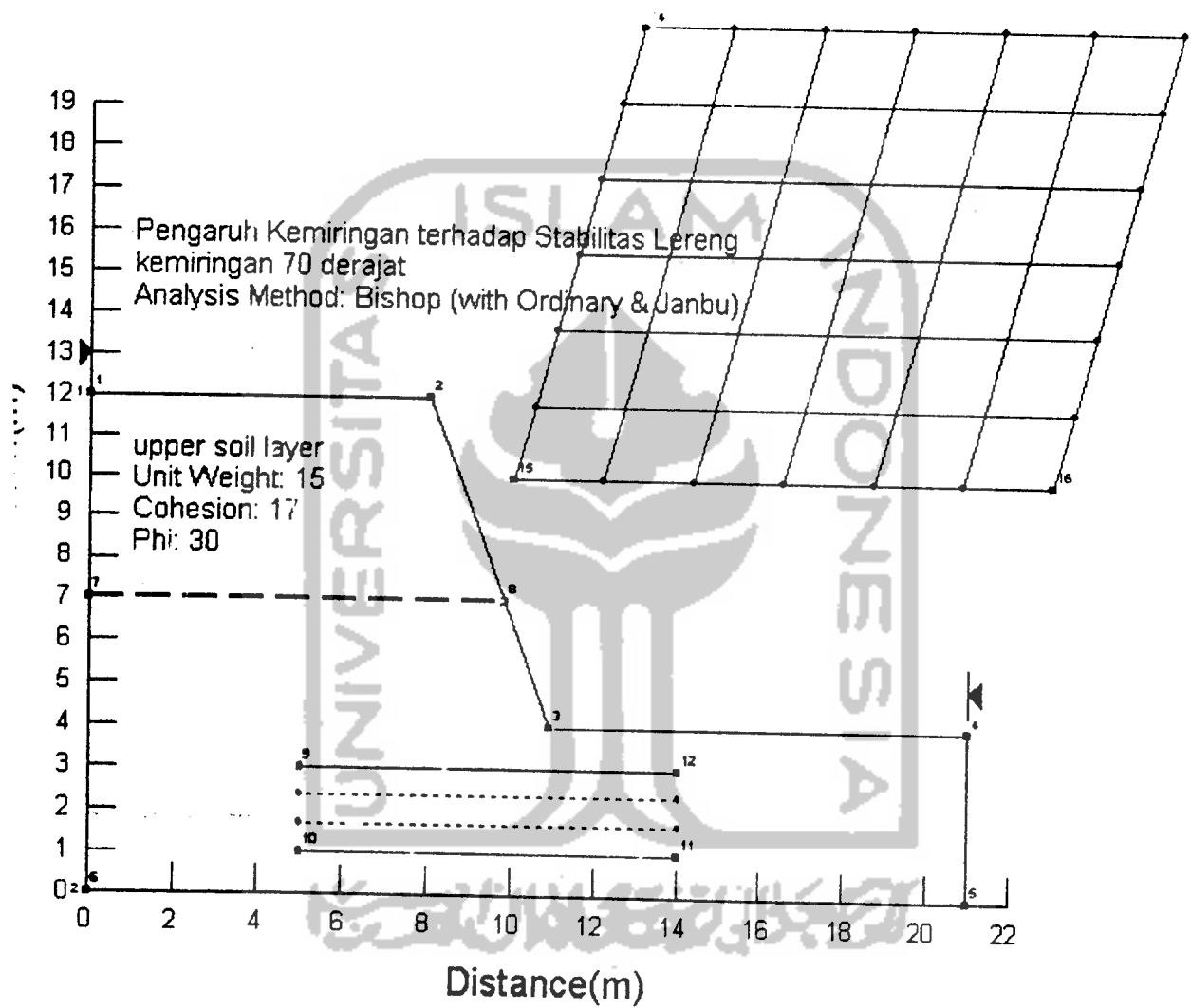
Factor of Safety	1.1602
Phi Angle	30
C (Strength)	17
C (Force)	8.6006
Pore Water Pressure	30.483
Pore Water Force	15.422
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46076
Mid-Height	0.10798
Base Length	0.50592
Base Angle	24.392
Polygon Closure	0.00905
Anisotropic Strength Modifier	1
Weight	0.74631
Base Shear Force	0.18988
Base Normal Force	0.9053
Left Side Normal Force	0.53418

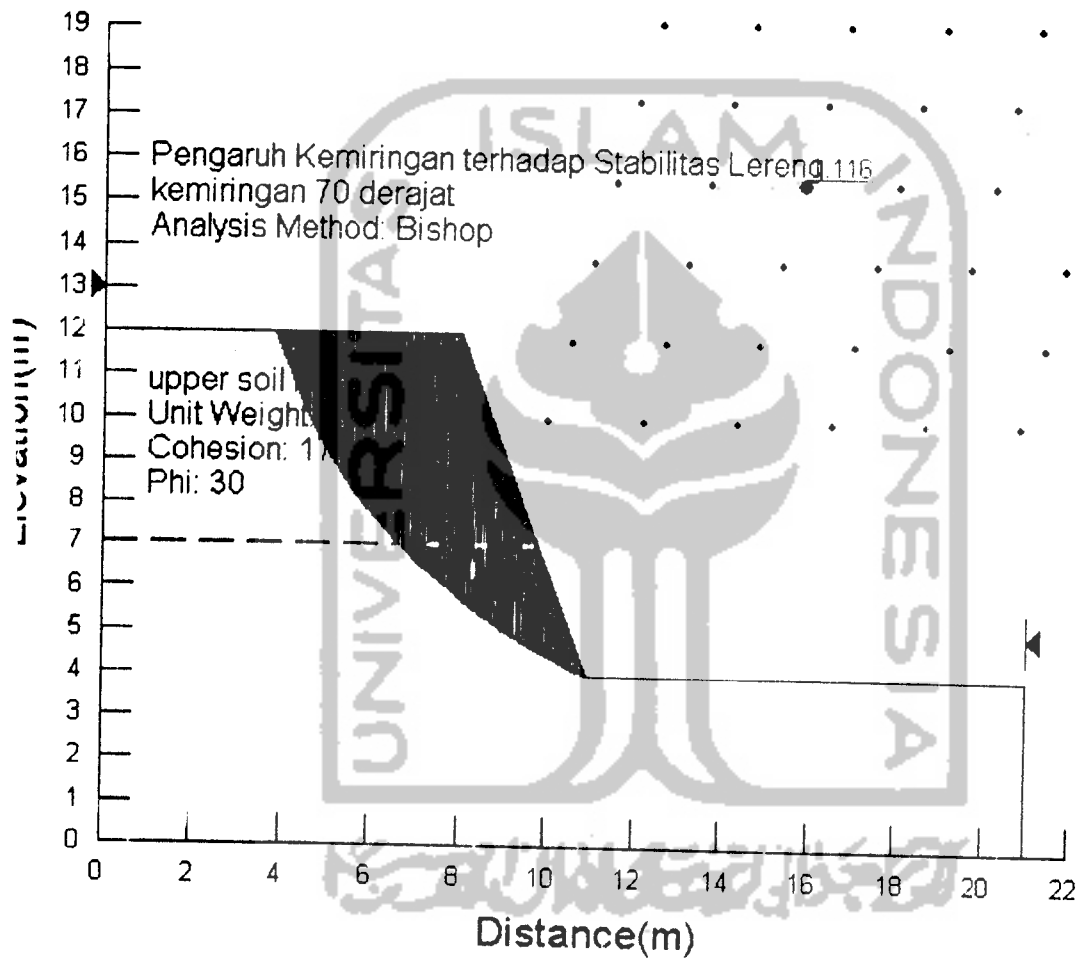
Slice 31 - Bishop Method



Shear Resistance vs. Slice #





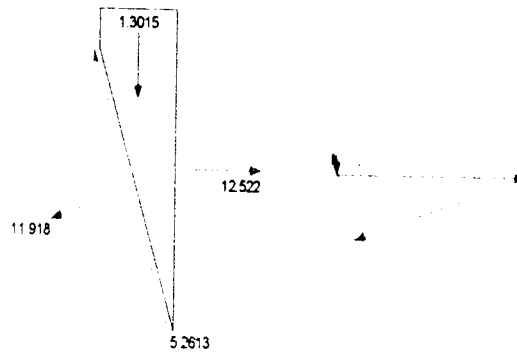


OUT PUT ANALISIS STABILITAS LERENG DENGAN KEMIRINGAN 70

Slice 1 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	12.749
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	0.37484
Base Length	0.74993
Base Angle	72.021
Polygon Closure	0.31305
Anisotropic Strength Modifier	1
Weight	1.3015
Base Shear Force	5.2613
Base Normal Force	11.918
Right Side Normal Force	12.522

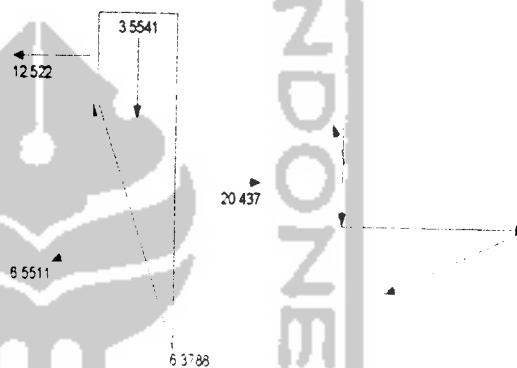
Slice 1 - Bishop Method



Slice 2 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	10.898
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	1.0236
Base Length	0.64105
Base Angle	68.832
Polygon Closure	0.43532
Anisotropic Strength Modifier	1
Weight	3.5541
Base Shear Force	6.3788
Base Normal Force	6.5511
Left Side Normal Force	12.522
Right Side Normal Force	20.437

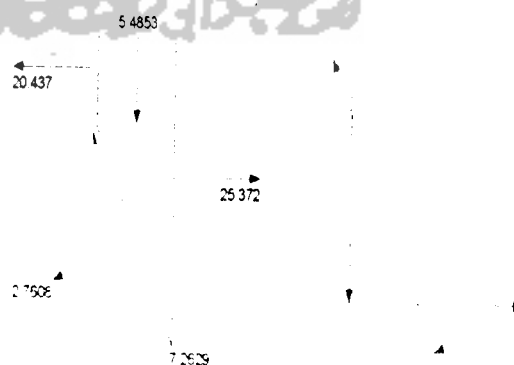
Slice 2 - Bishop Method



Slice 3 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	9.6962
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	1.5798
Base Length	0.57037
Base Angle	66.056
Polygon Closure	0.54472
Anisotropic Strength Modifier	1
Weight	5.4853
Base Shear Force	7.2629
Base Normal Force	2.7608
Left Side Normal Force	20.437
Right Side Normal Force	25.372

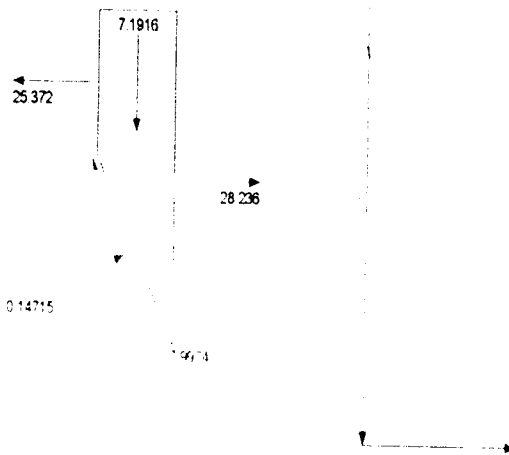
Slice 3 - Bishop Method



Slice 4 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	8.8371
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	2.0712
Base Length	0.51983
Base Angle	63.557
Polygon Closure	0.63979
Anisotropic Strength Modifier	1
Weight	7.1916
Base Shear Force	7.9974
Base Normal Force	0.14715
Left Side Normal Force	25.372
Right Side Normal Force	28.236

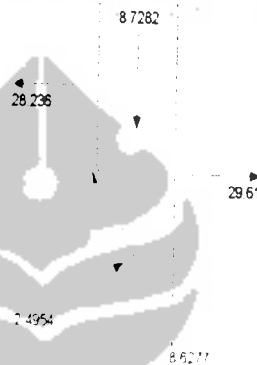
Slice 4 - Bishop Method



Slice 5 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	8.1846
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	2.5137
Base Length	0.48145
Base Angle	61.262
Polygon Closure	0.61097
Anisotropic Strength Modifier	1
Weight	8.7282
Base Shear Force	8.6277
Base Normal Force	2.4954
Left Side Normal Force	28.236
Right Side Normal Force	29.61

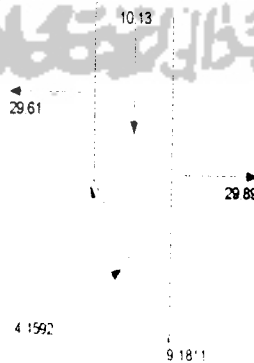
Slice 5 - Bishop Method



Slice 6 - Bishop Method

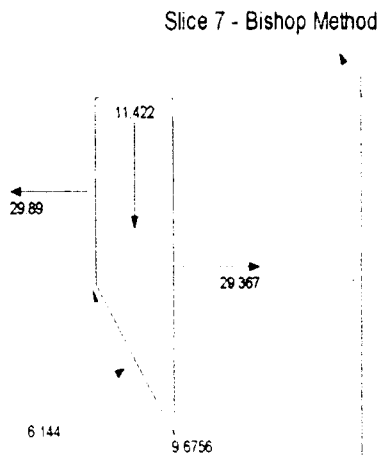
Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	7.6684
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	2.9175
Base Length	0.45108
Base Angle	59.125
Polygon Closure	0.6078
Anisotropic Strength Modifier	1
Weight	10.13
Base Shear Force	9.1811
Base Normal Force	4.4592
Left Side Normal Force	29.61
Right Side Normal Force	29.89

Slice 6 - Bishop Method



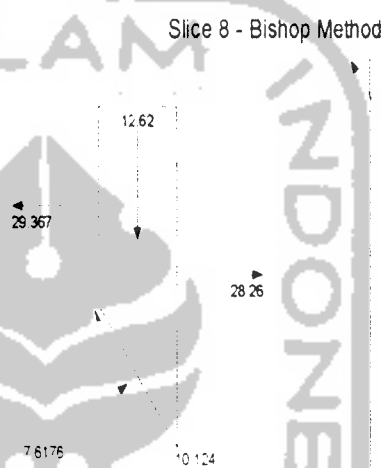
Slice 7 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	7.2475
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	3.2895
Base Length	0.42632
Base Angle	57.114
Polygon Closure	0.62821
Anisotropic Strength Modifier	1
Weight	11.422
Base Shear Force	9.6756
Base Normal Force	6.144
Left Side Normal Force	29.89
Right Side Normal Force	29.367



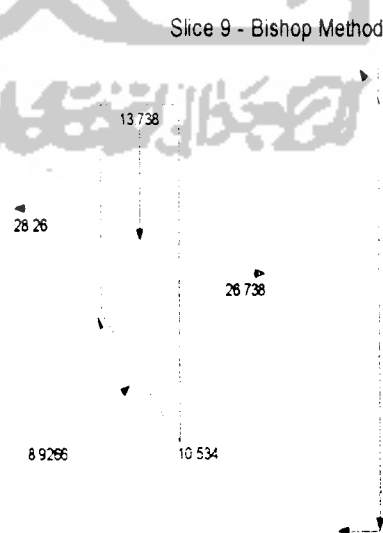
Slice 8 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	6.8964
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	3.6346
Base Length	0.40567
Base Angle	55.207
Polygon Closure	0.631
Anisotropic Strength Modifier	1
Weight	12.62
Base Shear Force	10.124
Base Normal Force	7.6176
Left Side Normal Force	29.367
Right Side Normal Force	28.26



Slice 9 - Bishop Method

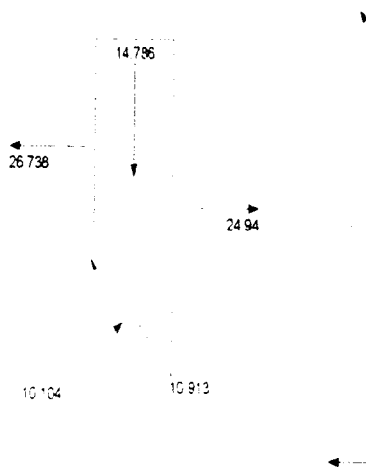
Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	6.5983
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	3.9566
Base Length	0.38813
Base Angle	53.388
Polygon Closure	0.6869
Anisotropic Strength Modifier	1
Weight	13.738
Base Shear Force	10.534
Base Normal Force	8.9266
Left Side Normal Force	28.26
Right Side Normal Force	26.738



Slice 10 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	6.3414
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	4.2583
Base Length	0.37302
Base Angle	51.643
Polygon Closure	0.66537
Anisotropic Strength Modifier	1
Weight	14.786
Base Shear Force	10.913
Base Normal Force	10.104
Left Side Normal Force	26.738
Right Side Normal Force	24.94

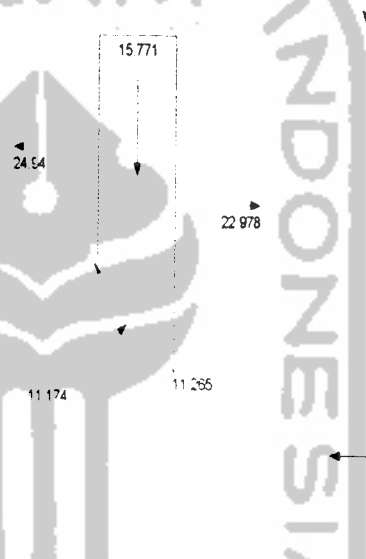
Slice 10 - Bishop Method



Slice 11 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	6.1174
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	4.5421
Base Length	0.35985
Base Angle	49.964
Polygon Closure	0.63084
Anisotropic Strength Modifier	1
Weight	15.771
Base Shear Force	11.265
Base Normal Force	11.174
Left Side Normal Force	24.94
Right Side Normal Force	22.978

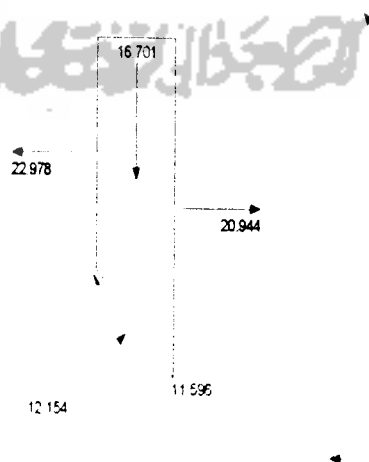
Slice 11 - Bishop Method



Slice 12 - Bishop Method

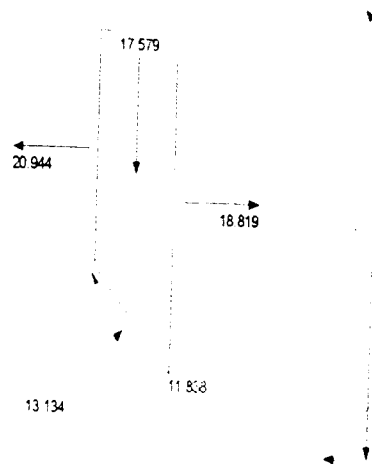
Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	5.9202
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	4.8098
Base Length	0.34825
Base Angle	48.341
Polygon Closure	0.58454
Anisotropic Strength Modifier	1
Weight	16.701
Base Shear Force	11.598
Base Normal Force	12.154
Left Side Normal Force	22.978
Right Side Normal Force	20.944

Slice 12 - Bishop Method



Slice 13 - Bishop Method

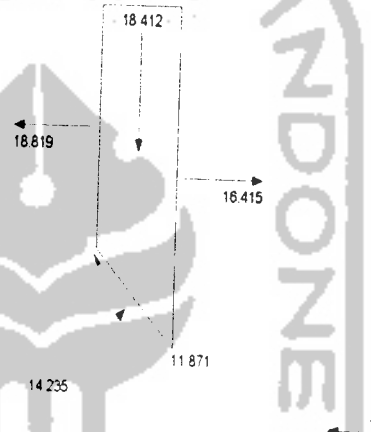
Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	5.7452
Pore Water Pressure	0.61615
Pore Water Force	0.20823
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	5.0628
Base Length	0.33795
Base Angle	46.768
Polygon Closure	0.61527
Anisotropic Strength Modifier	1
Weight	17.579
Base Shear Force	11.838
Base Normal Force	13.134
Left Side Normal Force	20.944
Right Side Normal Force	18.819



Slice 14 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	5.5886
Pore Water Pressure	2.9669
Pore Water Force	0.97535
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	5.3025
Base Length	0.32874
Base Angle	45.24
Polygon Closure	0.64442
Anisotropic Strength Modifier	1
Weight	18.412
Base Shear Force	11.871
Base Normal Force	14.235
Left Side Normal Force	18.819
Right Side Normal Force	16.415

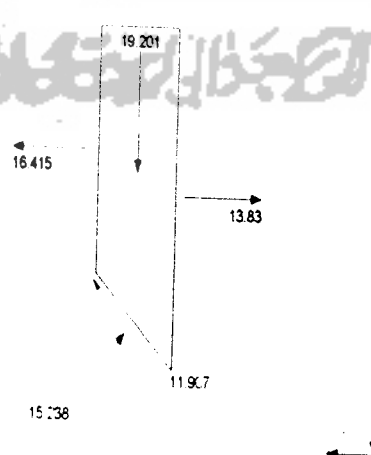
Slice 14 - Bishop Method



Slice 15 - Bishop Method

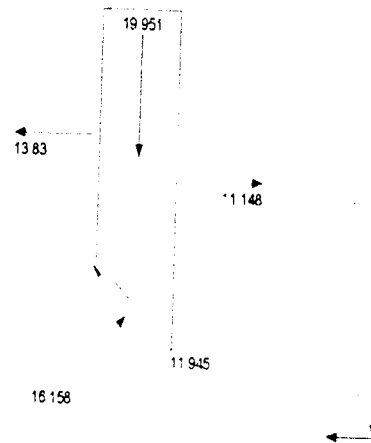
Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	5.4478
Pore Water Pressure	5.1972
Pore Water Force	1.6655
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	5.5299
Base Length	0.32046
Base Angle	43.752
Polygon Closure	0.57603
Anisotropic Strength Modifier	1
Weight	19.201
Base Shear Force	11.907
Base Normal Force	15.238
Left Side Normal Force	16.415
Right Side Normal Force	13.83

Slice 15 - Bishop Method



Slice 16 - Bishop Method

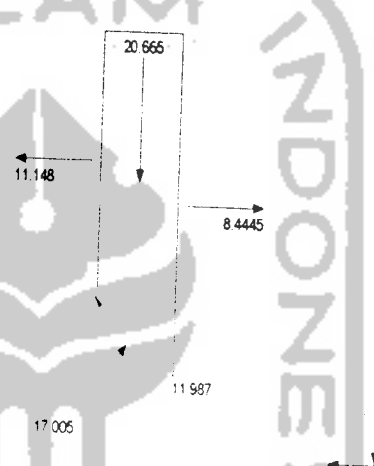
Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	5.3205
Pore Water Pressure	7.3157
Pore Water Force	2.2896
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	5.746
Base Length	0.31297
Base Angle	42.3
Polygon Closure	0.59853
Anisotropic Strength Modifier	1
Weight	19.951
Base Shear Force	11.945
Base Normal Force	16.158
Left Side Normal Force	13.83
Right Side Normal Force	11.148



Slice 17 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	5.2048
Pore Water Pressure	9.3303
Pore Water Force	2.8566
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	5.9514
Base Length	0.30617
Base Angle	40.881
Polygon Closure	0.61995
Anisotropic Strength Modifier	1
Weight	20.665
Base Shear Force	11.987
Base Normal Force	17.005
Left Side Normal Force	11.148
Right Side Normal Force	8.4445

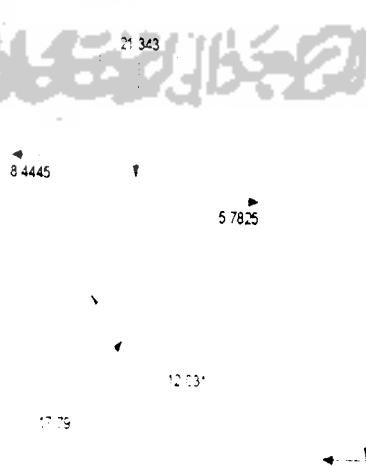
Slice 17 - Bishop Method



Slice 18 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	5.0993
Pore Water Pressure	11.248
Pore Water Force	3.3738
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.23148
Mid-Height	6.1469
Base Length	0.29996
Base Angle	39.492
Polygon Closure	0.53357
Anisotropic Strength Modifier	1
Weight	21.343
Base Shear Force	12.031
Base Normal Force	17.79
Left Side Normal Force	8.4445
Right Side Normal Force	5.7825

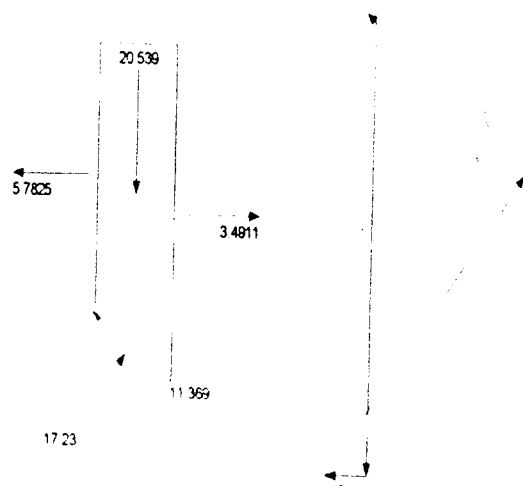
Slice 18 - Bishop Method



Slice 19 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	4.9172
Pore Water Pressure	13.058
Pore Water Force	3.777
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.22749
Mid-Height	6.019
Base Length	0.28925
Base Angle	38.142
Polygon Closure	0.51348
Anisotropic Strength Modifier	1
Weight	20.539
Base Shear Force	11.369
Base Normal Force	17.23
Left Side Normal Force	5.7825
Right Side Normal Force	3.4911

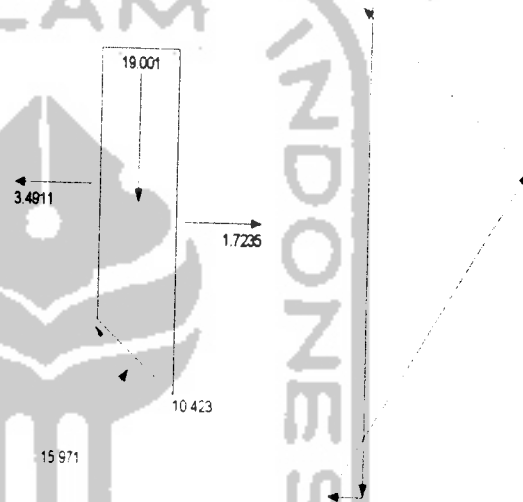
Slice 19 - Bishop Method



Slice 20 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	4.8314
Pore Water Pressure	14.769
Pore Water Force	4.1973
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.22749
Mid-Height	5.5684
Base Length	0.2842
Base Angle	36.828
Polygon Closure	0.47502
Anisotropic Strength Modifier	1
Weight	19.001
Base Shear Force	10.423
Base Normal Force	15.971
Left Side Normal Force	3.4911
Right Side Normal Force	1.7235

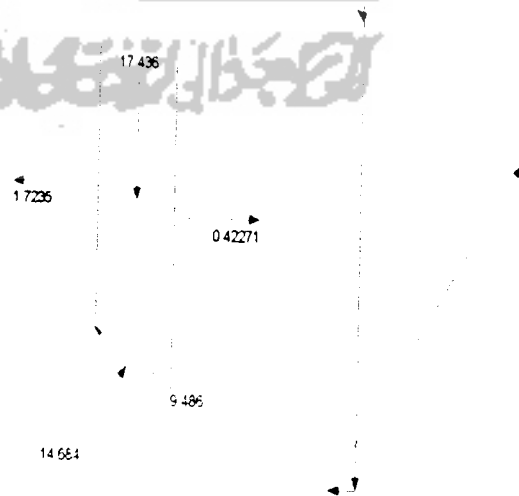
Slice 20 - Bishop Method



Slice 21 - Bishop Method

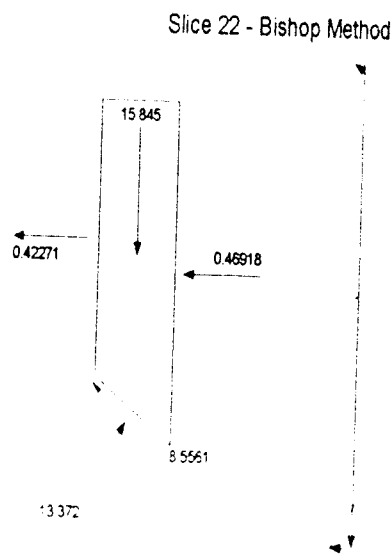
Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	4.7524
Pore Water Pressure	16.401
Pore Water Force	4.5848
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.22749
Mid-Height	5.1098
Base Length	0.27955
Base Angle	35.535
Polygon Closure	0.34872
Anisotropic Strength Modifier	1
Weight	17.436
Base Shear Force	9.486
Base Normal Force	14.664
Left Side Normal Force	1.7235
Right Side Normal Force	0.42271

Slice 21 - Bishop Method



Slice 22 - Bishop Method

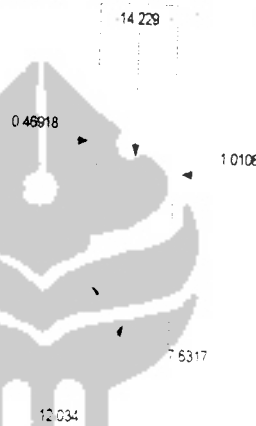
Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	4.6794
Pore Water Pressure	17.957
Pore Water Force	4.9427
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.22749
Mid-Height	4.6435
Base Length	0.27526
Base Angle	34.264
Polygon Closure	0.39612
Anisotropic Strength Modifier	1
Weight	15.845
Base Shear Force	8.5561
Base Normal Force	13.372
Left Side Normal Force	0.42271
Right Side Normal Force	0.46918



Slice 23 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	4.6118
Pore Water Pressure	19.441
Pore Water Force	5.274
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.22749
Mid-Height	4.1698
Base Length	0.27128
Base Angle	33.011
Polygon Closure	0.28458
Anisotropic Strength Modifier	1
Weight	14.229
Base Shear Force	7.6317
Base Normal Force	12.034
Left Side Normal Force	0.46918
Right Side Normal Force	1.0108

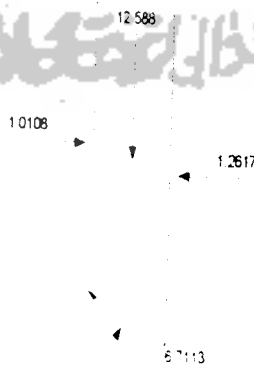
Slice 23 - Bishop Method



Slice 24 - Bishop Method

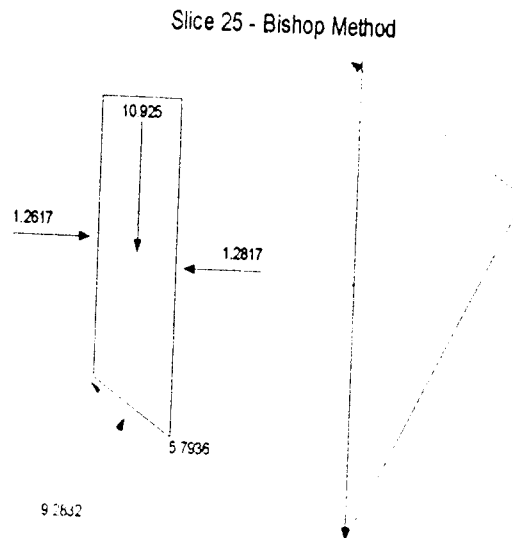
Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	4.5492
Pore Water Pressure	20.856
Pore Water Force	5.5811
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.22749
Mid-Height	3.6891
Base Length	0.2676
Base Angle	31.776
Polygon Closure	0.3147
Anisotropic Strength Modifier	1
Weight	12.588
Base Shear Force	6.7113
Base Normal Force	10.671
Left Side Normal Force	1.0108
Right Side Normal Force	1.2617

Slice 24 - Bishop Method



Slice 25 - Bishop Method

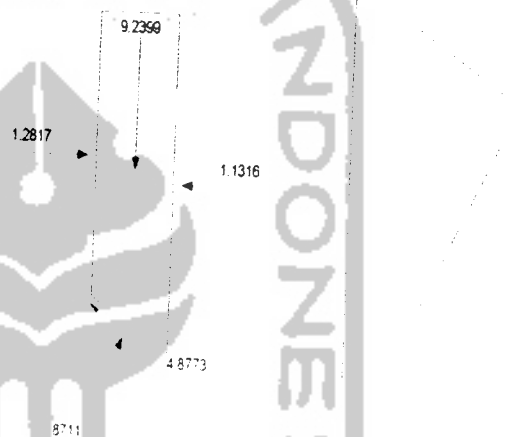
Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	4.491
Pore Water Pressure	22.206
Pore Water Force	5.8662
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.22749
Mid-Height	3.2017
Base Length	0.26418
Base Angle	30.557
Polygon Closure	0.32775
Anisotropic Strength Modifier	1
Weight	10.925
Base Shear Force	5.7936
Base Normal Force	9.2832
Left Side Normal Force	1.2817
Right Side Normal Force	1.2817



Slice 26 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	4.4369
Pore Water Pressure	23.491
Pore Water Force	6.1311
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.22749
Mid-Height	2.7078
Base Length	0.261
Base Angle	29.354
Polygon Closure	0.231
Anisotropic Strength Modifier	1
Weight	9.2399
Base Shear Force	4.8773
Base Normal Force	7.8711
Left Side Normal Force	1.2817
Right Side Normal Force	1.1316

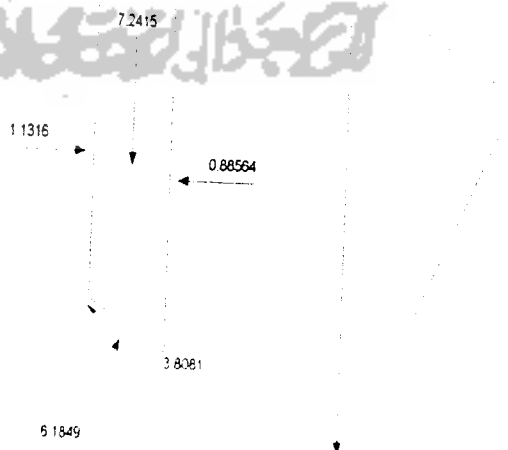
Slice 26 - Bishop Method



Slice 27 - Bishop Method

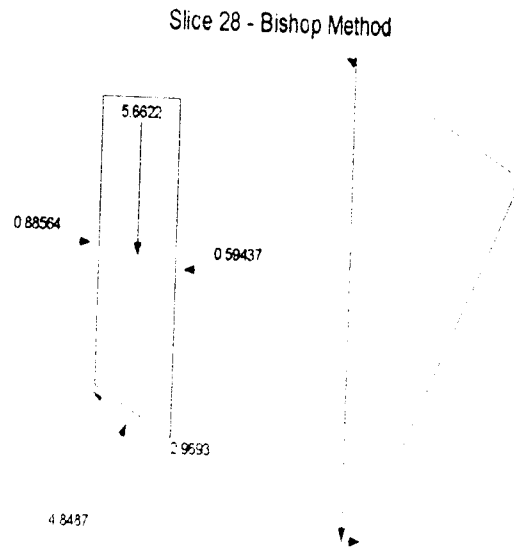
Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	4.197
Pore Water Pressure	24.689
Pore Water Force	6.0953
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.2176
Mid-Height	2.2186
Base Length	0.24688
Base Angle	28.189
Polygon Closure	0.21724
Anisotropic Strength Modifier	1
Weight	7.2415
Base Shear Force	3.8081
Base Normal Force	6.1849
Left Side Normal Force	1.1316
Right Side Normal Force	0.88564

Slice 27 - Bishop Method



Slice 28 - Bishop Method

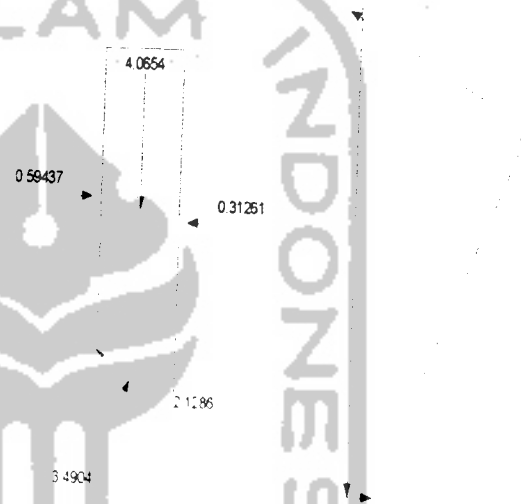
Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	4.1539
Pore Water Pressure	25.807
Pore Water Force	6.3059
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.21759
Mid-Height	1.7348
Base Length	0.24435
Base Angle	27.065
Polygon Closure	0.14155
Anisotropic Strength Modifier	1
Weight	5.6622
Base Shear Force	2.9693
Base Normal Force	4.8487
Left Side Normal Force	0.88564
Right Side Normal Force	0.59437



Slice 29 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	4.1139
Pore Water Pressure	26.87
Pore Water Force	6.5025
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.2176
Mid-Height	1.2456
Base Length	0.242
Base Angle	25.949
Polygon Closure	0.12196
Anisotropic Strength Modifier	1
Weight	4.0654
Base Shear Force	2.1286
Base Normal Force	3.4904
Left Side Normal Force	0.59437
Right Side Normal Force	0.31261

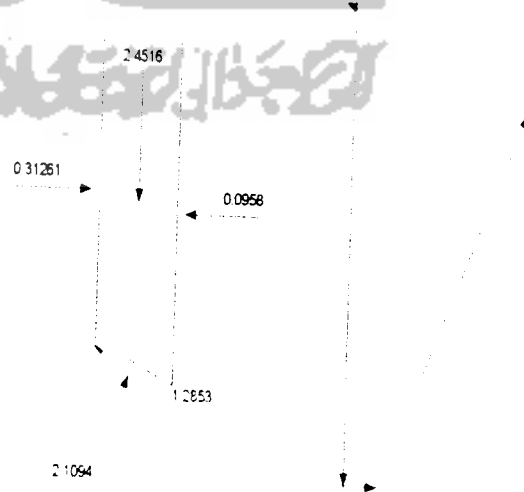
Slice 29 - Bishop Method



Slice 30 - Bishop Method

Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	4.0765
Pore Water Pressure	27.883
Pore Water Force	6.6862
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.2176
Mid-Height	0.75112
Base Length	0.23979
Base Angle	24.845
Polygon Closure	0.06129
Anisotropic Strength Modifier	1
Weight	2.4516
Base Shear Force	1.2853
Base Normal Force	2.1094
Left Side Normal Force	0.31261
Right Side Normal Force	0.0958

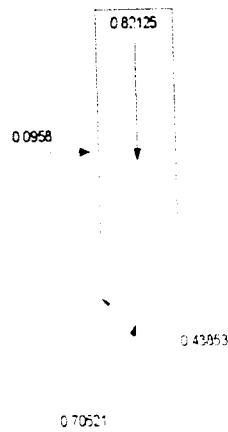
Slice 30 - Bishop Method



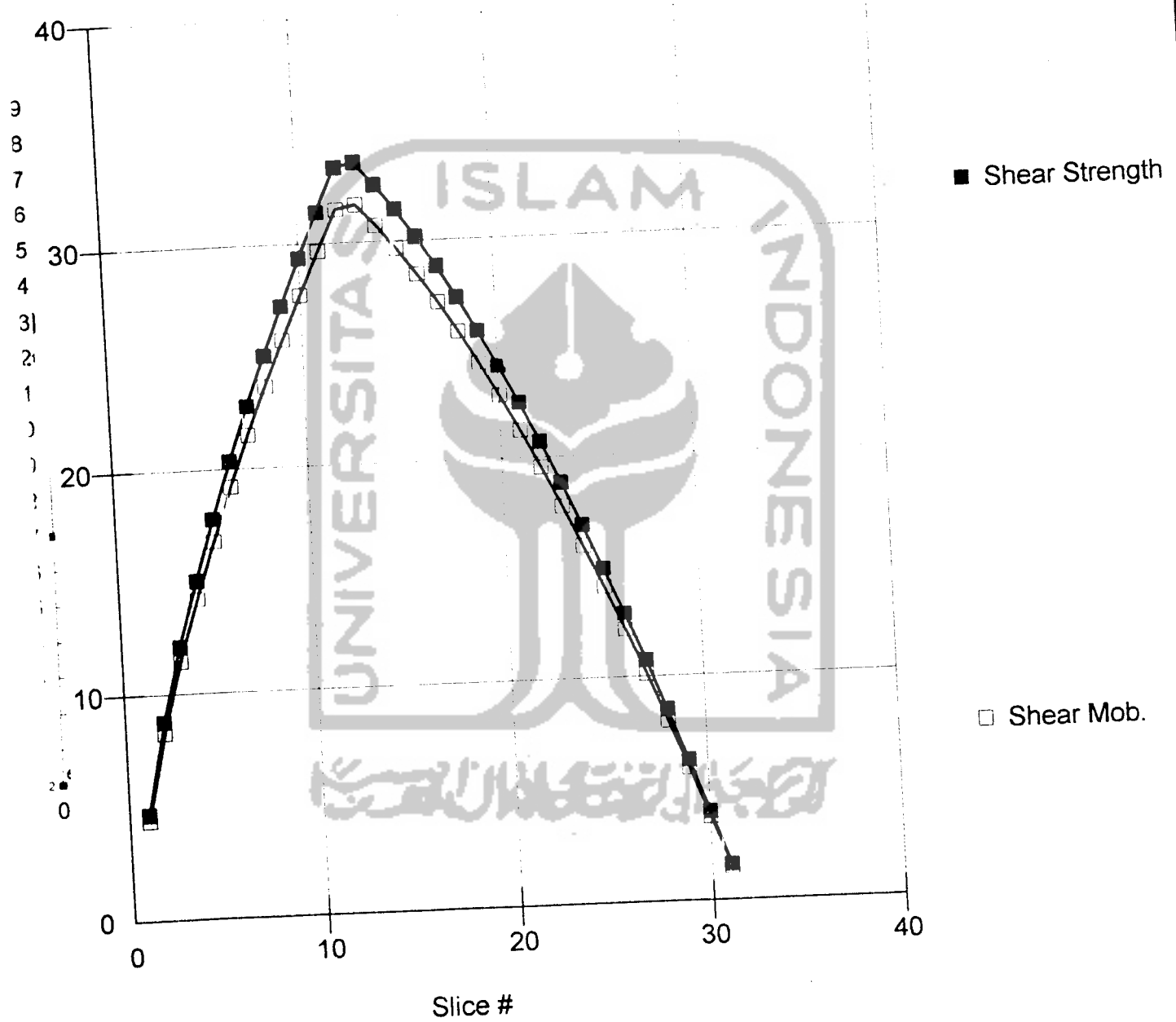
Slice 31 - Bishop Method

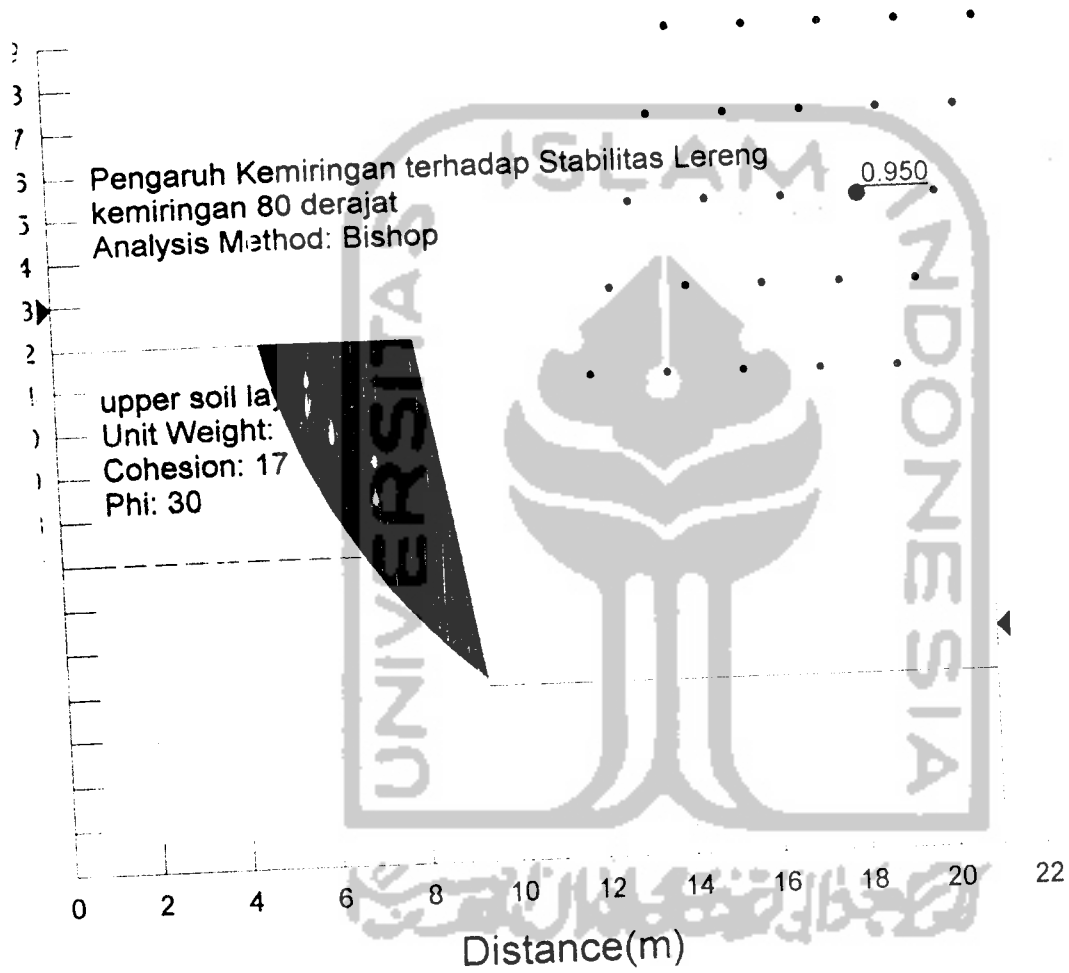
Factor of Safety	1.1157
Phi Angle	30
C (Strength)	17
C (Force)	4.0413
Pore Water Pressure	28.848
Pore Water Force	6.8578
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.21759
Mid-Height	0.25161
Base Length	0.23772
Base Angle	23.751
Polygon Closure	0.02464
Anisotropic Strength Modifier	1
Weight	0.82125
Base Shear Force	0.43853
Base Normal Force	0.70521
Left Side Normal Force	0.0958

Slice 31 - Bishop Method



Shear Resistance vs. Slice



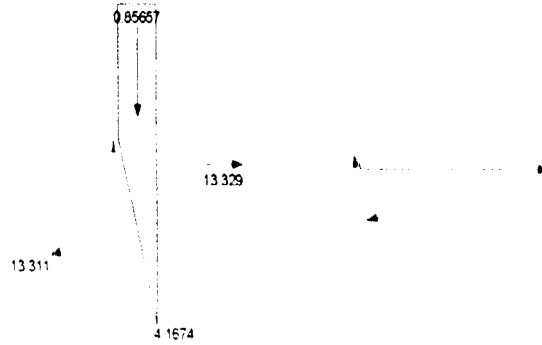


OUT PUT ANALISIS STABILITAS LERENG DENGAN KEMIRINGAN 80

Slice 1 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	11.643
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16308
Mid-Height	0.35015
Base Length	0.6849
Base Angle	76.225
Polygon Closure	0.46652
Anisotropic Strength Modifier	1
Weight	0.85657
Base Shear Force	4.1674
Base Normal Force	13.311
Right Side Normal Force	13.329

Slice 1 - Bishop Method



Slice 2 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	9.8419
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16309
Mid-Height	0.95356
Base Length	0.57894
Base Angle	73.638
Polygon Closure	0.59462
Anisotropic Strength Modifier	1
Weight	2.3327
Base Shear Force	5.0318
Base Normal Force	8.7677
Left Side Normal Force	13.329
Right Side Normal Force	22.477

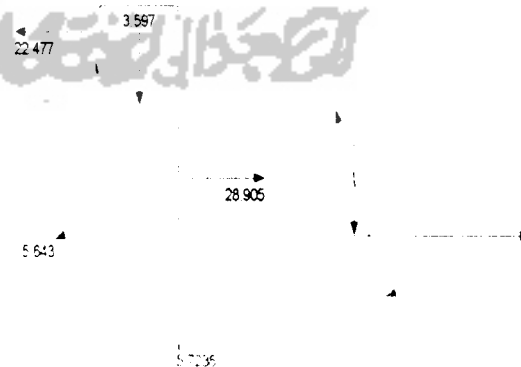
Slice 2 - Bishop Method



Slice 3 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	8.6953
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16308
Mid-Height	1.4704
Base Length	0.51149
Base Angle	71.407
Polygon Closure	0.67494
Anisotropic Strength Modifier	1
Weight	3.597
Base Shear Force	5.7236
Base Normal Force	5.643
Left Side Normal Force	22.477
Right Side Normal Force	28.905

Slice 3 - Bishop Method



Slice 4 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	7.884
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16308
Mid-Height	1.928
Base Length	0.46376
Base Angle	69.411
Polygon Closure	0.78804
Anisotropic Strength Modifier	1
Weight	4.7165
Base Shear Force	6.3043
Base Normal Force	3.2818
Left Side Normal Force	28.905
Right Side Normal Force	33.399

Slice 4 - Bishop Method

Slice 5 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	7.2714
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16309
Mid-Height	2.3416
Base Length	0.42773
Base Angle	67.587
Polygon Closure	0.78281
Anisotropic Strength Modifier	1
Weight	5.7283
Base Shear Force	6.807
Base Normal Force	1.3936
Left Side Normal Force	33.399
Right Side Normal Force	36.446

Slice 5 - Bishop Method

Slice 6 - Bishop Method

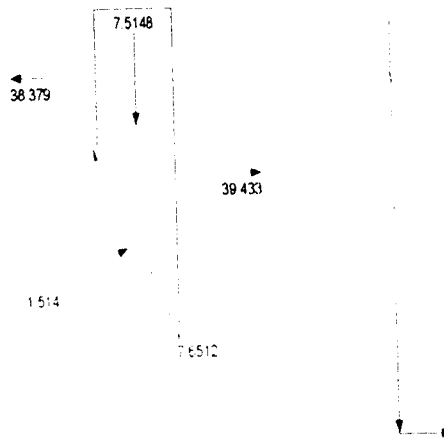
Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	6.7882
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16308
Mid-Height	2.7208
Base Length	0.39931
Base Angle	65.894
Polygon Closure	0.90645
Anisotropic Strength Modifier	1
Weight	6.6558
Base Shear Force	7.2516
Base Normal Force	0.17496
Left Side Normal Force	36.446
Right Side Normal Force	38.379

Slice 6 - Bishop Method

Slice 7 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	6.3949
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16309
Mid-Height	3.0719
Base Length	0.37617
Base Angle	64.308
Polygon Closure	0.91814
Anisotropic Strength Modifier	1
Weight	7.5148
Base Shear Force	7.6512
Base Normal Force	1.514
Left Side Normal Force	38.379
Right Side Normal Force	39.433

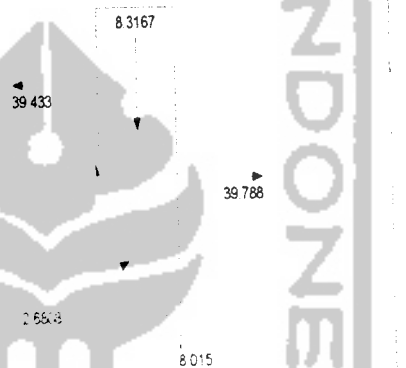
Slice 7 - Bishop Method



Slice 8 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	6.0669
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16308
Mid-Height	3.3997
Base Length	0.35687
Base Angle	62.808
Polygon Closure	0.95642
Anisotropic Strength Modifier	1
Weight	8.3167
Base Shear Force	8.015
Base Normal Force	2.6808
Left Side Normal Force	39.433
Right Side Normal Force	39.788

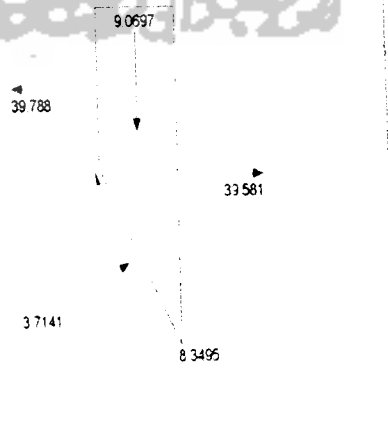
Slice 8 - Bishop Method



Slice 9 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	5.7881
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16309
Mid-Height	3.7075
Base Length	0.34048
Base Angle	61.38
Polygon Closure	0.95232
Anisotropic Strength Modifier	1
Weight	9.0697
Base Shear Force	8.3495
Base Normal Force	3.7141
Left Side Normal Force	39.788
Right Side Normal Force	33.581

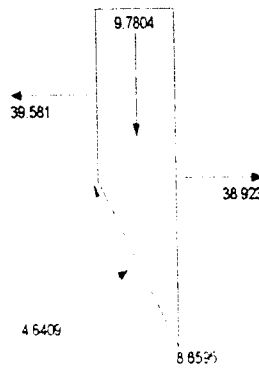
Slice 9 - Bishop Method



Slice 10 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	5.5476
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16308
Mid-Height	3.998
Base Length	0.32633
Base Angle	60.016
Polygon Closure	0.97804
Anisotropic Strength Modifier	1
Weight	9.7804
Base Shear Force	8.6595
Base Normal Force	4.6409
Left Side Normal Force	39.581
Right Side Normal Force	38.923

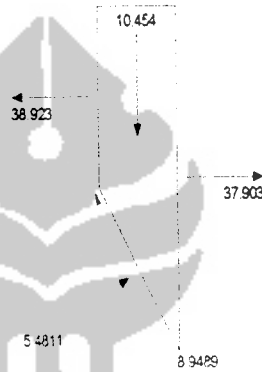
Slice 10 - Bishop Method



Slice 11 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	5.3375
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16309
Mid-Height	4.2733
Base Length	0.31397
Base Angle	58.706
Polygon Closure	0.99313
Anisotropic Strength Modifier	1
Weight	10.454
Base Shear Force	8.9489
Base Normal Force	5.4811
Left Side Normal Force	38.923
Right Side Normal Force	37.903

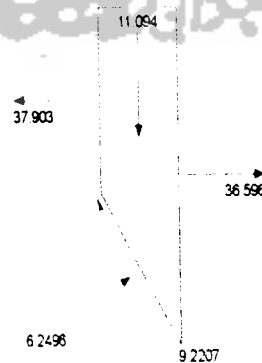
Slice 11 - Bishop Method



Slice 12 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	5.1519
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16308
Mid-Height	4.535
Base Length	0.30306
Base Angle	57.443
Polygon Closure	0.99846
Anisotropic Strength Modifier	1
Weight	11.094
Base Shear Force	9.2207
Base Normal Force	6.2496
Left Side Normal Force	37.903
Right Side Normal Force	36.596

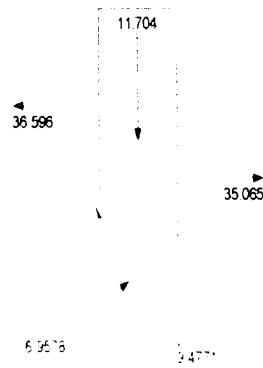
Slice 12 - Bishop Method



Slice 13 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	4.9867
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16308
Mid-Height	4.7845
Base Length	0.29334
Base Angle	56.223
Polygon Closure	0.99484
Anisotropic Strength Modifier	1
Weight	11.704
Base Shear Force	9.4771
Base Normal Force	6.9578
Left Side Normal Force	38.596
Right Side Normal Force	35.065

Slice 13 - Bishop Method



Slice 14 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	4.8384
Pore Water Pressure	0.22465
Pore Water Force	0.06394
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16309
Mid-Height	5.0229
Base Length	0.28461
Base Angle	55.04
Polygon Closure	0.98296
Anisotropic Strength Modifier	1
Weight	12.287
Base Shear Force	9.6994
Base Normal Force	7.6443
Left Side Normal Force	35.065
Right Side Normal Force	33.328

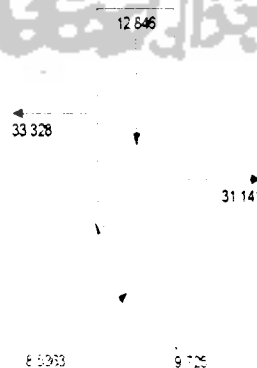
Slice 14 - Bishop Method



Slice 15 - Bishop Method

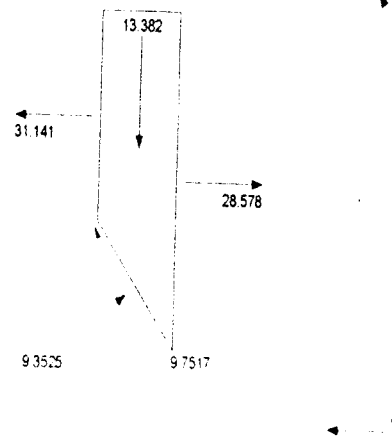
Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	4.7045
Pore Water Pressure	2.4638
Pore Water Force	0.68181
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16309
Mid-Height	5.2512
Base Length	0.27674
Base Angle	53.891
Polygon Closure	1.0277
Anisotropic Strength Modifier	1
Weight	12.846
Base Shear Force	9.725
Base Normal Force	8.5363
Left Side Normal Force	33.328
Right Side Normal Force	31.141

Slice 15 - Bishop Method



Slice 16 - Bishop Method

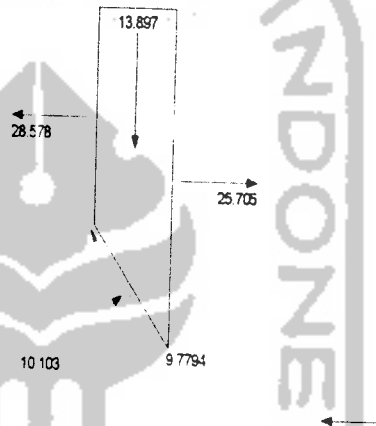
Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	4.5828
Pore Water Pressure	4.6117
Pore Water Force	1.2432
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16309
Mid-Height	5.4702
Base Length	0.26958
Base Angle	52.773
Polygon Closure	1.0036
Anisotropic Strength Modifier	1
Weight	13.382
Base Shear Force	9.7517
Base Normal Force	9.3525
Left Side Normal Force	31.141
Right Side Normal Force	28.578



Slice 17 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	4.4717
Pore Water Pressure	6.6754
Pore Water Force	1.7559
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16308
Mid-Height	5.6807
Base Length	0.26304
Base Angle	51.684
Polygon Closure	0.97279
Anisotropic Strength Modifier	1
Weight	13.897
Base Shear Force	9.7794
Base Normal Force	10.103
Left Side Normal Force	28.578
Right Side Normal Force	25.705

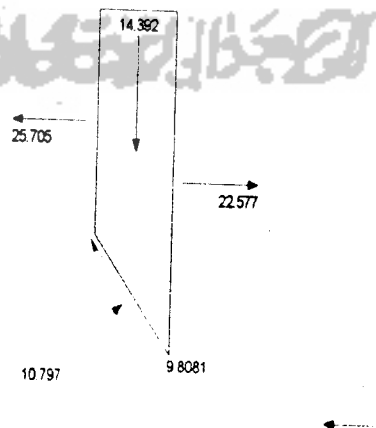
Slice 17 - Bishop Method



Slice 18 - Bishop Method

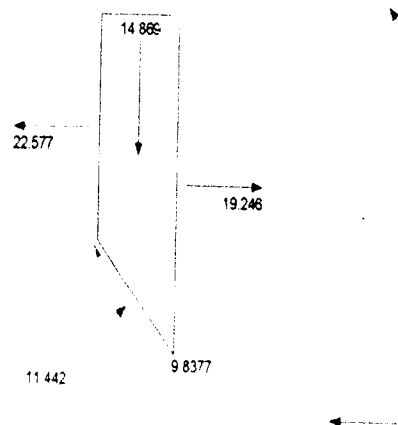
Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	4.3697
Pore Water Pressure	8.6612
Pore Water Force	2.2263
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16309
Mid-Height	5.8831
Base Length	0.25704
Base Angle	50.619
Polygon Closure	1.0074
Anisotropic Strength Modifier	1
Weight	14.392
Base Shear Force	9.8081
Base Normal Force	10.797
Left Side Normal Force	25.705
Right Side Normal Force	22.577

Slice 18 - Bishop Method



Slice 19 - Bishop Method

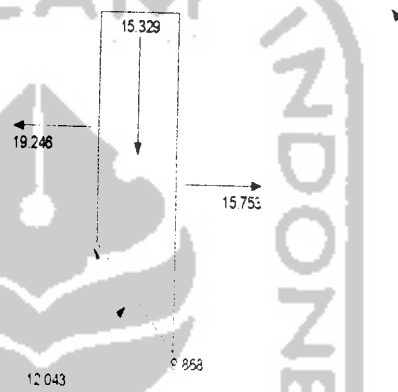
Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	4.2758
Pore Water Pressure	10.574
Pore Water Force	2.6595
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16308
Mid-Height	6.0782
Base Length	0.25152
Base Angle	49.579
Polygon Closure	0.96649
Anisotropic Strength Modifier	1
Weight	14.869
Base Shear Force	9.8377
Base Normal Force	11.442
Left Side Normal Force	22.577
Right Side Normal Force	19.246



Slice 20 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	4.189
Pore Water Pressure	12.418
Pore Water Force	3.0599
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16309
Mid-Height	6.2662
Base Length	0.24641
Base Angle	48.56
Polygon Closure	0.91974
Anisotropic Strength Modifier	1
Weight	15.329
Base Shear Force	9.868
Base Normal Force	12.043
Left Side Normal Force	19.246
Right Side Normal Force	15.753

Slice 20 - Bishop Method



Slice 21 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	4.1085
Pore Water Pressure	14.198
Pore Water Force	3.4313
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16308
Mid-Height	6.4477
Base Length	0.24168
Base Angle	47.561
Polygon Closure	0.94638
Anisotropic Strength Modifier	1
Weight	15.773
Base Shear Force	9.8992
Base Normal Force	12.605
Left Side Normal Force	15.753
Right Side Normal Force	12.138

Slice 21 - Bishop Method



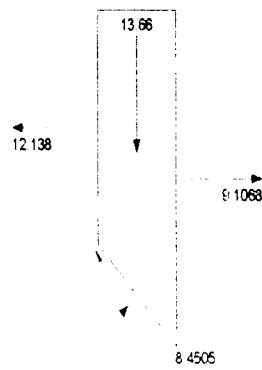
Slice 22 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	3.6373
Pore Water Pressure	15.833
Pore Water Force	3.3877
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.14693
Mid-Height	6.1978
Base Length	0.21396
Base Angle	46.629
Polygon Closure	0.8196
Anisotropic Strength Modifier	1
Weight	13.66
Base Shear Force	8.4505
Base Normal Force	10.994
Left Side Normal Force	12.138
Right Side Normal Force	9.1068

12.138

10.994

Slice 22 - Bishop Method



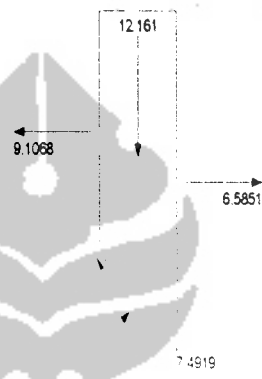
Slice 23 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	3.5803
Pore Water Pressure	17.336
Pore Water Force	3.651
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.14693
Mid-Height	5.5177
Base Length	0.21061
Base Angle	45.76
Polygon Closure	0.72966
Anisotropic Strength Modifier	1
Weight	12.161
Base Shear Force	7.4919
Base Normal Force	9.7781
Left Side Normal Force	9.1068
Right Side Normal Force	6.5851

9.1068

9.7781

Slice 23 - Bishop Method



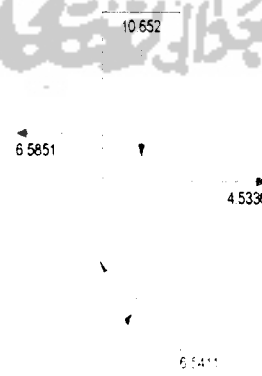
Slice 24 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	3.5266
Pore Water Pressure	18.793
Pore Water Force	3.8986
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.14693
Mid-Height	4.833
Base Length	0.20745
Base Angle	44.904
Polygon Closure	0.63912
Anisotropic Strength Modifier	1
Weight	10.652
Base Shear Force	6.5411
Base Normal Force	8.554
Left Side Normal Force	6.5851
Right Side Normal Force	4.5336

6.5851

8.554

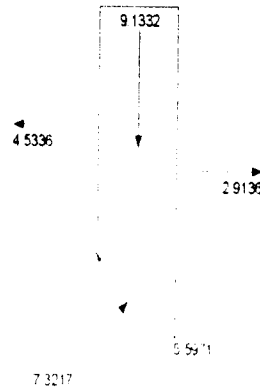
Slice 24 - Bishop Method



Slice 25 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	3.476
Pore Water Pressure	20.209
Pore Water Force	4.1321
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.14693
Mid-Height	4.1439
Base Length	0.20447
Base Angle	44.061
Polygon Closure	0.50233
Anisotropic Strength Modifier	1
Weight	9.1332
Base Shear Force	5.5971
Base Normal Force	7.3217
Left Side Normal Force	4.5336
Right Side Normal Force	2.9136

Slice 25 - Bishop Method



Slice 26 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	3.4283
Pore Water Pressure	21.583
Pore Water Force	4.3525
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.14693
Mid-Height	3.4507
Base Length	0.20166
Base Angle	43.23
Polygon Closure	0.45632
Anisotropic Strength Modifier	1
Weight	7.6054
Base Shear Force	4.6592
Base Normal Force	6.0815
Left Side Normal Force	2.9136
Right Side Normal Force	1.6867

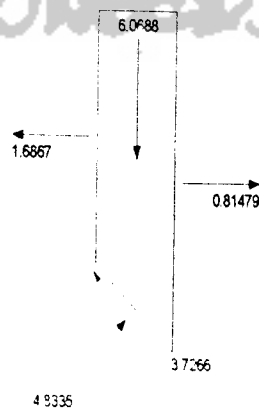
Slice 26 - Bishop Method



Slice 27 - Bishop Method

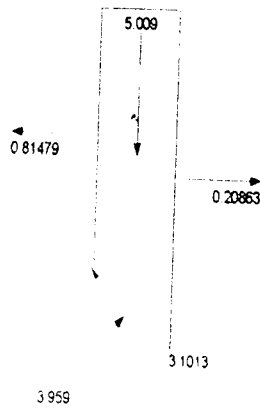
Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	3.3831
Pore Water Pressure	22.918
Pore Water Force	4.5608
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.14693
Mid-Height	2.7536
Base Length	0.19901
Base Angle	42.41
Polygon Closure	0.33373
Anisotropic Strength Modifier	1
Weight	6.0688
Base Shear Force	3.7266
Base Normal Force	4.8335
Left Side Normal Force	1.6867
Right Side Normal Force	0.81479

Slice 27 - Bishop Method



Slice 28 - Bishop Method

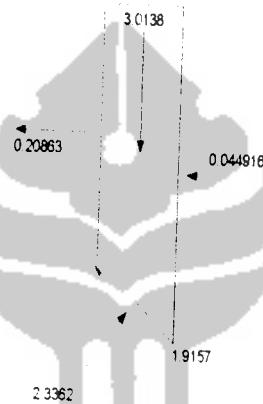
Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	3.7817
Pore Water Pressure	24.301
Pore Water Force	5.4058
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16648
Mid-Height	2.0058
Base Length	0.22245
Base Angle	41.548
Polygon Closure	0.30054
Anisotropic Strength Modifier	1
Weight	5.009
Base Shear Force	3.1013
Base Normal Force	3.959
Left Side Normal Force	0.81479
Right Side Normal Force	0.20863



Slice 28 - Bishop Method

Slice 29 - Bishop Method

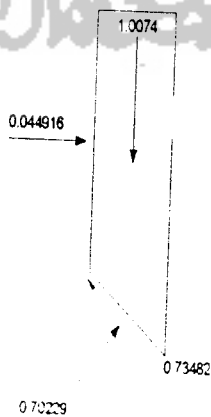
Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	3.73
Pore Water Pressure	25.725
Pore Water Force	5.6443
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16648
Mid-Height	1.2069
Base Length	0.21941
Base Angle	40.644
Polygon Closure	0.18083
Anisotropic Strength Modifier	1
Weight	3.0138
Base Shear Force	1.9157
Base Normal Force	2.3362
Left Side Normal Force	0.20863
Right Side Normal Force	0.04492



Slice 29 - Bishop Method

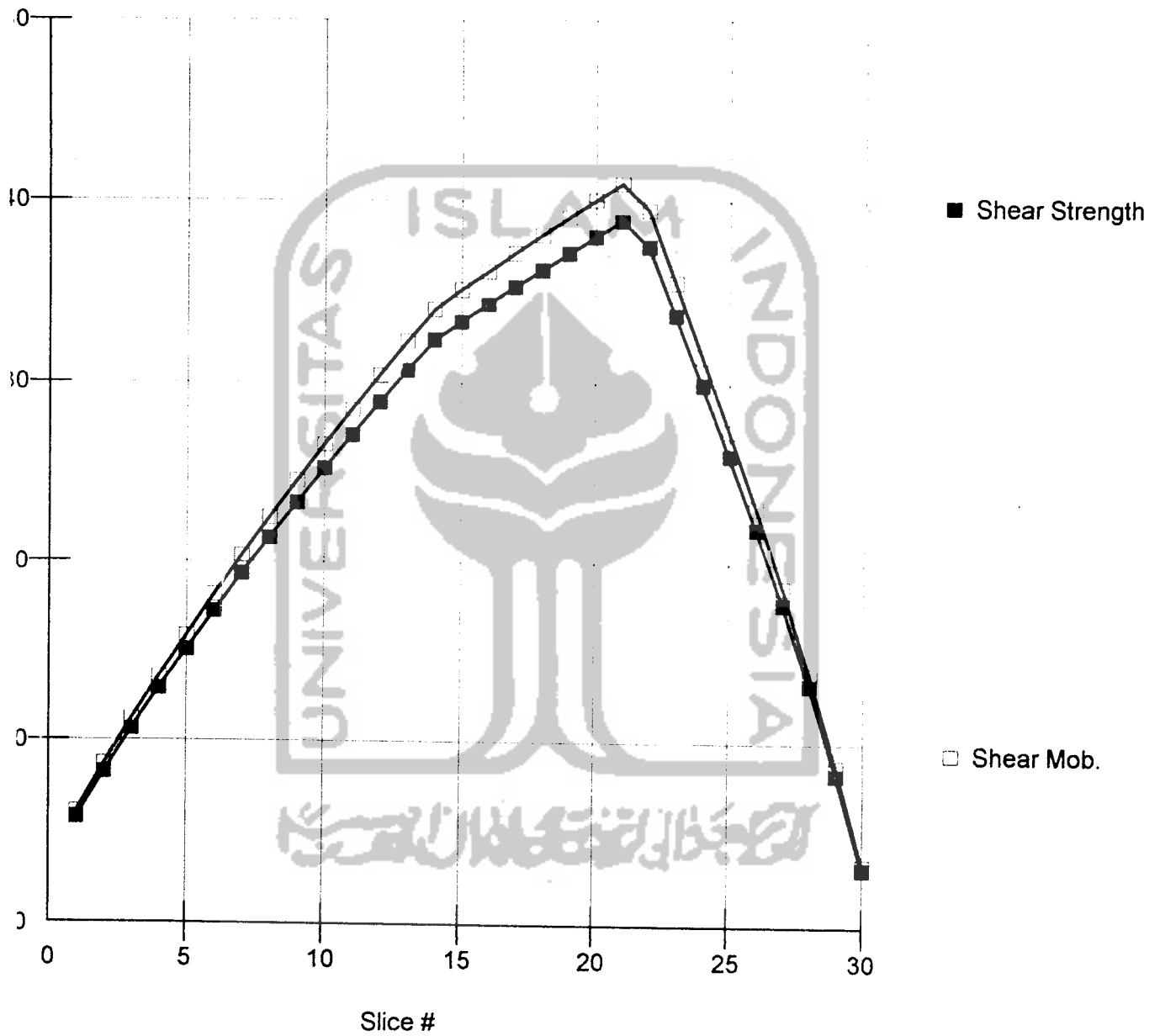
Slice 30 - Bishop Method

Factor of Safety	0.95007
Phi Angle	30
C (Strength)	17
C (Force)	3.6814
Pore Water Pressure	27.104
Pore Water Force	5.8695
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.16648
Mid-Height	0.40338
Base Length	0.21655
Base Angle	39.754
Polygon Closure	0.07556
Anisotropic Strength Modifier	1
Weight	1.0074
Base Shear Force	0.73482
Base Normal Force	0.70229
Left Side Normal Force	0.04492



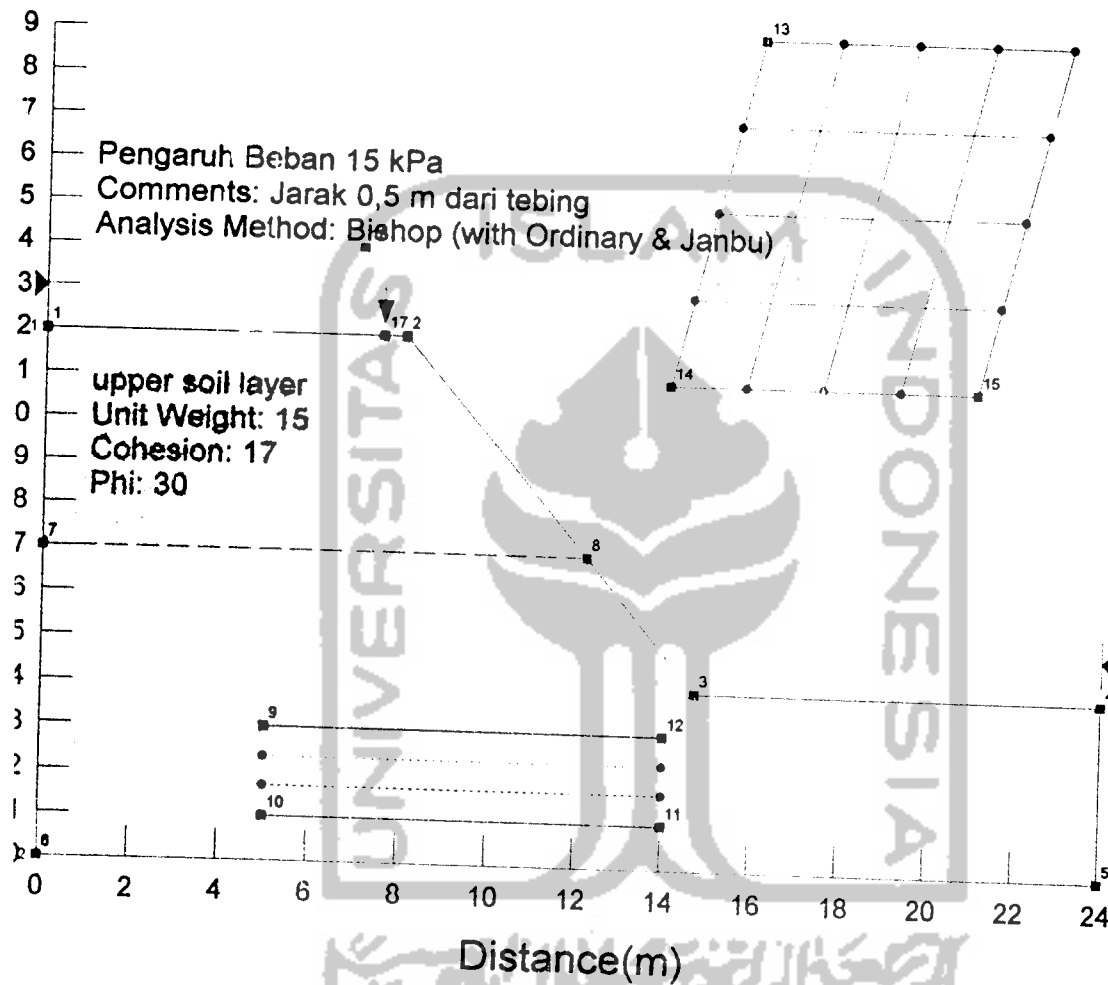
Slice 30 - Bishop Method

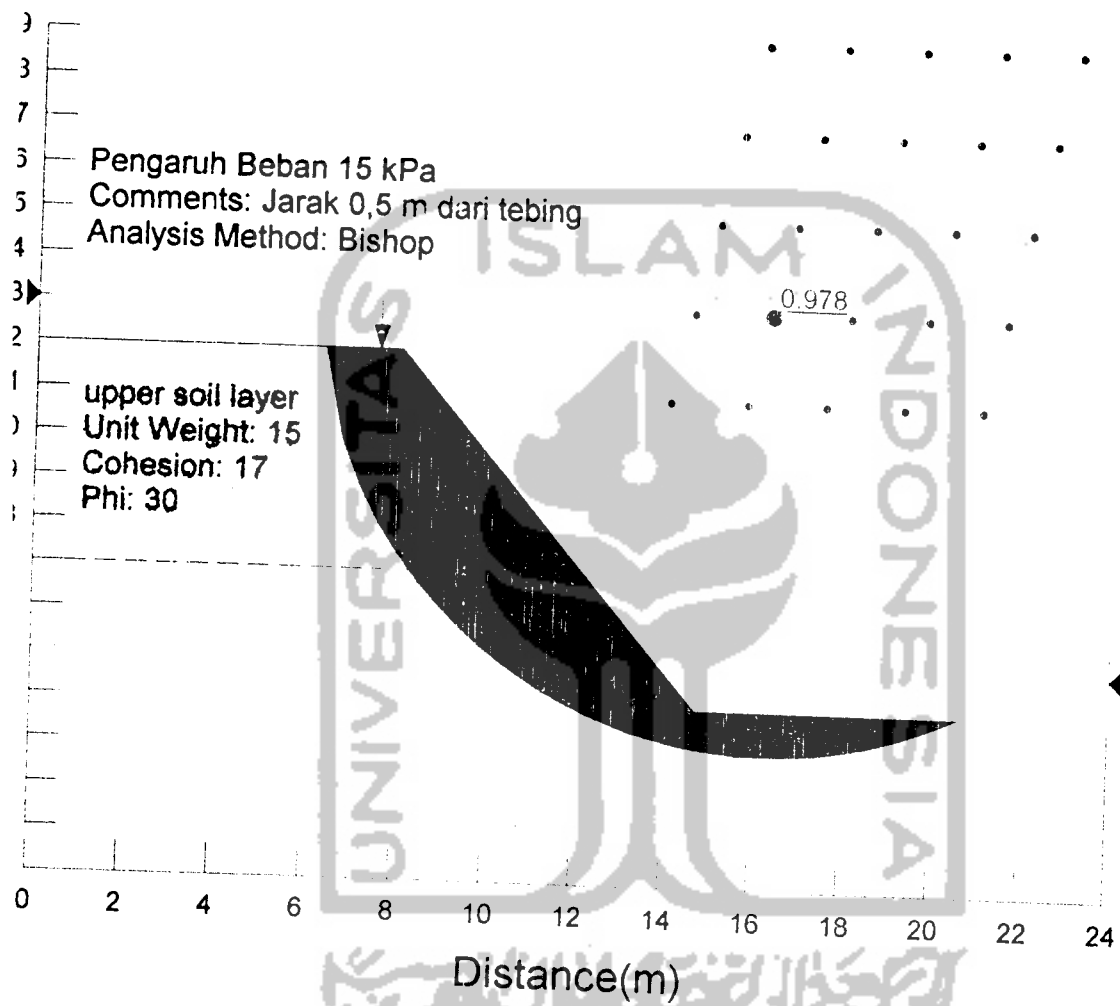
Shear Resistance vs. Slice #





LAMPIRAN III



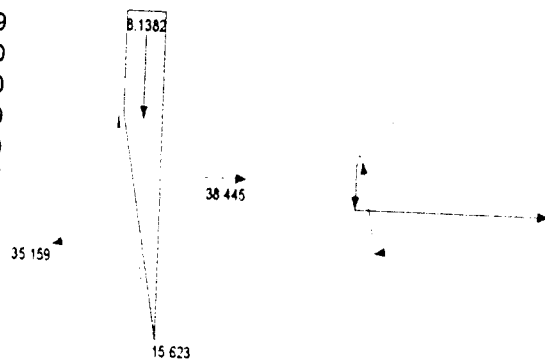


OUT PUT ANALISIS STABILITAS LERENG DENGAN POSISI BEBAN 0,5 M

Slice 1 - Bishop Method

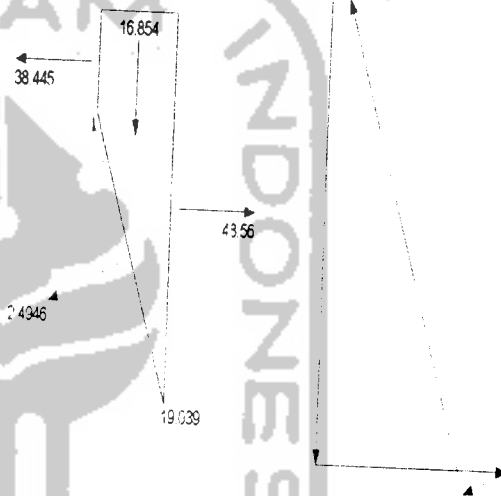
Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	35.519
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.42497
Mid-Height	1.2767
Base Length	2.0894
Base Angle	78.264
Polygon Closure Error	1.1533
Anisotropic Strength Modifier	1
Weight	8.1382
Base Shear Force	15.623
Base Normal Force	35.159
Right Side Normal Force	38.445

Slice 1 - Bishop Method



Slice 2 - Bishop Method

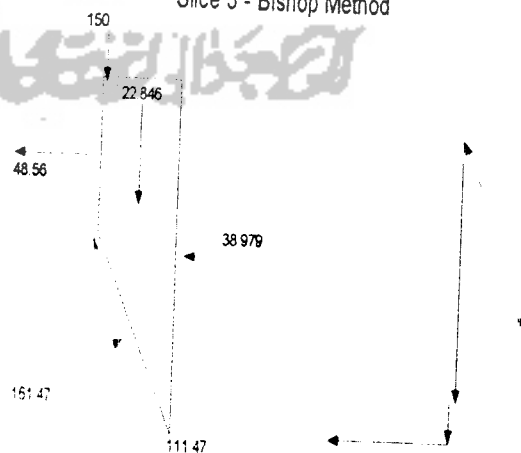
Slice 2 - Bishop Method	
Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	20.056
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.42497
Mid-Height	2.644
Base Length	1.1797
Base Angle	68.886
Polygon Closure Error	0.95195
Anisotropic Strength Modifier	1
Weight	16.854
Base Shear Force	19.039
Base Normal Force	2.4946
Left Side Normal Force	38.445
Right Side Normal Force	48.56



Slice 3 - Bishop Method

Slice 3 - Bishop Method	
Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	15.825
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.42497
Mid-Height	3.584
Base Length	0.93087
Base Angle	62.837
Polygon Closure Error	4.8441
Anisotropic Strength Modifier	1
Weight	22.846
Base Shear Force	111.47
Base Normal Force	161.47
Left Side Normal Force	48.56
Right Side Normal Force	38.979

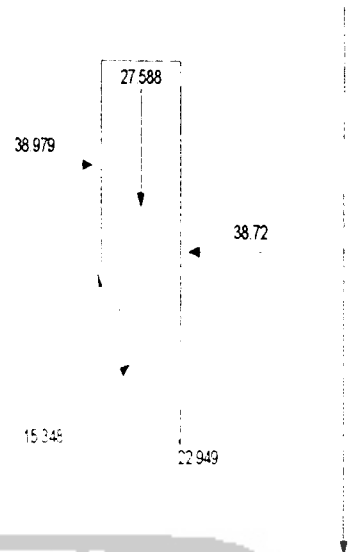
Slice 3 - Bishop Method



Slice 4 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	13.587
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.42497
Mid-Height	4.3279
Base Length	0.79924
Base Angle	57.879
Polygon Closure Error	0.96558
Anisotropic Strength Modifier	1
Weight	27.588
Base Shear Force	22.949
Base Normal Force	15.348
Left Side Normal Force	38.979
Right Side Normal Force	38.72

Slice 4 - Bishop Method



Slice 5 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	13.275
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	4.6996
Base Length	0.78087
Base Angle	53.351
Polygon Closure Error	0.98574
Anisotropic Strength Modifier	1
Weight	32.858
Base Shear Force	25.689
Base Normal Force	20.533
Left Side Normal Force	38.72
Right Side Normal Force	38.692

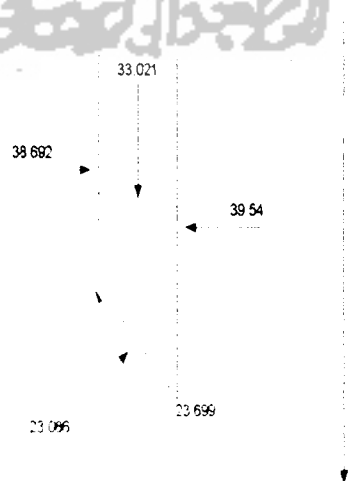
Slice 5 - Bishop Method



Slice 6 - Bishop Method

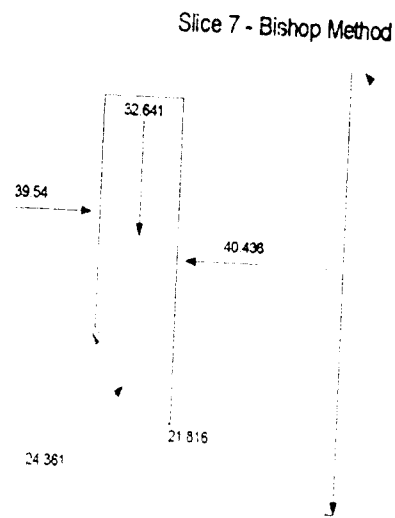
Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	12.096
Pore Water Pressure	5.4566
Pore Water Force	3.8826
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	4.723
Base Length	0.71154
Base Angle	49.074
Polygon Closure Error	1.1557
Anisotropic Strength Modifier	1
Weight	33.021
Base Shear Force	23.699
Base Normal Force	23.086
Left Side Normal Force	38.692
Right Side Normal Force	39.54

Slice 6 - Bishop Method



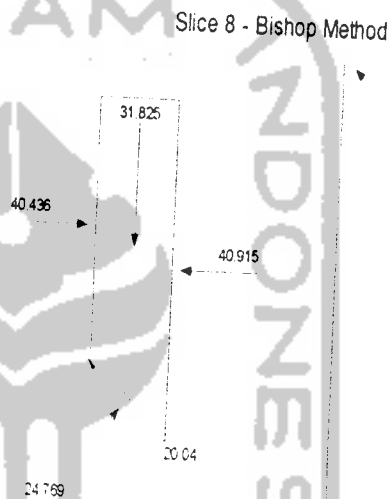
Slice 7 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	11.234
Pore Water Pressure	10.372
Pore Water Force	6.8538
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	4.6685
Base Length	0.66082
Base Angle	45.142
Polygon Closure Error	1.1424
Anisotropic Strength Modifier	1
Weight	32.641
Base Shear Force	21.816
Base Normal Force	24.361
Left Side Normal Force	39.54
Right Side Normal Force	40.436



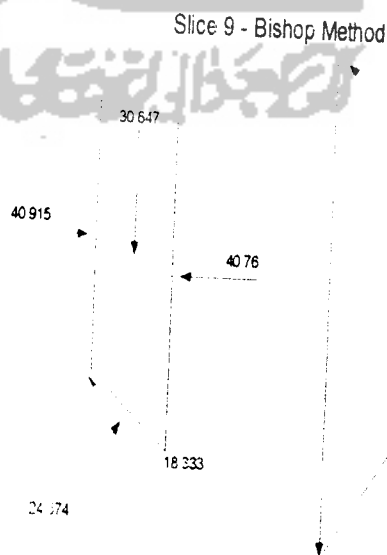
Slice 8 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	10.574
Pore Water Pressure	14.676
Pore Water Force	9.129
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	4.5518
Base Length	0.62203
Base Angle	41.466
Polygon Closure Error	0.95475
Anisotropic Strength Modifier	1
Weight	31.825
Base Shear Force	20.04
Base Normal Force	24.769
Left Side Normal Force	40.436
Right Side Normal Force	40.915



Slice 9 - Bishop Method

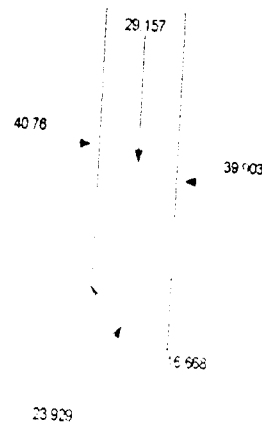
Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	10.054
Pore Water Pressure	18.472
Pore Water Force	10.925
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	4.3833
Base Length	0.59142
Base Angle	37.989
Polygon Closure Error	0.91941
Anisotropic Strength Modifier	1
Weight	30.647
Base Shear Force	18.333
Base Normal Force	24.574
Left Side Normal Force	40.915
Right Side Normal Force	40.76



Slice 10 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	9.6347
Pore Water Pressure	21.832
Pore Water Force	12.373
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	4.1703
Base Length	0.56675
Base Angle	34.671
Polygon Closure Error	0.72892
Anisotropic Strength Modifier	1
Weight	29.157
Base Shear Force	16.668
Base Normal Force	23.929
Left Side Normal Force	40.76
Right Side Normal Force	39.903

Slice 10 - Bishop Method



Slice 11 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	9.2915
Pore Water Pressure	24.808
Pore Water Force	13.559
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	3.9182
Base Length	0.54656
Base Angle	31.482
Polygon Closure Error	0.82185
Anisotropic Strength Modifier	1
Weight	27.395
Base Shear Force	15.026
Base Normal Force	22.926
Left Side Normal Force	39.903
Right Side Normal Force	38.37

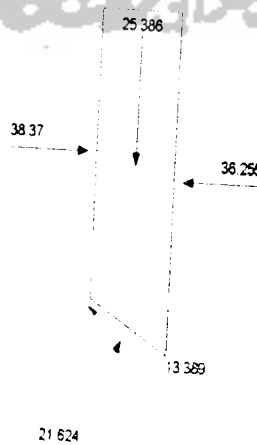
Slice 11 - Bishop Method



Slice 12 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	9.0078
Pore Water Pressure	27.439
Pore Water Force	14.539
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	3.6309
Base Length	0.52987
Base Angle	28.397
Polygon Closure Error	0.50772
Anisotropic Strength Modifier	1
Weight	25.386
Base Shear Force	13.389
Base Normal Force	21.624
Left Side Normal Force	38.37
Right Side Normal Force	36.255

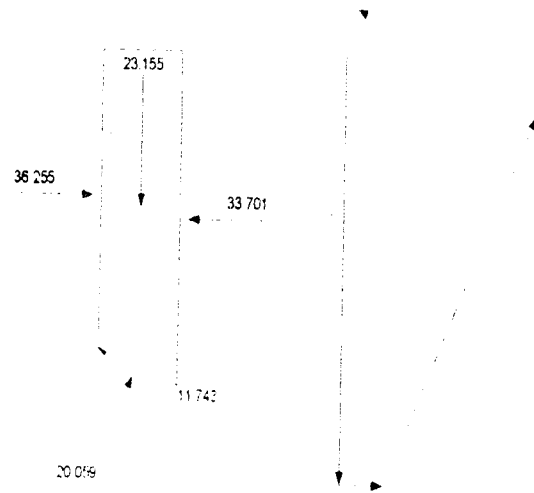
Slice 12 - Bishop Method



Slice 13 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.7718
Pore Water Pressure	29.758
Pore Water Force	15.355
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	3.3117
Base Length	0.51599
Base Angle	25.401
Polygon Closure Error	0.57888
Anisotropic Strength Modifier	1
Weight	23.155
Base Shear Force	11.743
Base Normal Force	20.059
Left Side Normal Force	36.255
Right Side Normal Force	33.701

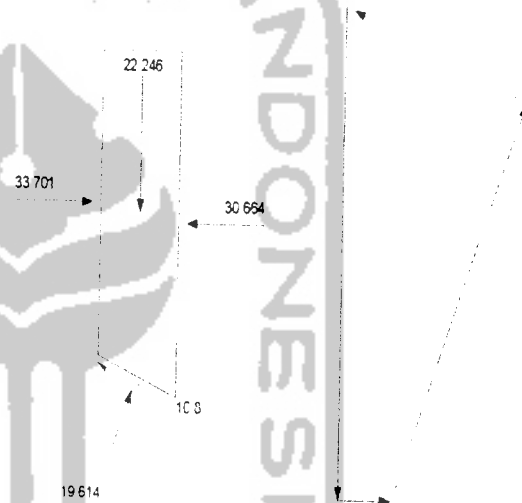
Slice 13 - Bishop Method



Slice 14 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	9.2465
Pore Water Pressure	31.862
Pore Water Force	17.33
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.9434
Base Length	0.54391
Base Angle	22.364
Polygon Closure Error	0.44492
Anisotropic Strength Modifier	1
Weight	22.246
Base Shear Force	10.8
Base Normal Force	19.614
Left Side Normal Force	33.701
Right Side Normal Force	30.664

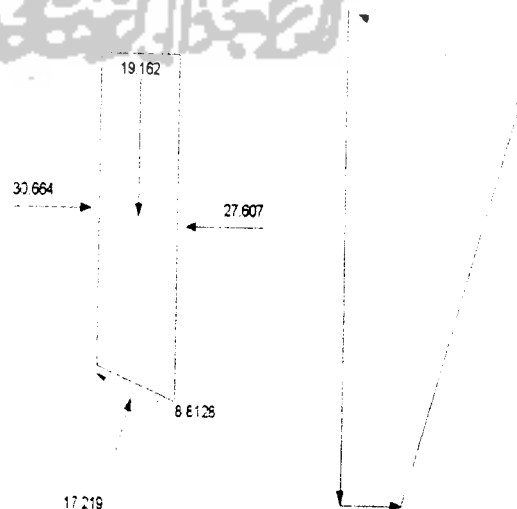
Slice 14 - Bishop Method



Slice 15 - Bishop Method

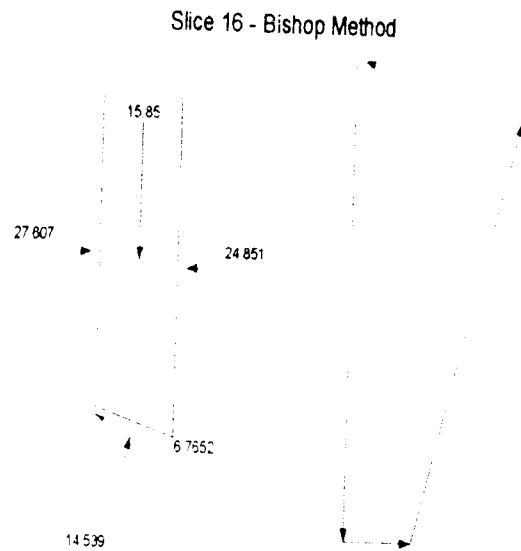
Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	9.059
Pore Water Pressure	33.737
Pore Water Force	17.978
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.5396
Base Length	0.53288
Base Angle	19.279
Polygon Closure Error	0.47905
Anisotropic Strength Modifier	1
Weight	19.162
Base Shear Force	8.8128
Base Normal Force	17.219
Left Side Normal Force	30.664
Right Side Normal Force	27.607

Slice 15 - Bishop Method



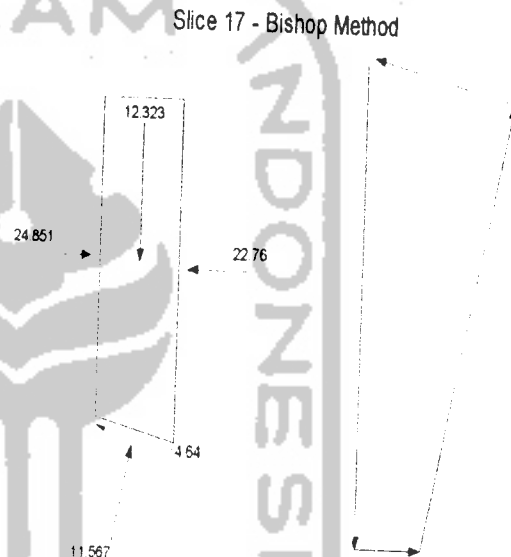
Slice 16 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.9069
Pore Water Pressure	35.316
Pore Water Force	18.503
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.1007
Base Length	0.52393
Base Angle	18.251
Polygon Closure Error	0.317
Anisotropic Strength Modifier	1
Weight	15.85
Base Shear Force	6.7652
Base Normal Force	14.539
Left Side Normal Force	27.607
Right Side Normal Force	24.851



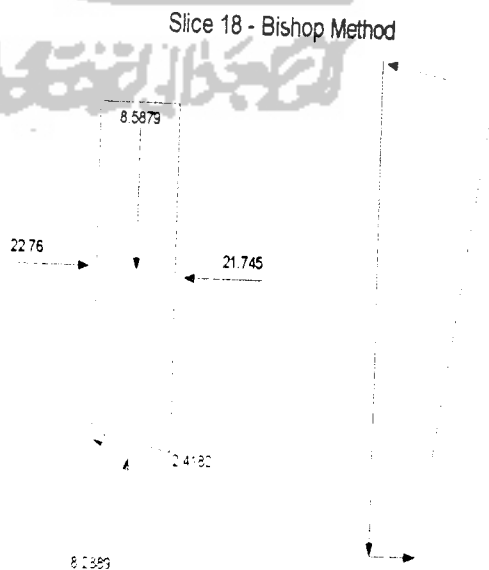
Slice 17 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.7855
Pore Water Pressure	36.616
Pore Water Force	18.923
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	1.6332
Base Length	0.5168
Base Angle	13.269
Polygon Closure Error	0.18485
Anisotropic Strength Modifier	1
Weight	12.323
Base Shear Force	4.64
Base Normal Force	11.567
Left Side Normal Force	24.851
Right Side Normal Force	22.76

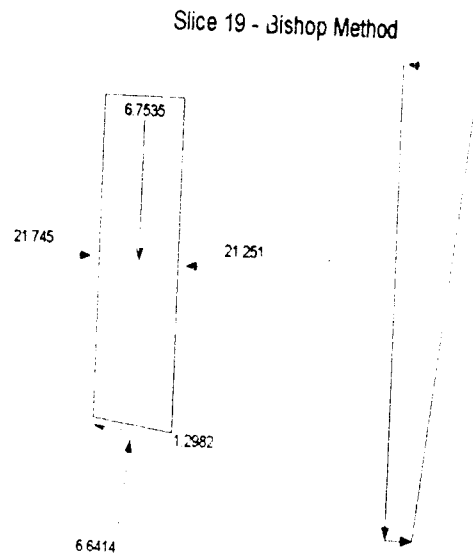


Slice 18 - Bishop Method

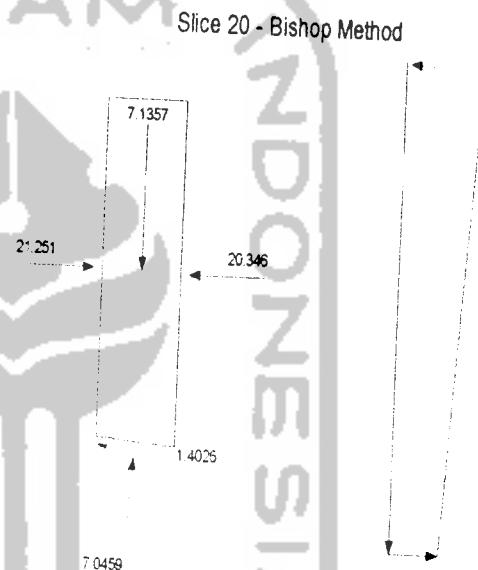
Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.6917
Pore Water Pressure	37.645
Pore Water Force	19.247
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	1.1382
Base Length	0.51128
Base Angle	10.324
Polygon Closure Error	0.085879
Anisotropic Strength Modifier	1
Weight	8.5879
Base Shear Force	2.4182
Base Normal Force	8.2889
Left Side Normal Force	22.76
Right Side Normal Force	21.745



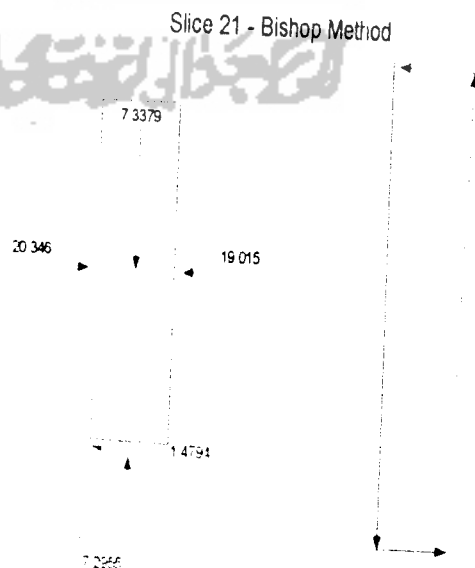
Slice 19 - Bishop Method	
Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.4278
Pore Water Pressure	38.406
Pore Water Force	19.04
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49158
Mid-Height	0.9159
Base Length	0.49575
Base Angle	7.4383
Polygon Closure Error	0.067535
Anisotropic Strength Modifier	1
Weight	6.7535
Base Shear Force	1.2982
Base Normal Force	6.6414
Left Side Normal Force	21.745
Right Side Normal Force	21.251



Slice 20 - Bishop Method	
Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.3837
Pore Water Pressure	38.916
Pore Water Force	19.192
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49157
Mid-Height	0.96774
Base Length	0.49316
Base Angle	4.6052
Polygon Closure Error	0.071357
Anisotropic Strength Modifier	1
Weight	7.1357
Base Shear Force	1.4026
Base Normal Force	7.0459
Left Side Normal Force	21.251
Right Side Normal Force	20.346

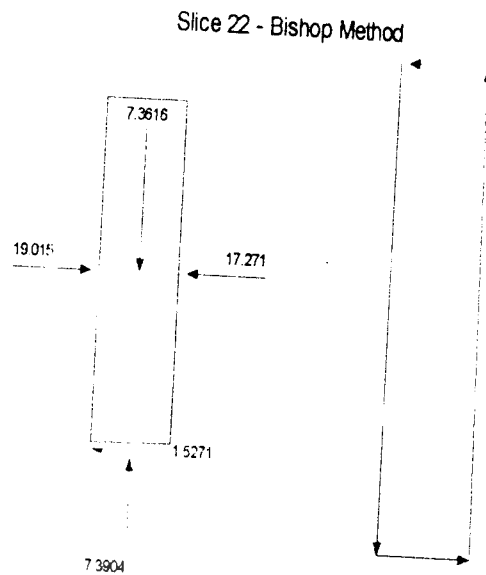


Slice 21 - Bishop Method	
Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.3607
Pore Water Pressure	39.184
Pore Water Force	19.271
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49157
Mid-Height	0.99516
Base Length	0.49181
Base Angle	1.7831
Polygon Closure Error	0.11007
Anisotropic Strength Modifier	1
Weight	7.3379
Base Shear Force	1.4794
Base Normal Force	7.2955
Left Side Normal Force	20.346
Right Side Normal Force	19.015



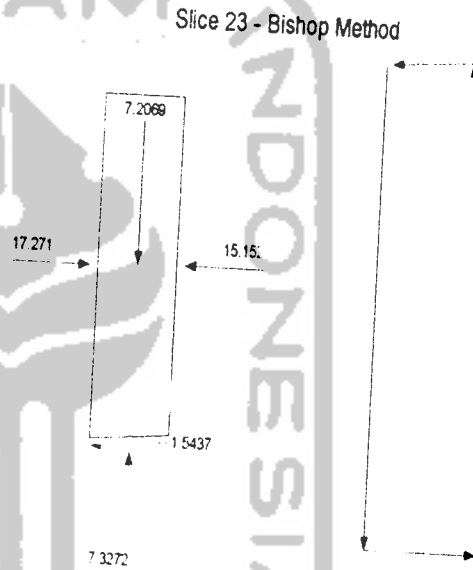
Slice 22 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.3582
Pore Water Pressure	39.216
Pore Water Force	19.281
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49158
Mid-Height	0.99837
Base Length	0.49166
Base Angle	1.0347
Polygon Closure Error	0.14781
Anisotropic Strength Modifier	1
Weight	7.3616
Base Shear Force	1.5271
Base Normal Force	7.3904
Left Side Normal Force	19.015
Right Side Normal Force	17.271



Slice 23 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.3758
Pore Water Pressure	39.01
Pore Water Force	19.22
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49158
Mid-Height	0.97739
Base Length	0.49269
Base Angle	3.8543
Polygon Closure Error	0.10991
Anisotropic Strength Modifier	1
Weight	7.2069
Base Shear Force	1.5437
Base Normal Force	7.3272
Left Side Normal Force	17.271
Right Side Normal Force	15.152



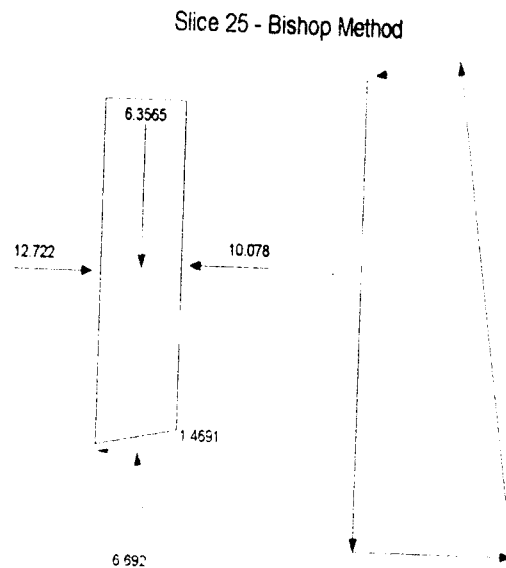
Slice 24 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.4139
Pore Water Pressure	38.567
Pore Water Force	19.088
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49157
Mid-Height	0.93206
Base Length	0.49494
Base Angle	6.6846
Polygon Closure Error	0.14197
Anisotropic Strength Modifier	1
Weight	6.8727
Base Shear Force	1.5259
Base Normal Force	7.0985
Left Side Normal Force	15.152
Right Side Normal Force	12.722



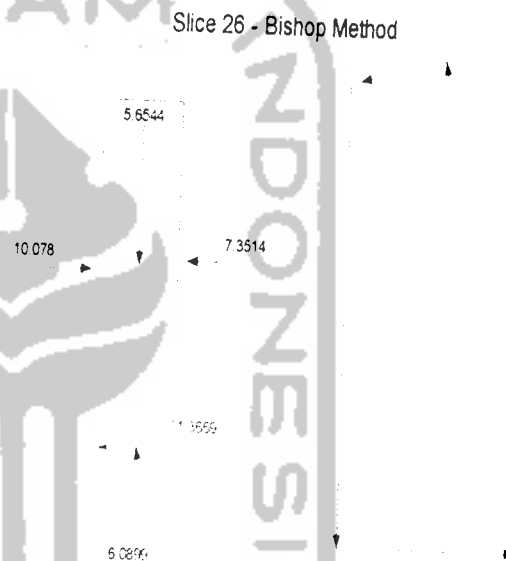
Slice 25 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.4738
Pore Water Pressure	37.879
Pore Water Force	18.881
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49158
Mid-Height	0.86208
Base Length	0.49846
Base Angle	9.5306
Polygon Closure Error	0.13384
Anisotropic Strength Modifier	1
Weight	6.3565
Base Shear Force	1.4691
Base Normal Force	6.692
Left Side Normal Force	12.722
Right Side Normal Force	10.078



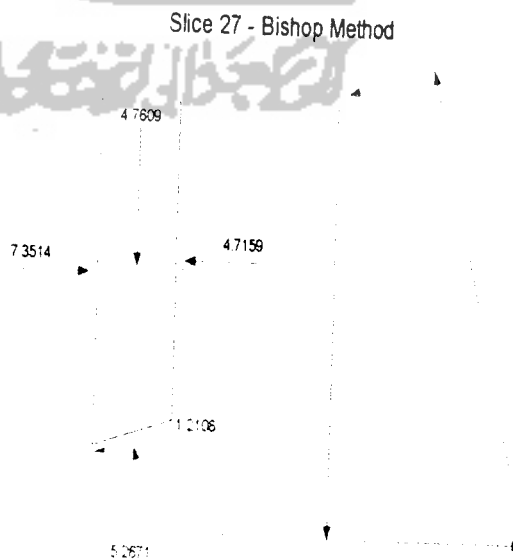
Slice 26 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.5563
Pore Water Pressure	36.945
Pore Water Force	18.595
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49157
Mid-Height	0.76684
Base Length	0.50331
Base Angle	12.401
Polygon Closure Error	0.15225
Anisotropic Strength Modifier	1
Weight	5.6544
Base Shear Force	1.3669
Base Normal Force	6.0899
Left Side Normal Force	10.078
Right Side Normal Force	7.3514



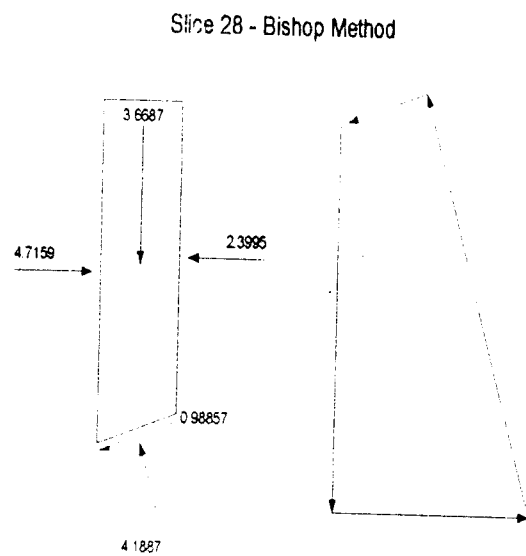
Slice 27 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.6641
Pore Water Pressure	35.756
Pore Water Force	18.223
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49158
Mid-Height	0.64567
Base Length	0.50965
Base Angle	15.303
Polygon Closure Error	0.13168
Anisotropic Strength Modifier	1
Weight	4.7609
Base Shear Force	1.2108
Base Normal Force	5.2671
Left Side Normal Force	7.3514
Right Side Normal Force	4.7159



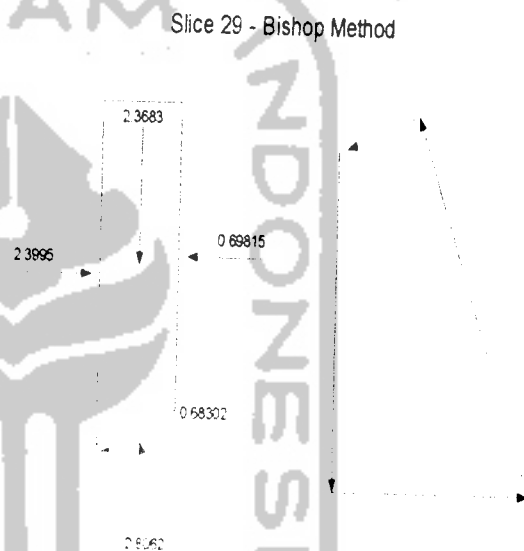
Slice 28 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.7991
Pore Water Pressure	34.305
Pore Water Force	17.756
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49157
Mid-Height	0.49754
Base Length	0.51759
Base Angle	18.246
Polygon Closure Error	0.083774
Anisotropic Strength Modifier	1
Weight	3.6687
Base Shear Force	0.98857
Base Normal Force	4.1887
Left Side Normal Force	4.7159
Right Side Normal Force	2.3995



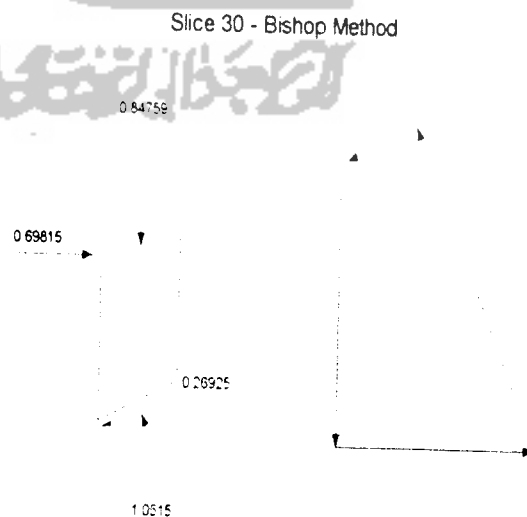
Slice 29 - Bishop Method

Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	8.9659
Pore Water Pressure	32.574
Pore Water Force	17.18
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49158
Mid-Height	0.32118
Base Length	0.52741
Base Angle	21.24
Polygon Closure Error	0.070155
Anisotropic Strength Modifier	1
Weight	2.3683
Base Shear Force	0.68302
Base Normal Force	2.8062
Left Side Normal Force	2.3995
Right Side Normal Force	0.69815

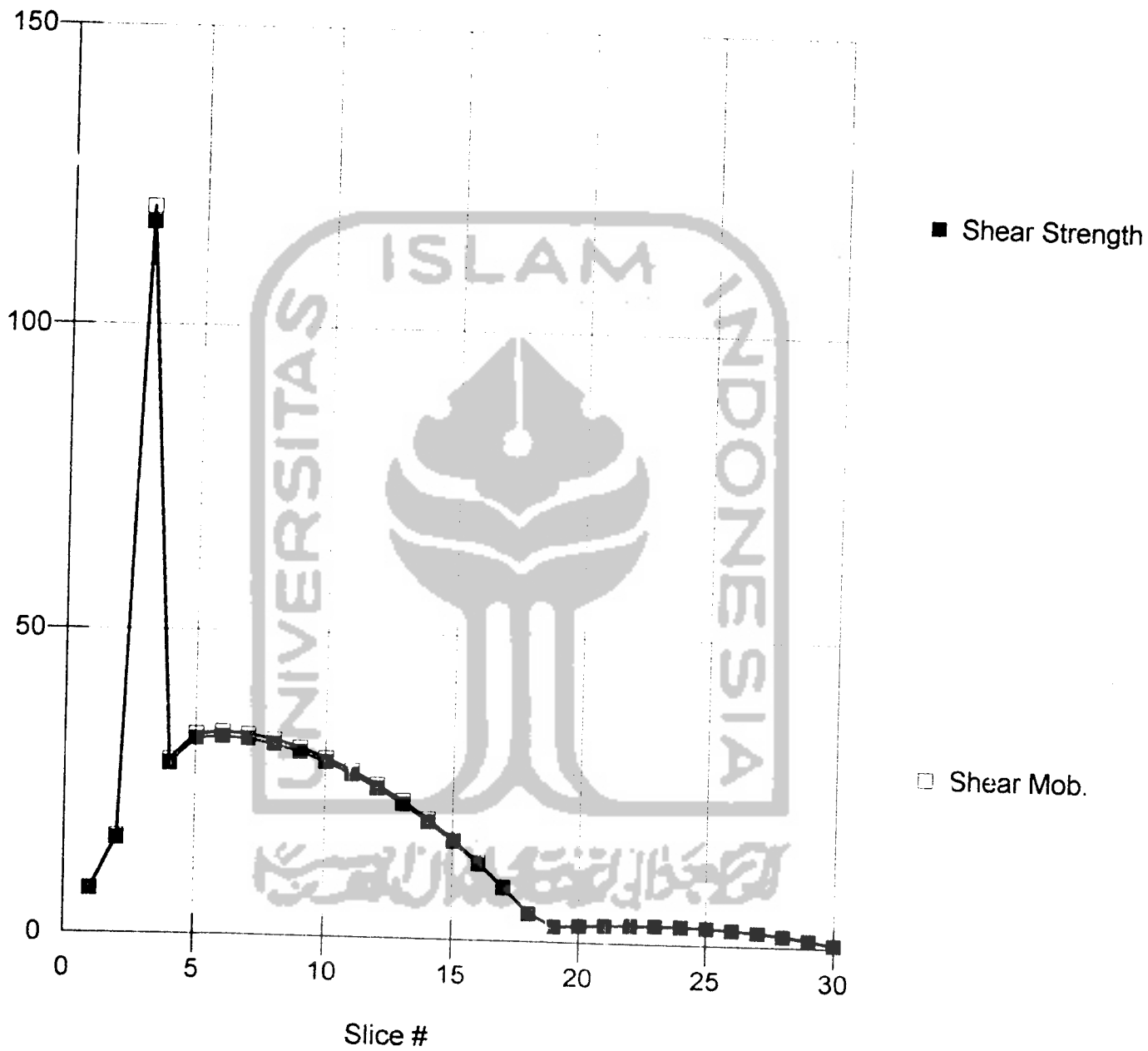


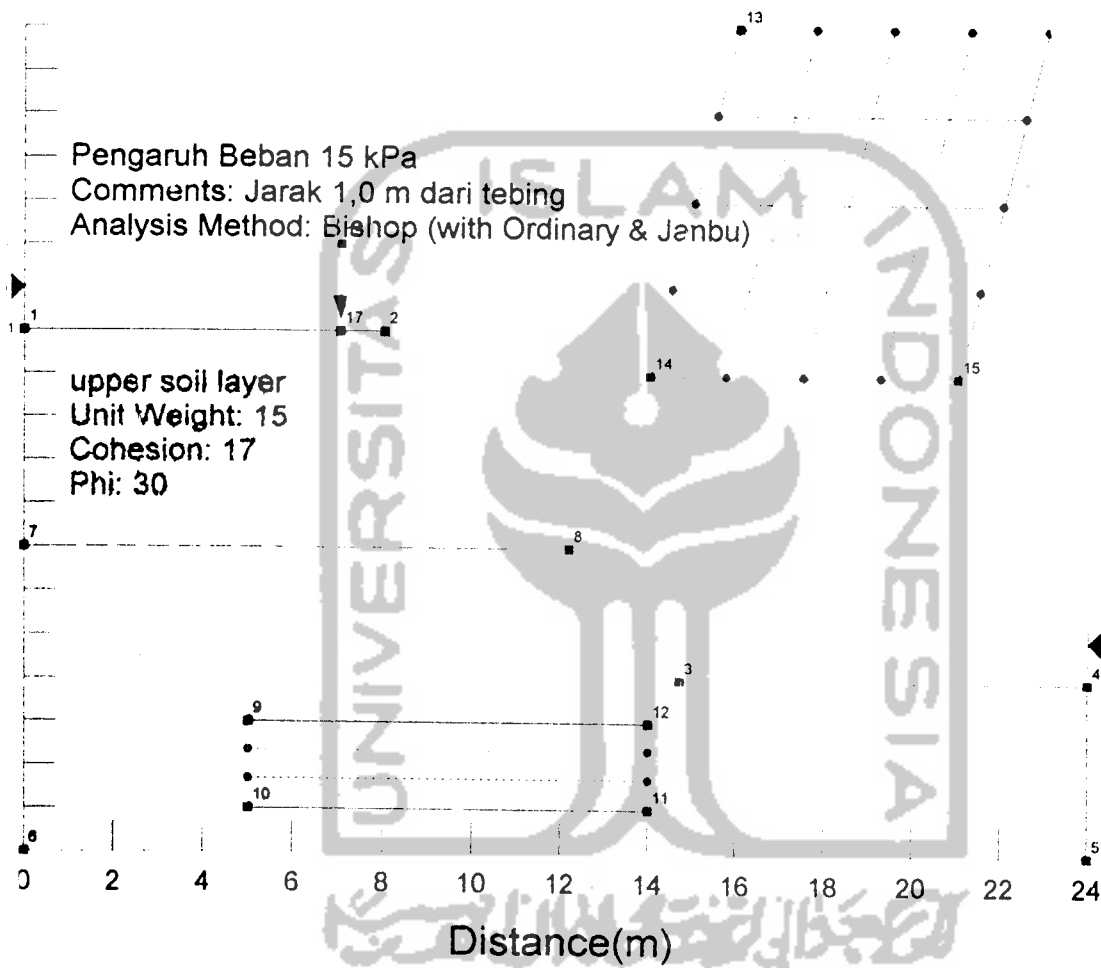
Slice 30 - Bishop Method

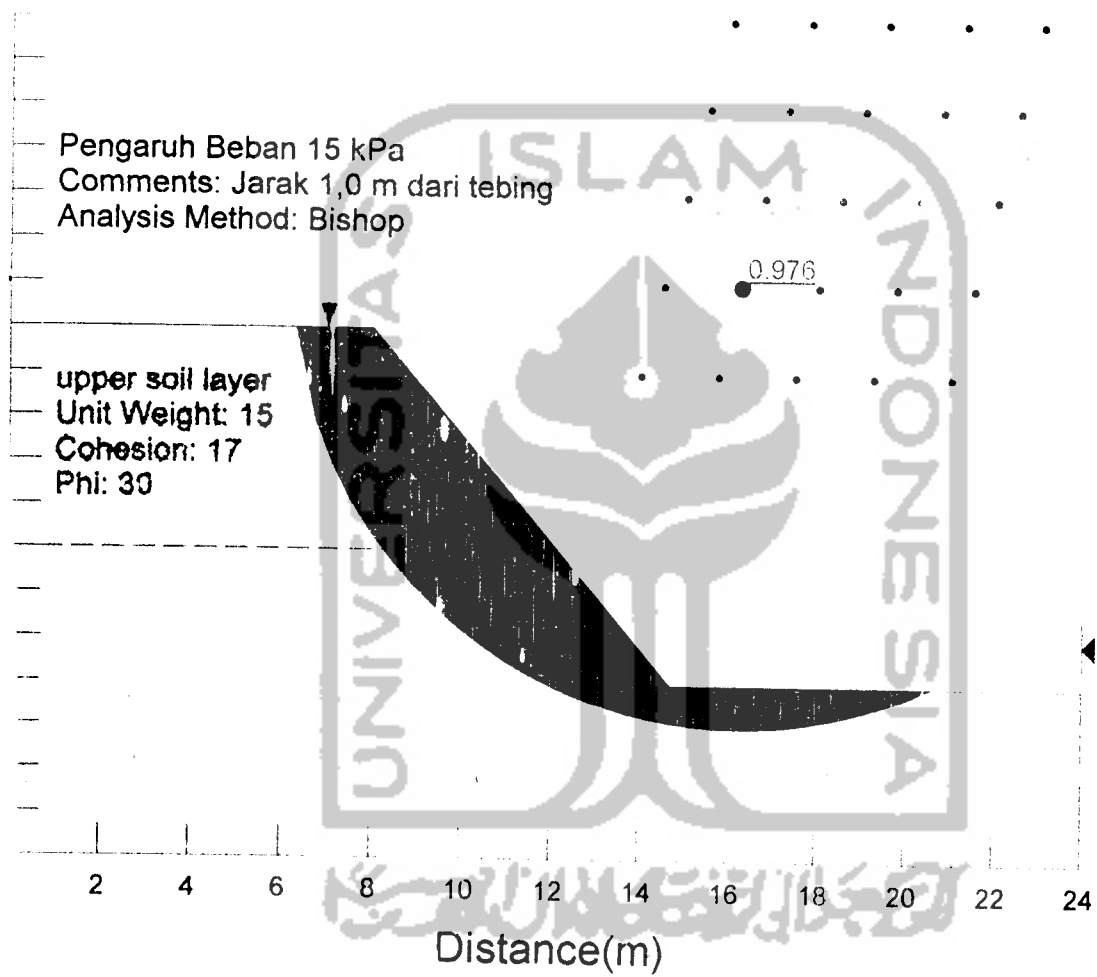
Factor of Safety	0.978
Phi Angle	30
C (Strength)	17
C (Force)	9.1688
Pore Water Pressure	30.552
Pore Water Force	16.478
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49157
Mid-Height	0.11495
Base Length	0.53934
Base Angle	24.297
Polygon Closure Error	0.02103
Anisotropic Strength Modifier	1
Weight	0.84759
Base Shear Force	0.26925
Base Normal Force	1.0515
Left Side Normal Force	0.69815



Shear Resistance vs. Slice #



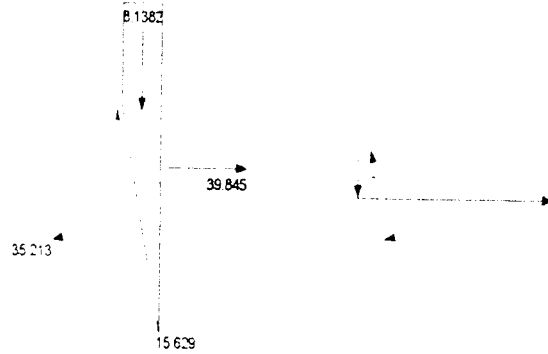




Slice 1 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	35.519
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.42497
Mid-Height	1.2767
Base Length	2.0894
Base Angle	78.264
Polygon Closure Error	2.5899
Anisotropic Strength Modifier	1
Weight	8.1382
Base Shear Force	15.629
Base Normal Force	35.213
Right Side Normal Force	39.845

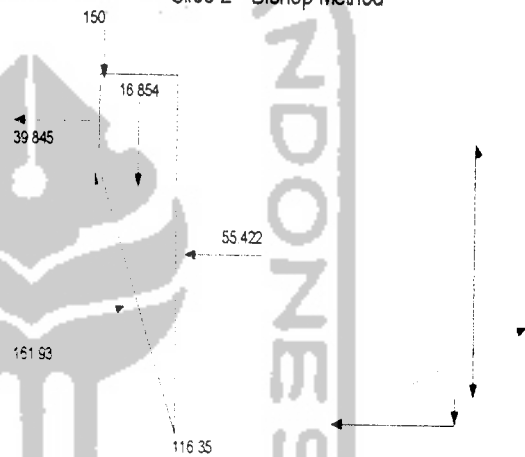
Slice 1 - Bishop Method



Slice 2 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	20.056
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.42497
Mid-Height	2.644
Base Length	1.1797
Base Angle	68.886
Polygon Closure Error	14.574
Anisotropic Strength Modifier	1
Weight	16.854
Base Shear Force	116.35
Base Normal Force	161.93
Left Side Normal Force	39.845
Right Side Normal Force	55.422
Line Load	150

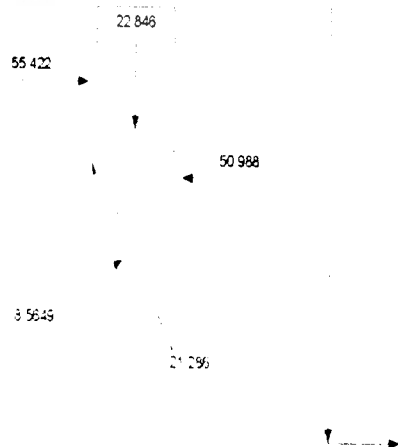
Slice 2 - Bishop Method



Slice 3 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	15.825
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.42497
Mid-Height	3.584
Base Length	0.93087
Base Angle	62.837
Polygon Closure Error	2.1704
Anisotropic Strength Modifier	1
Weight	22.846
Base Shear Force	21.286
Base Normal Force	8.5649
Left Side Normal Force	55.422
Right Side Normal Force	50.988

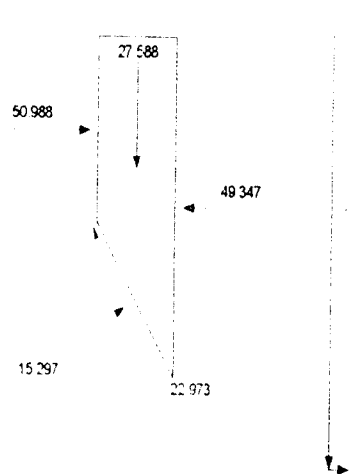
Slice 3 - Bishop Method



Slice 4 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	13.587
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.42497
Mid-Height	4.3279
Base Length	0.79924
Base Angle	57.879
Polygon Closure Error	2.207
Anisotropic Strength Modifier	1
Weight	27.586
Base Shear Force	22.973
Base Normal Force	15.297
Left Side Normal Force	50.988
Right Side Normal Force	49.347

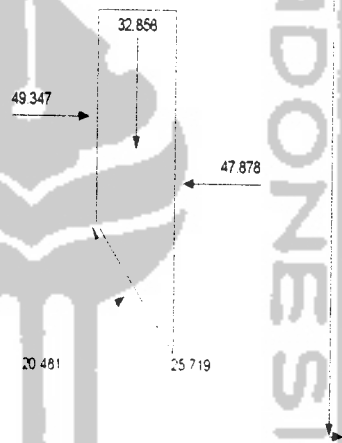
Slice 4 - Bishop Method



Slice 5 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	13.275
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	4.6996
Base Length	0.78087
Base Angle	53.351
Polygon Closure Error	2.3001
Anisotropic Strength Modifier	1
Weight	32.858
Base Shear Force	25.719
Base Normal Force	20.481
Left Side Normal Force	49.347
Right Side Normal Force	47.878

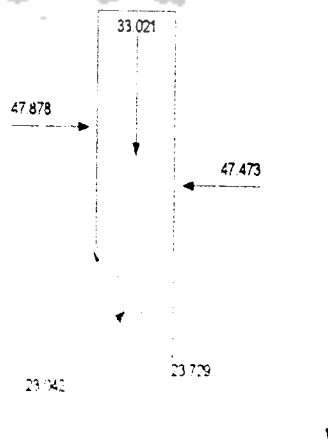
Slice 5 - Bishop Method



Slice 6 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	12.096
Pore Water Pressure	5.4566
Pore Water Force	3.8626
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	4.723
Base Length	0.71154
Base Angle	49.074
Polygon Closure Error	2.3115
Anisotropic Strength Modifier	1
Weight	33.021
Base Shear Force	23.729
Base Normal Force	23.042
Left Side Normal Force	47.878
Right Side Normal Force	47.473

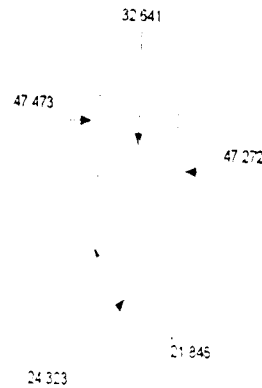
Slice 6 - Bishop Method



Slice 7 - Bishop Method

Factor of Safety	0.973
Phi Angle	30
C (Strength)	17
C (Force)	11.234
Pore Water Pressure	10.372
Pore Water Force	6.8538
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	4.6685
Base Length	0.66082
Base Angle	45.142
Polygon Closure Error	2.1217
Anisotropic Strength Modifier	1
Weight	32.641
Base Shear Force	21.846
Base Normal Force	24.323
Left Side Normal Force	47.473
Right Side Normal Force	47.272

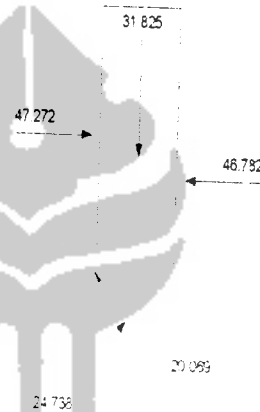
Slice 7 - Bishop Method



Slice 8 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	10.574
Pore Water Pressure	14.676
Pore Water Force	9.129
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	4.5518
Base Length	0.62203
Base Angle	41.466
Polygon Closure Error	1.7504
Anisotropic Strength Modifier	1
Weight	31.825
Base Shear Force	20.069
Base Normal Force	24.738
Left Side Normal Force	47.272
Right Side Normal Force	46.782

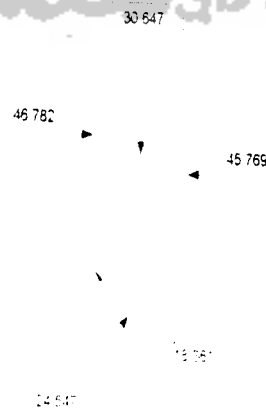
Slice 8 - Bishop Method



Slice 9 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	10.054
Pore Water Pressure	18.472
Pore Water Force	10.925
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	4.3833
Base Length	0.59142
Base Angle	37.989
Polygon Closure Error	1.6856
Anisotropic Strength Modifier	1
Weight	30.647
Base Shear Force	18.361
Base Normal Force	24.547
Left Side Normal Force	46.782
Right Side Normal Force	45.769

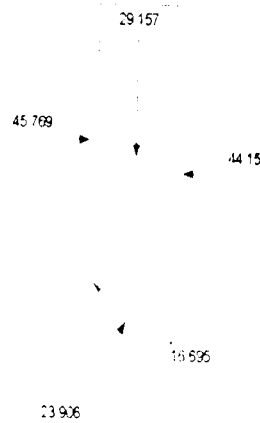
Slice 9 - Bishop Method



Slice 10 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	9.6347
Pore Water Pressure	21.832
Pore Water Force	12.373
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	4.1703
Base Length	0.56675
Base Angle	34.671
Polygon Closure Error	1.4578
Anisotropic Strength Modifier	1
Weight	29.157
Base Shear Force	16.695
Base Normal Force	23.906
Left Side Normal Force	45.769
Right Side Normal Force	44.15

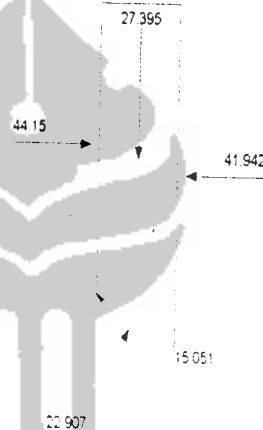
Slice 10 - Bishop Method



Slice 11 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	9.2915
Pore Water Pressure	24.808
Pore Water Force	13.559
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	3.9182
Base Length	0.54656
Base Angle	31.482
Polygon Closure Error	1.5067
Anisotropic Strength Modifier	1
Weight	27.395
Base Shear Force	15.051
Base Normal Force	22.907
Left Side Normal Force	44.15
Right Side Normal Force	41.942

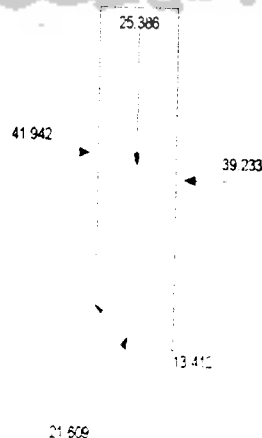
Slice 11 - Bishop Method



Slice 12 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	9.0078
Pore Water Pressure	27.439
Pore Water Force	14.539
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	3.6309
Base Length	0.52987
Base Angle	28.397
Polygon Closure Error	1.1424
Anisotropic Strength Modifier	1
Weight	25.386
Base Shear Force	13.412
Base Normal Force	21.609
Left Side Normal Force	41.942
Right Side Normal Force	39.233

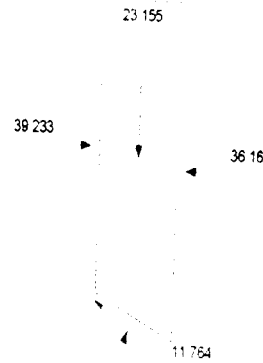
Slice 12 - Bishop Method



Slice 13 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.7718
Pore Water Pressure	29.758
Pore Water Force	15.355
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.46611
Mid-Height	3.3117
Base Length	0.51599
Base Angle	25.401
Polygon Closure Error	1.042
Anisotropic Strength Modifier	1
Weight	23.155
Base Shear Force	11.764
Base Normal Force	20.047
Left Side Normal Force	39.233
Right Side Normal Force	36.16

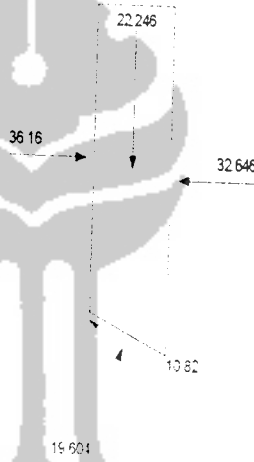
Slice 13 - Bishop Method



Slice 14 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	9.2465
Pore Water Pressure	31.862
Pore Water Force	17.33
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.9484
Base Length	0.54391
Base Angle	22.364
Polygon Closure Error	0.88984
Anisotropic Strength Modifier	1
Weight	22.246
Base Shear Force	10.82
Base Normal Force	19.604
Left Side Normal Force	36.16
Right Side Normal Force	32.646

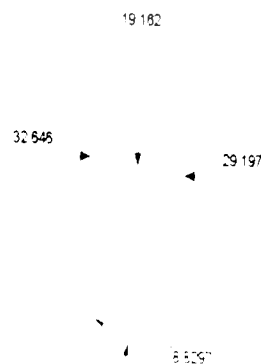
Slice 14 - Bishop Method



Slice 15 - Bishop Method

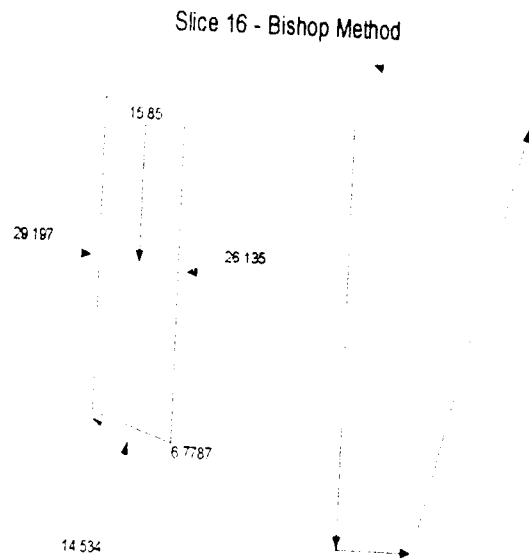
Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	9.059
Pore Water Pressure	33.737
Pore Water Force	17.978
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.5396
Base Length	0.53288
Base Angle	19.279
Polygon Closure Error	0.76648
Anisotropic Strength Modifier	1
Weight	19.162
Base Shear Force	8.8297
Base Normal Force	17.212
Left Side Normal Force	32.646
Right Side Normal Force	29.197

Slice 15 - Bishop Method



Slice 16 - Bishop Method

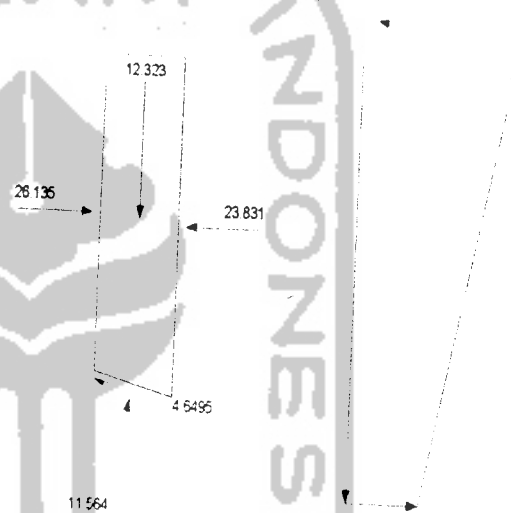
Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.9069
Pore Water Pressure	35.316
Pore Water Force	18.503
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.1007
Base Length	0.52393
Base Angle	16.251
Polygon Closure Error	0.634
Anisotropic Strength Modifier	1
Weight	15.85
Base Shear Force	6.7787
Base Normal Force	14.534
Left Side Normal Force	29.197
Right Side Normal Force	26.135



Slice 17 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.7855
Pore Water Pressure	36.616
Pore Water Force	18.923
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	1.6332
Base Length	0.5168
Base Angle	13.269
Polygon Closure Error	0.4313
Anisotropic Strength Modifier	1
Weight	12.323
Base Shear Force	4.6495
Base Normal Force	11.564
Left Side Normal Force	26.135
Right Side Normal Force	23.831

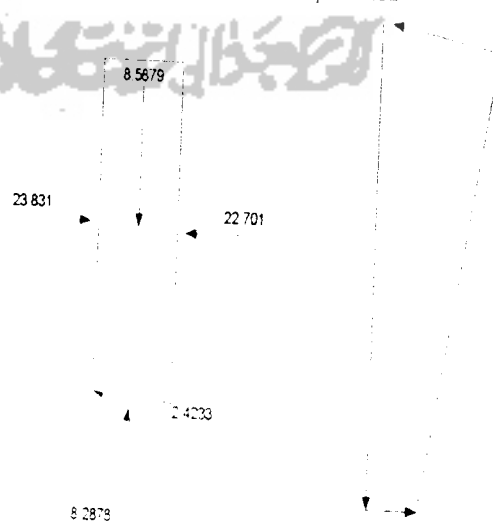
Slice 17 - Bishop Method



Slice 18 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.6917
Pore Water Pressure	37.645
Pore Water Force	19.247
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	1.1382
Base Length	0.51128
Base Angle	10.324
Polygon Closure Error	0.2147
Anisotropic Strength Modifier	1
Weight	8.5879
Base Shear Force	2.4233
Base Normal Force	8.2878
Left Side Normal Force	23.831
Right Side Normal Force	22.701

Slice 18 - Bishop Method



Slice 19 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.4278
Pore Water Pressure	38.406
Pore Water Force	19.04
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49158
Mid-Height	0.9159
Base Length	0.49575
Base Angle	7.4383
Polygon Closure Error	0.13507
Anisotropic Strength Modifier	1
Weight	6.7535
Base Shear Force	1.301
Base Normal Force	6.6409
Left Side Normal Force	22.701
Right Side Normal Force	22.143

Slice 19 - Bishop Method

Slice 20 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.3837
Pore Water Pressure	38.916
Pore Water Force	19.192
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49157
Mid-Height	0.96774
Base Length	0.49316
Base Angle	4.6052
Polygon Closure Error	0.14271
Anisotropic Strength Modifier	1
Weight	7.1357
Base Shear Force	1.4058
Base Normal Force	7.0456
Left Side Normal Force	22.143
Right Side Normal Force	21.167

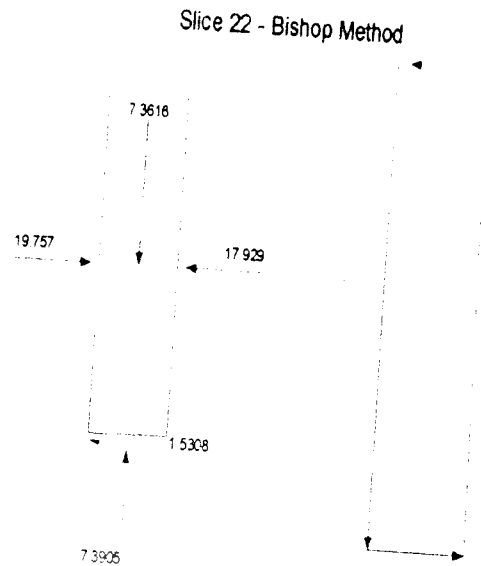
Slice 20 - Bishop Method

Slice 21 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.3607
Pore Water Pressure	39.184
Pore Water Force	19.271
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49157
Mid-Height	0.99516
Base Length	0.49181
Base Angle	1.7831
Polygon Closure Error	0.18345
Anisotropic Strength Modifier	1
Weight	7.3379
Base Shear Force	1.4828
Base Normal Force	7.2953
Left Side Normal Force	21.167
Right Side Normal Force	19.757

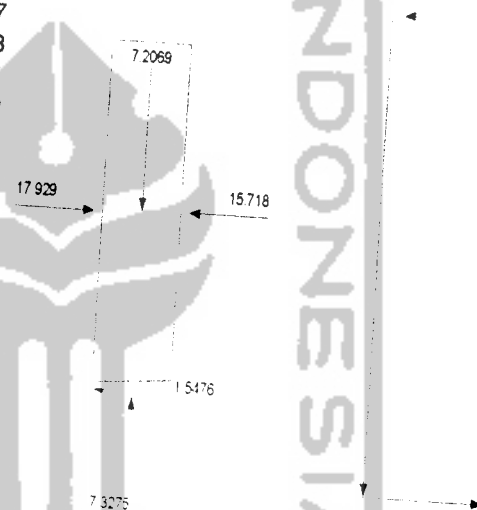
Slice 21 - Bishop Method

Slice 22 - Bishop Method	
Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.3582
Pore Water Pressure	39.216
Pore Water Force	19.281
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49158
Mid-Height	0.99837
Base Length	0.49166
Base Angle	1.0347
Polygon Closure Error	0.22172
Anisotropic Strength Modifier	1
Weight	7.3616
Base Shear Force	1.5308
Base Normal Force	7.3905
Left Side Normal Force	19.757
Right Side Normal Force	17.929



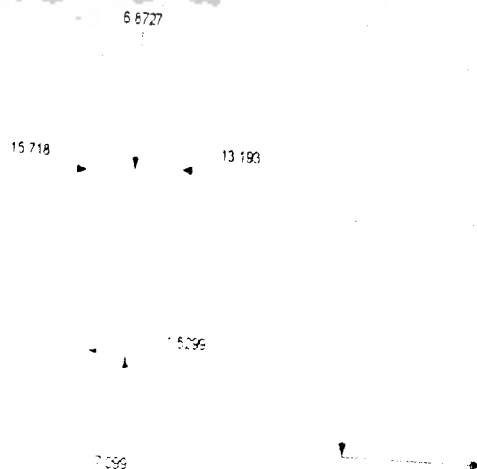
Slice 23 - Bishop Method	
Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.3758
Pore Water Pressure	39.01
Pore Water Force	19.22
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49158
Mid-Height	0.97739
Base Length	0.49269
Base Angle	3.8548
Polygon Closure Error	0.21982
Anisotropic Strength Modifier	1
Weight	7.2069
Base Shear Force	1.5476
Base Normal Force	7.3275
Left Side Normal Force	17.929
Right Side Normal Force	15.718

Slice 23 - Bishop Method



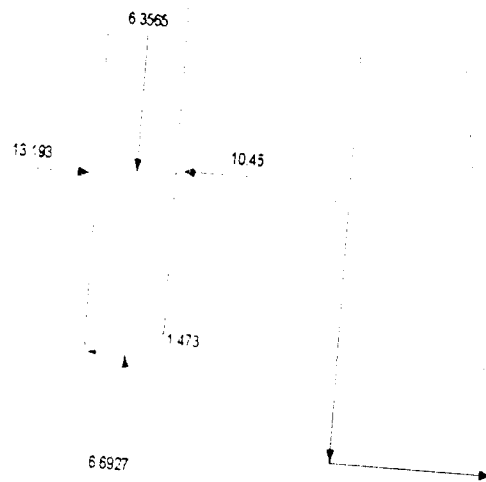
Slice 24 - Bishop Method	
Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.4139
Pore Water Pressure	38.567
Pore Water Force	19.088
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49157
Mid-Height	0.93206
Base Length	0.49494
Base Angle	6.6846
Polygon Closure Error	0.21297
Anisotropic Strength Modifier	1
Weight	6.8727
Base Shear Force	1.5299
Base Normal Force	7.099
Left Side Normal Force	15.718
Right Side Normal Force	13.193

Slice 24 - Bishop Method



Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.4738
Pore Water Pressure	37.879
Pore Water Force	18.881
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49158
Mid-Height	0.86208
Base Length	0.49846
Base Angle	9.5306
Polygon Closure Error	0.16732
Anisotropic Strength Modifier	1
Weight	6.3565
Base Shear Force	1.473
Base Normal Force	6.6927
Left Side Normal Force	13.193
Right Side Normal Force	10.45

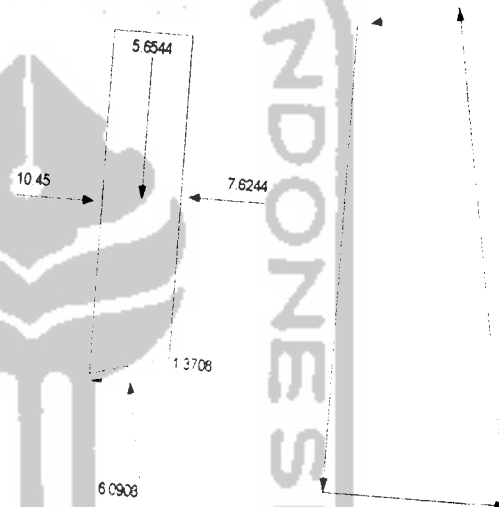
Slice 25 - Bishop Method



Slice 26 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.5563
Pore Water Pressure	36.945
Pore Water Force	18.595
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49157
Mid-Height	0.76684
Base Length	0.50331
Base Angle	12.401
Polygon Closure Error	0.21318
Anisotropic Strength Modifier	1
Weight	5.6544
Base Shear Force	1.3708
Base Normal Force	6.0908
Left Side Normal Force	10.45
Right Side Normal Force	7.6244

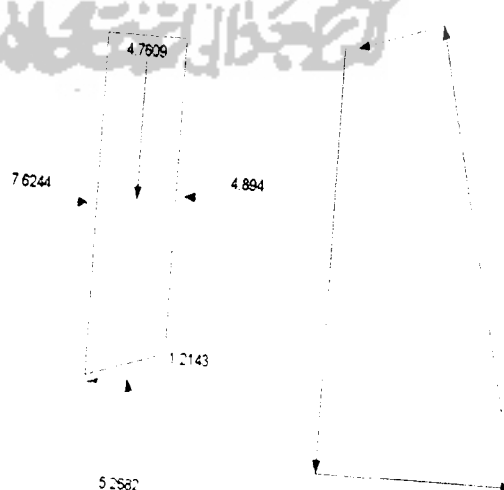
Slice 26 - Bishop Method



Slice 27 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.6641
Pore Water Pressure	35.756
Pore Water Force	18.223
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49158
Mid-Height	0.64567
Base Length	0.50965
Base Angle	15.303
Polygon Closure Error	0.18439
Anisotropic Strength Modifier	1
Weight	4.7609
Base Shear Force	1.2143
Base Normal Force	5.2682
Left Side Normal Force	7.6244
Right Side Normal Force	4.894

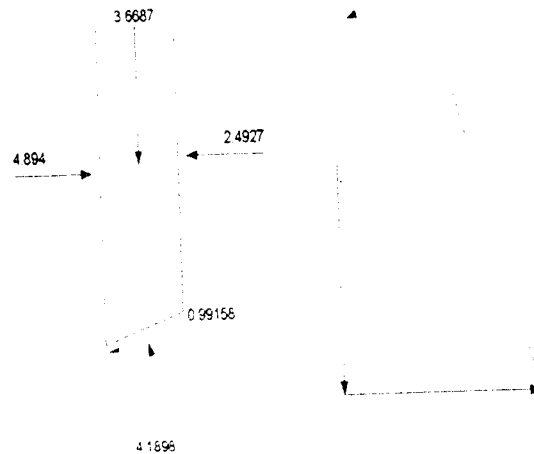
Slice 27 - Bishop Method



Slice 28 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.7991
Pore Water Pressure	34.305
Pore Water Force	17.756
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49157
Mid-Height	0.49754
Base Length	0.51759
Base Angle	18.246
Polygon Closure Error	0.16759
Anisotropic Strength Modifier	1
Weight	3.6687
Base Shear Force	0.99158
Base Normal Force	4.1898
Left Side Normal Force	4.894
Right Side Normal Force	2.4927

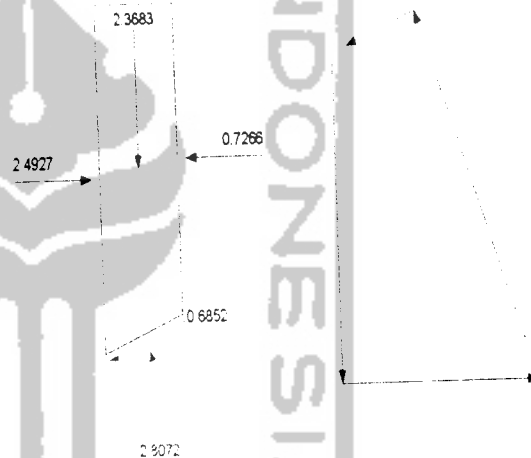
Slice 28 - Bishop Method



Slice 29 - Bishop Method

Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	8.9659
Pore Water Pressure	32.574
Pore Water Force	17.18
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49158
Mid-Height	0.32118
Base Length	0.52741
Base Angle	21.24
Polygon Closure Error	0.12632
Anisotropic Strength Modifier	1
Weight	2.3683
Base Shear Force	0.6852
Base Normal Force	2.8072
Left Side Normal Force	2.4927
Right Side Normal Force	0.7266

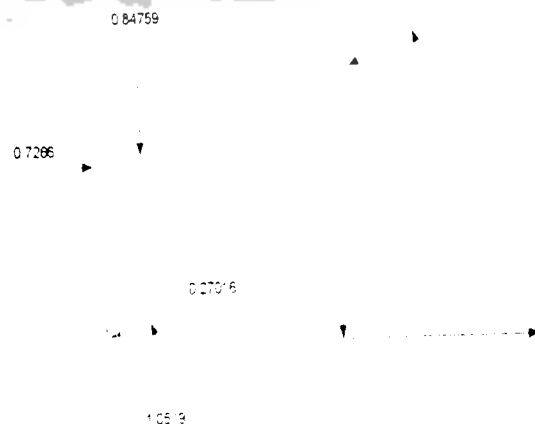
Slice 29 - Bishop Method



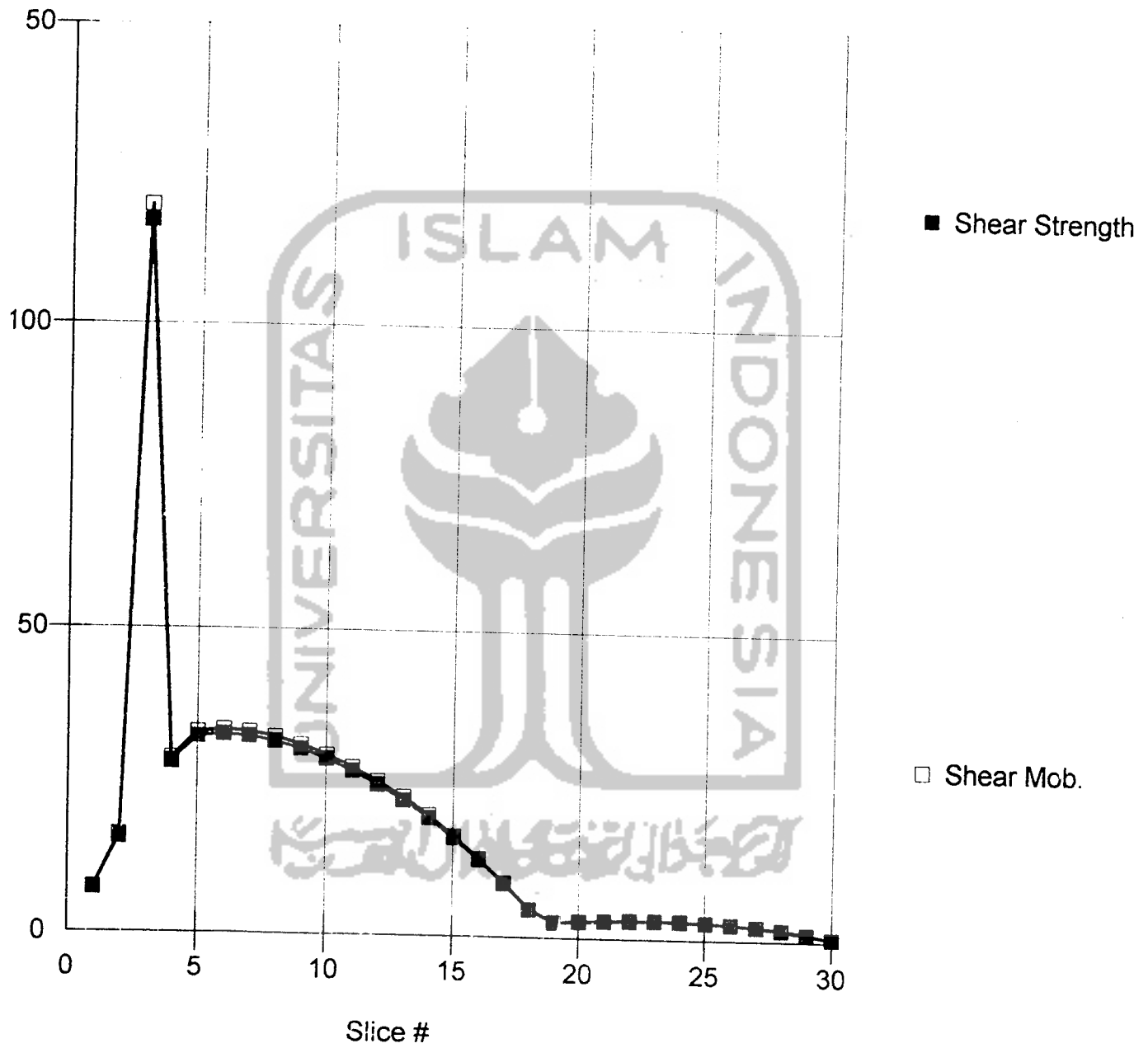
Slice 30 - Bishop Method

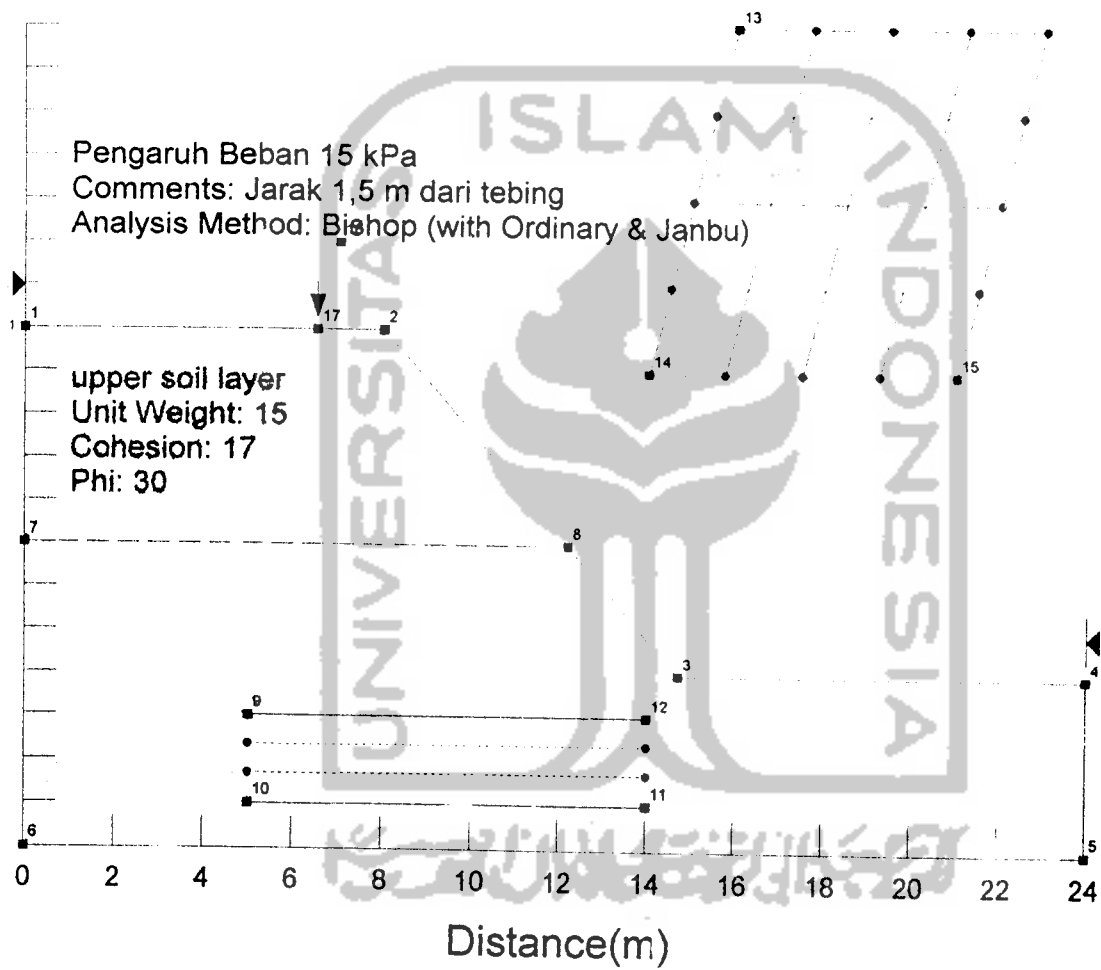
Factor of Safety	0.976
Phi Angle	30
C (Strength)	17
C (Force)	9.1688
Pore Water Pressure	30.552
Pore Water Force	16.478
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.49157
Mid-Height	0.11495
Base Length	0.53934
Base Angle	24.297
Polygon Closure Error	0.052595
Anisotropic Strength Modifier	1
Weight	0.84759
Base Shear Force	0.27016
Base Normal Force	1.0519
Left Side Normal Force	0.7266

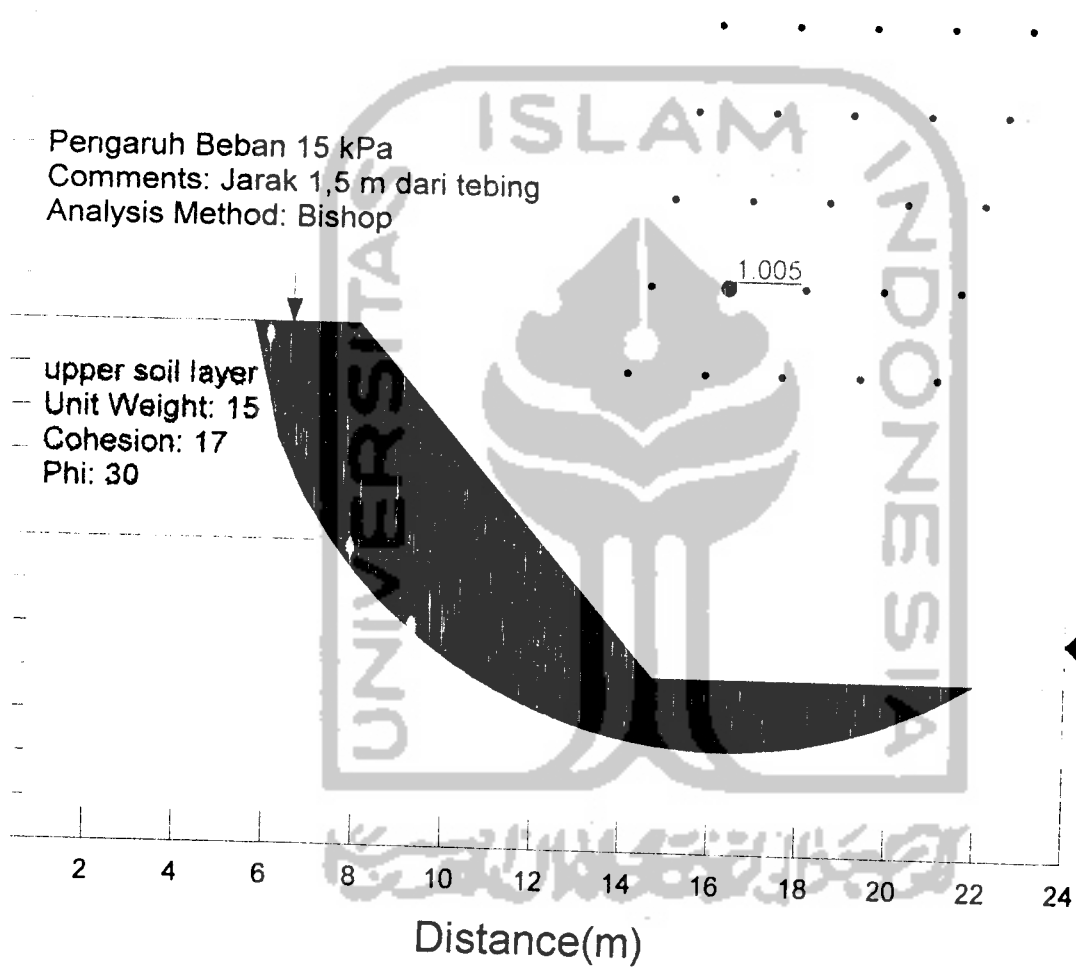
Slice 30 - Bishop Method



Shear Resistance vs. Slice #





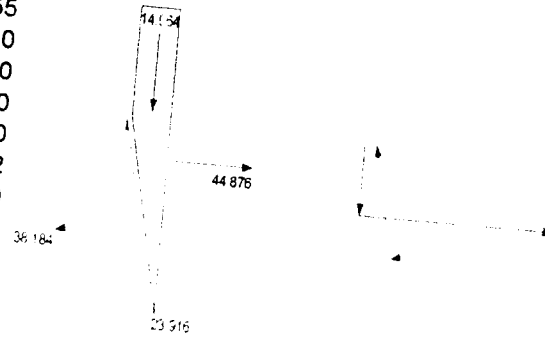


Slice 1 - Bishop Method

Factor of Safety
 Phi Angle
 C (Strength)
 C (Force)
 Pore Water Pressure
 Pore Water Force
 Pore Air Pressure
 Pore Air Force
 Slice Width
 Mid-Height
 Base Length
 Base Angle
 Polygon Closure Error
 Anisotropic Strength Modifier
 Weight
 Base Shear Force
 Base Normal Force
 Right Side Normal Force

1.005
 30
 17
 45.955
 0
 0
 0
 0
 0.59242
 1.8839
 2.7033
 77.341
 2.6926
 1
 14.964
 23.916
 38.184
 44.876

Slice 1 - Bishop Method

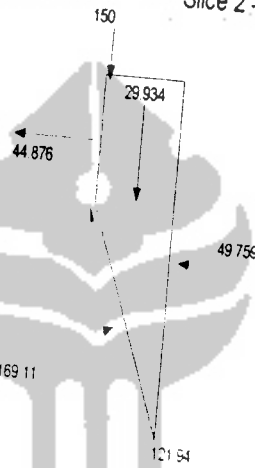


Slice 2 - Bishop Method

Factor of Safety
 Phi Angle
 C (Strength)
 C (Force)
 Pore Water Pressure
 Pore Water Force
 Pore Air Pressure
 Pore Air Force
 Slice Width
 Mid-Height
 Base Length
 Base Angle
 Polygon Closure Error
 Anisotropic Strength Modifier
 Weight
 Base Shear Force
 Base Normal Force
 Left Side Normal Force
 Right Side Normal Force
 Line Load

1.005
 30
 17
 24.884
 0
 0
 0
 0
 0.59242
 3.3686
 1.4638
 66.127
 10.992
 1
 29.934
 121.94
 169.11
 44.876
 49.759
 150

Slice 2 - Bishop Method

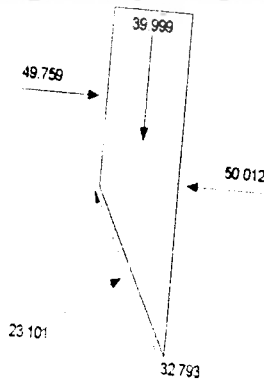


Slice 3 - Bishop Method

Factor of Safety
 Phi Angle
 C (Strength)
 C (Force)
 Pore Water Pressure
 Pore Water Force
 Pore Air Pressure
 Pore Air Force
 Slice Width
 Mid-Height
 Base Length
 Base Angle
 Polygon Closure Error
 Anisotropic Strength Modifier
 Weight
 Base Shear Force
 Base Normal Force
 Left Side Normal Force
 Right Side Normal Force

1.005
 30
 17
 19.607
 0
 0
 0
 0
 0.59242
 4.5012
 1.1534
 59.093
 2.7999
 1
 39.999
 32.793
 23.101
 49.759
 50.012

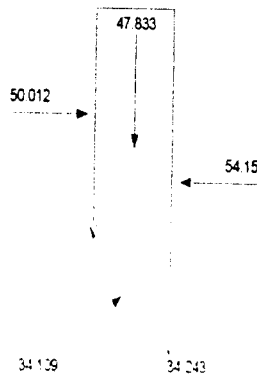
Slice 3 - Bishop Method



Slice 4 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	16.863
Pore Water Pressure	3.7554
Pore Water Force	3.7252
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.59242
Mid-Height	5.3828
Base Length	0.99196
Base Angle	53.329
Polygon Closure Error	2.6308
Anisotropic Strength Modifier	1
Weight	47.833
Base Shear Force	34.243
Base Normal Force	34.109
Left Side Normal Force	50.012
Right Side Normal Force	54.15

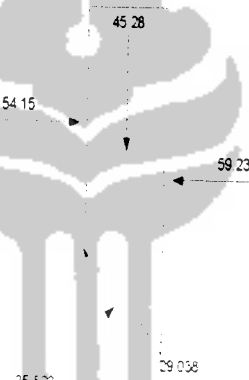
Slice 4 - Bishop Method



Slice 5 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	13.463
Pore Water Pressure	10.487
Pore Water Force	8.3053
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	5.7566
Base Length	0.79193
Base Angle	48.536
Polygon Closure Error	2.264
Anisotropic Strength Modifier	1
Weight	45.28
Base Shear Force	29.038
Base Normal Force	35.523
Left Side Normal Force	54.15
Right Side Normal Force	59.23

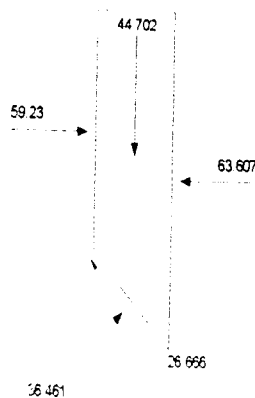
Slice 5 - Bishop Method



Slice 6 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	12.485
Pore Water Pressure	15.898
Pore Water Force	11.675
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	5.6832
Base Length	0.73438
Base Angle	44.436
Polygon Closure Error	2.4586
Anisotropic Strength Modifier	1
Weight	44.702
Base Shear Force	26.666
Base Normal Force	36.461
Left Side Normal Force	59.23
Right Side Normal Force	63.607

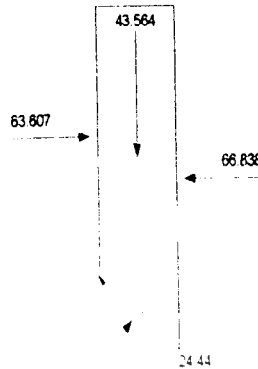
Slice 6 - Bishop Method



Slice 7 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	11.742
Pore Water Pressure	20.609
Pore Water Force	14.235
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	5.5386
Base Length	0.69071
Base Angle	40.608
Polygon Closure Error	1.9604
Anisotropic Strength Modifier	1
Weight	43.564
Base Shear Force	24.44
Base Normal Force	36.432
Left Side Normal Force	63.607
Right Side Normal Force	66.838

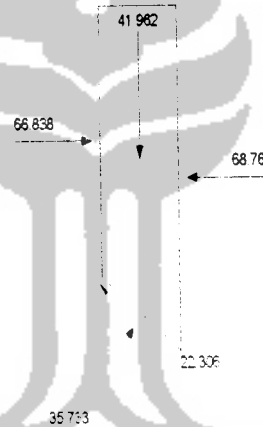
Slice 7 - Bishop Method



Slice 8 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	11.16
Pore Water Pressure	24.741
Pore Water Force	16.242
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	5.3348
Base Length	0.65649
Base Angle	36.989
Polygon Closure Error	1.8883
Anisotropic Strength Modifier	1
Weight	41.962
Base Shear Force	22.306
Base Normal Force	35.733
Left Side Normal Force	66.838
Right Side Normal Force	68.76

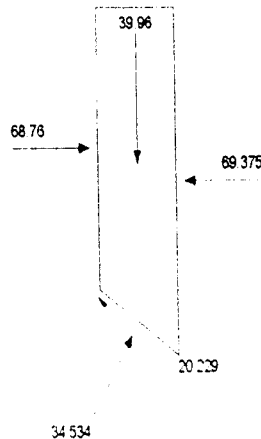
Slice 8 - Bishop Method



Slice 9 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	10.695
Pore Water Pressure	28.374
Pore Water Force	17.85
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	5.0803
Base Length	0.62909
Base Angle	33.536
Polygon Closure Error	1.5984
Anisotropic Strength Modifier	1
Weight	39.96
Base Shear Force	20.229
Base Normal Force	34.534
Left Side Normal Force	68.76
Right Side Normal Force	69.375

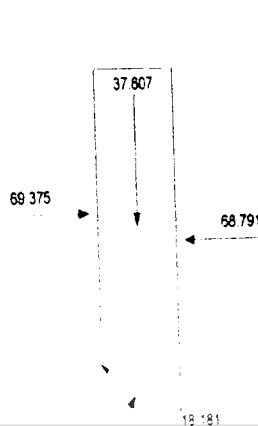
Slice 9 - Bishop Method



Slice 10 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	10.316
Pore Water Pressure	31.569
Pore Water Force	19.157
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52438
Mid-Height	4.7812
Base Length	0.60683
Base Angle	30.216
Polygon Closure Error	1.6923
Anisotropic Strength Modifier	1
Weight	37.607
Base Shear Force	18.181
Base Normal Force	32.933
Left Side Normal Force	69.375
Right Side Normal Force	68.791

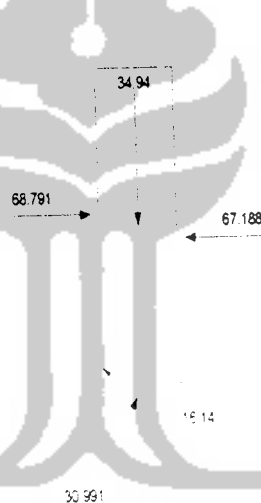
Slice 10 - Bishop Method



Slice 11 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	10.005
Pore Water Pressure	34.375
Pore Water Force	20.231
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	4.4421
Base Length	0.58854
Base Angle	27.005
Polygon Closure Error	1.3976
Anisotropic Strength Modifier	1
Weight	34.94
Base Shear Force	16.14
Base Normal Force	30.991
Left Side Normal Force	68.791
Right Side Normal Force	67.188

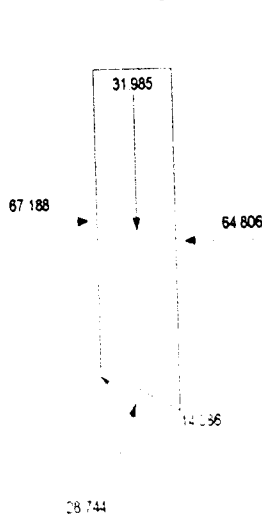
Slice 11 - Bishop Method



Slice 12 - Bishop Method

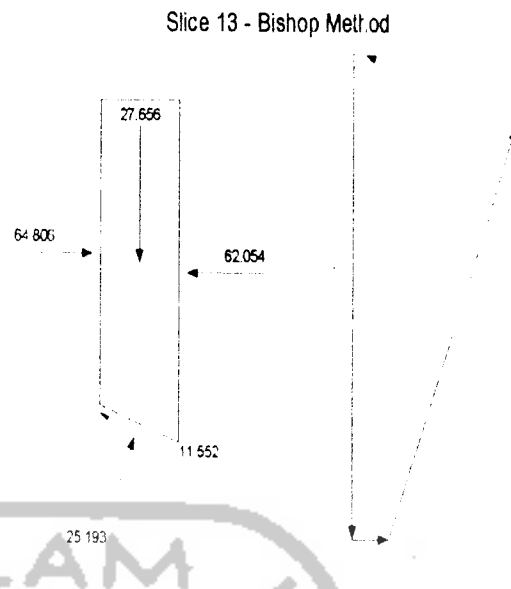
Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	9.7493
Pore Water Pressure	36.819
Pore Water Force	21.115
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52438
Mid-Height	4.0665
Base Length	0.57349
Base Angle	23.834
Polygon Closure Error	0.95955
Anisotropic Strength Modifier	1
Weight	31.985
Base Shear Force	14.086
Base Normal Force	28.744
Left Side Normal Force	67.188
Right Side Normal Force	64.806

Slice 12 - Bishop Method



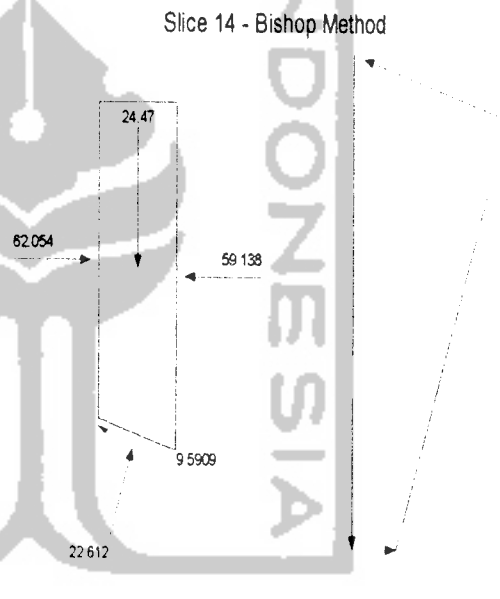
Slice 13 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	9.1531
Pore Water Pressure	38.894
Pore Water Force	20.941
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	3.6655
Base Length	0.53842
Base Angle	20.897
Polygon Closure Error	0.82968
Anisotropic Strength Modifier	1
Weight	27.656
Base Shear Force	11.552
Base Normal Force	25.193
Left Side Normal Force	64.806
Right Side Normal Force	62.054



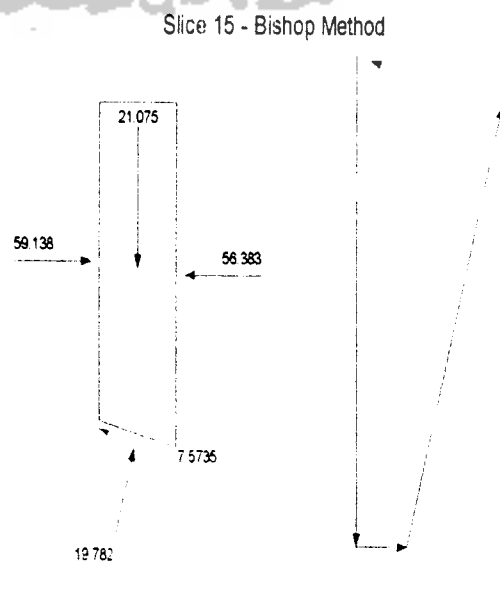
Slice 14 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	8.9926
Pore Water Pressure	40.637
Pore Water Force	21.496
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	3.2432
Base Length	0.52898
Base Angle	18.03
Polygon Closure Error	0.61175
Anisotropic Strength Modifier	1
Weight	24.47
Base Shear Force	9.5909
Base Normal Force	22.612
Left Side Normal Force	62.054
Right Side Normal Force	59.138



Slice 15 - Bishop Method

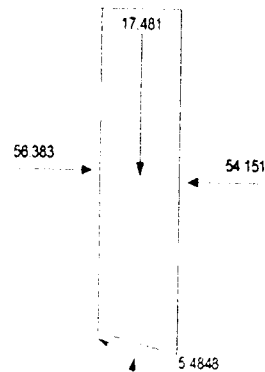
Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	8.8614
Pore Water Pressure	42.108
Pore Water Force	21.949
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.7933
Base Length	0.52126
Base Angle	15.209
Polygon Closure Error	0.73763
Anisotropic Strength Modifier	1
Weight	21.075
Base Shear Force	7.5735
Base Normal Force	19.782
Left Side Normal Force	59.138
Right Side Normal Force	56.383



Slice 16 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	8.7561
Pore Water Pressure	43.321
Pore Water Force	22.313
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.317
Base Length	0.51506
Base Angle	12.426
Polygon Closure Error	0.43703
Anisotropic Strength Modifier	1
Weight	17.481
Base Shear Force	5.4848
Base Normal Force	16.692
Left Side Normal Force	56.383
Right Side Normal Force	54.151

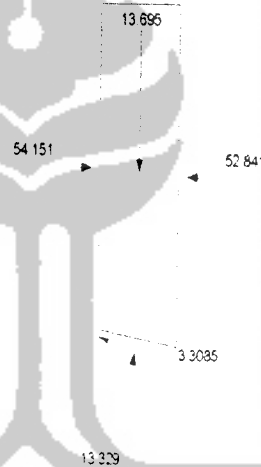
Slice 16 - Bishop Method



Slice 17 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	8.6743
Pore Water Pressure	44.284
Pore Water Force	22.596
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	1.8151
Base Length	0.51025
Base Angle	9.6716
Polygon Closure Error	0.2739
Anisotropic Strength Modifier	1
Weight	13.695
Base Shear Force	3.3085
Base Normal Force	13.329
Left Side Normal Force	54.151
Right Side Normal Force	52.841

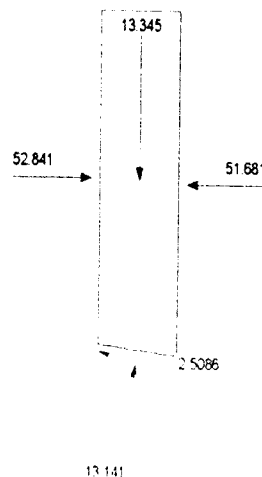
Slice 17 - Bishop Method



Slice 18 - Bishop Method

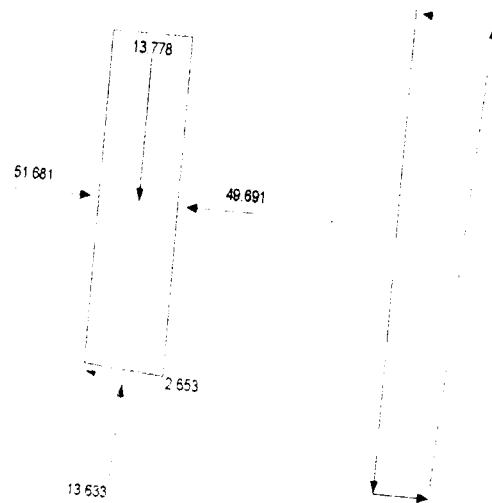
Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	9.5677
Pore Water Pressure	45.039
Pore Water Force	25.348
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.5919
Base Length	0.56281
Base Angle	6.7894
Polygon Closure Error	0.2669
Anisotropic Strength Modifier	1
Weight	13.345
Base Shear Force	2.5086
Base Normal Force	13.141
Left Side Normal Force	52.841
Right Side Normal Force	51.681

Slice 18 - Bishop Method



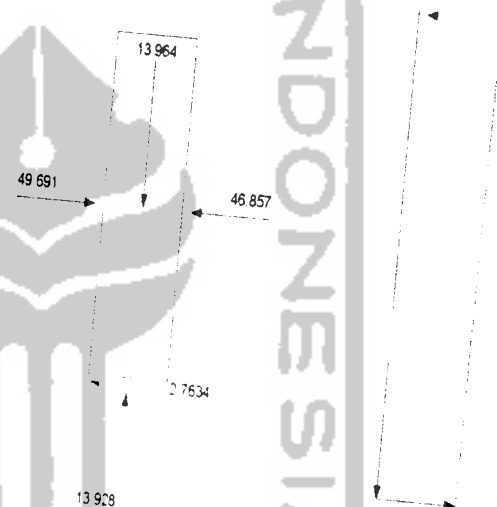
Slice 19 - Bishop Method	
Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	9.5213
Pore Water Pressure	45.544
Pore Water Force	25.508
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.6436
Base Length	0.56007
Base Angle	3.7732
Polygon Closure Error	0.20667
Anisotropic Strength Modifier	1
Weight	13.778
Base Shear Force	2.653
Base Normal Force	13.633
Left Side Normal Force	51.681
Right Side Normal Force	49.691

Slice 19 - Bishop Method



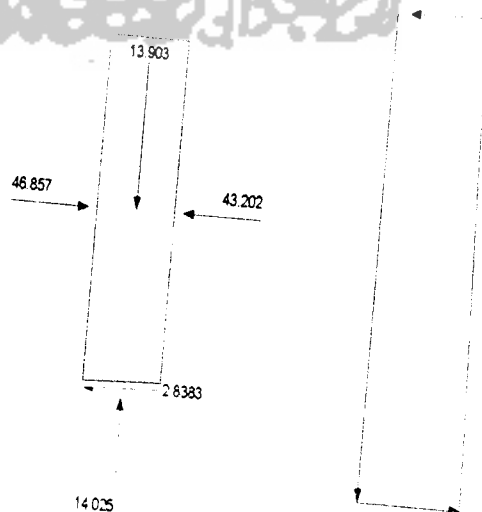
Slice 20 - Bishop Method	
Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	9.5015
Pore Water Pressure	45.762
Pore Water Force	25.577
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.6657
Base Length	0.55891
Base Angle	0.76764
Polygon Closure Error	0.27928
Anisotropic Strength Modifier	1
Weight	13.964
Base Shear Force	2.7634
Base Normal Force	13.928
Left Side Normal Force	49.691
Right Side Normal Force	46.857

Slice 20 - Bishop Method

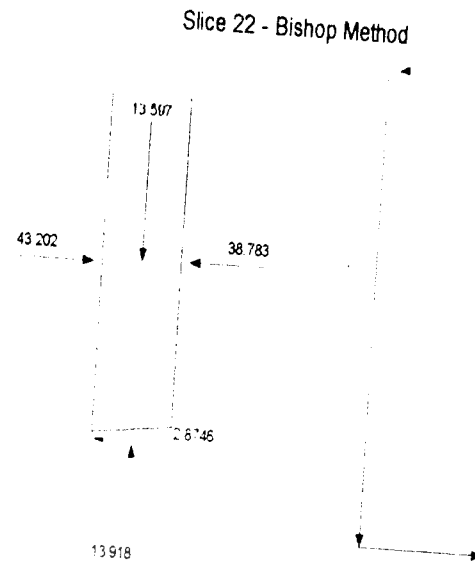


Slice 21 - Bishop Method	
Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	9.5079
Pore Water Pressure	45.692
Pore Water Force	25.555
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.6586
Base Length	0.55929
Base Angle	2.236
Polygon Closure Error	0.42075
Anisotropic Strength Modifier	1
Weight	13.903
Base Shear Force	2.8383
Base Normal Force	14.025
Left Side Normal Force	46.857
Right Side Normal Force	43.202

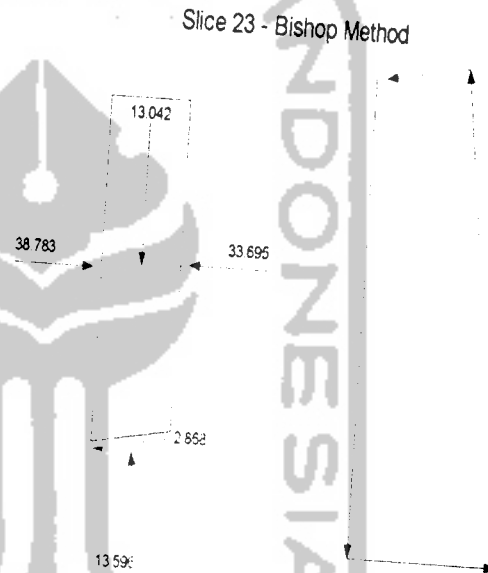
Slice 21 - Bishop Method



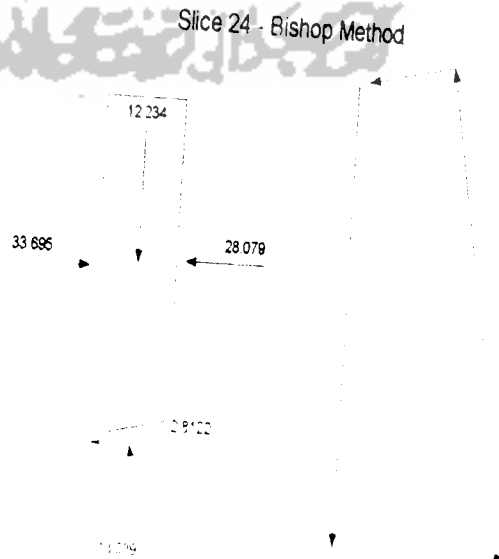
Slice 22 - Bishop Method	
Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	9.5406
Pore Water Pressure	45.334
Pore Water Force	25.442
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.622
Base Length	0.56121
Base Angle	5.2456
Polygon Closure Error	0.34795
Anisotropic Strength Modifier	1
Weight	13.597
Base Shear Force	2.8746
Base Normal Force	13.918
Left Side Normal Force	43.202
Right Side Normal Force	38.783



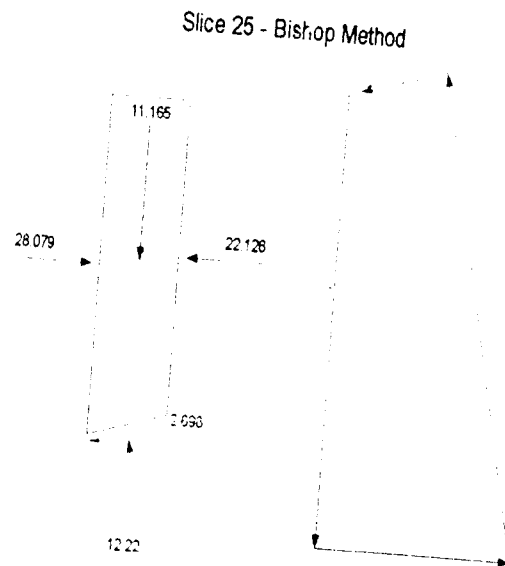
Slice 23 - Bishop Method	
Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	9.6005
Pore Water Pressure	44.685
Pore Water Force	25.235
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.5558
Base Length	0.56473
Base Angle	8.27
Polygon Closure Error	0.3399
Anisotropic Strength Modifier	1
Weight	13.042
Base Shear Force	2.868
Base Normal Force	13.596
Left Side Normal Force	38.783
Right Side Normal Force	33.695



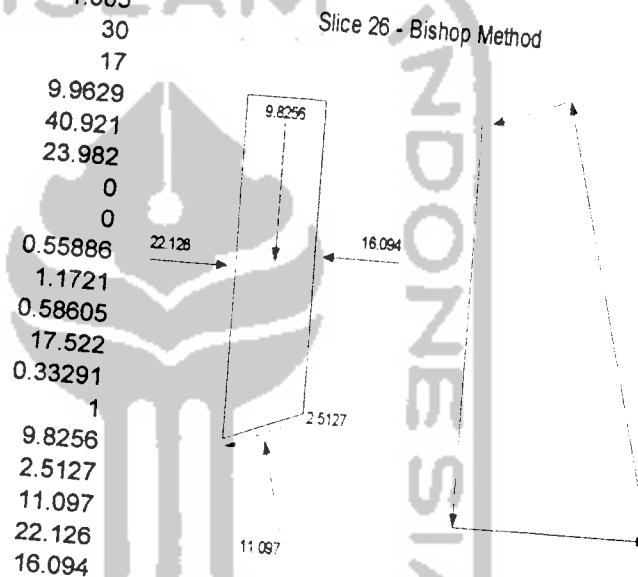
Slice 24 - Bishop Method	
Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	9.689
Pore Water Pressure	43.738
Pore Water Force	24.928
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.4594
Base Length	0.56994
Base Angle	11.318
Polygon Closure Error	0.32597
Anisotropic Strength Modifier	1
Weight	12.234
Base Shear Force	2.8122
Base Normal Force	13.039
Left Side Normal Force	33.695
Right Side Normal Force	28.079



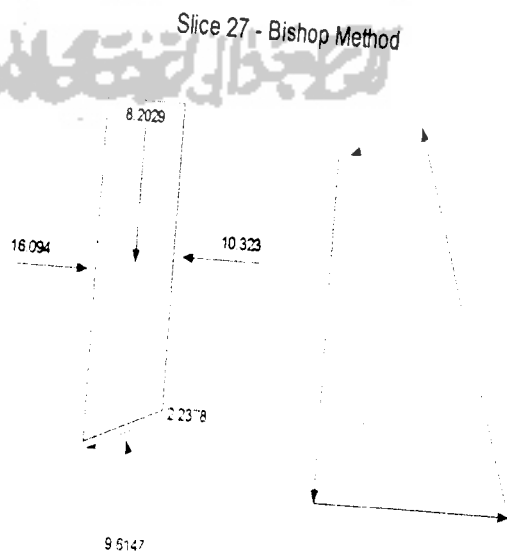
Slice 25 - Bishop Method	
Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	9.8089
Pore Water Pressure	42.488
Pore Water Force	24.515
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55887
Mid-Height	1.3319
Base Length	0.57699
Base Angle	14.398
Polygon Closure Error	0.3666
Anisotropic Strength Modifier	1
Weight	11.165
Base Shear Force	2.698
Base Normal Force	12.22
Left Side Normal Force	28.079
Right Side Normal Force	22.126



Slice 26 - Bishop Method	
Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	9.9629
Pore Water Pressure	40.921
Pore Water Force	23.982
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	1.1721
Base Length	0.58605
Base Angle	17.522
Polygon Closure Error	0.33291
Anisotropic Strength Modifier	1
Weight	9.8256
Base Shear Force	2.5127
Base Normal Force	11.097
Left Side Normal Force	22.126
Right Side Normal Force	16.094

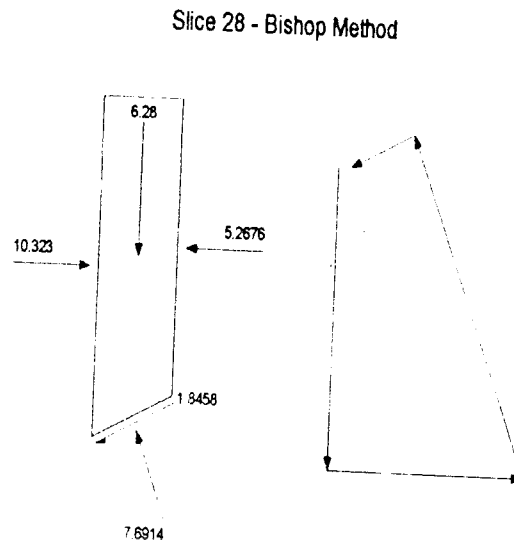


Slice 27 - Bishop Method	
Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	10.156
Pore Water Pressure	39.022
Pore Water Force	23.313
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	0.97853
Base Length	0.59743
Base Angle	20.702
Polygon Closure Error	0.33651
Anisotropic Strength Modifier	1
Weight	8.2029
Base Shear Force	2.2378
Base Normal Force	9.6147
Left Side Normal Force	16.094
Right Side Normal Force	10.323



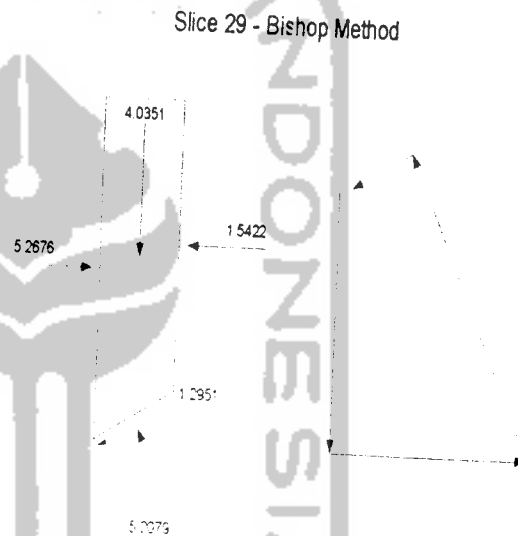
Slice 28 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	10.396
Pore Water Pressure	36.773
Pore Water Force	22.487
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	0.74915
Base Length	0.6115
Base Angle	23.949
Polygon Closure Error	0.30768
Anisotropic Strength Modifier	1
Weight	6.28
Base Shear Force	1.8458
Base Normal Force	7.6914
Left Side Normal Force	10.323
Right Side Normal Force	5.2676



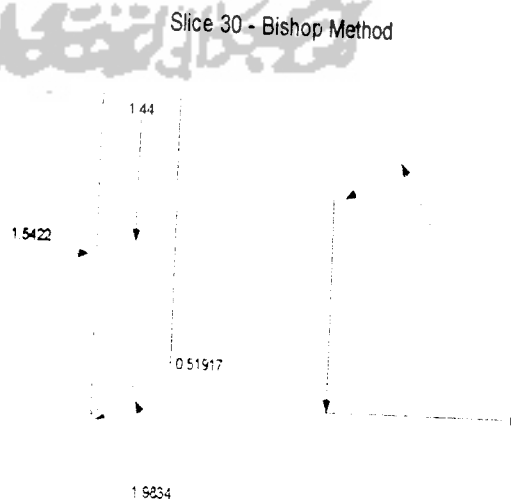
Slice 29 - Bishop Method

Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	10.69
Pore Water Pressure	34.146
Pore Water Force	21.471
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	0.48135
Base Length	0.6288
Base Angle	27.28
Polygon Closure Error	0.23436
Anisotropic Strength Modifier	1
Weight	4.0351
Base Shear Force	1.2951
Base Normal Force	5.2079
Left Side Normal Force	5.2676
Right Side Normal Force	1.5422

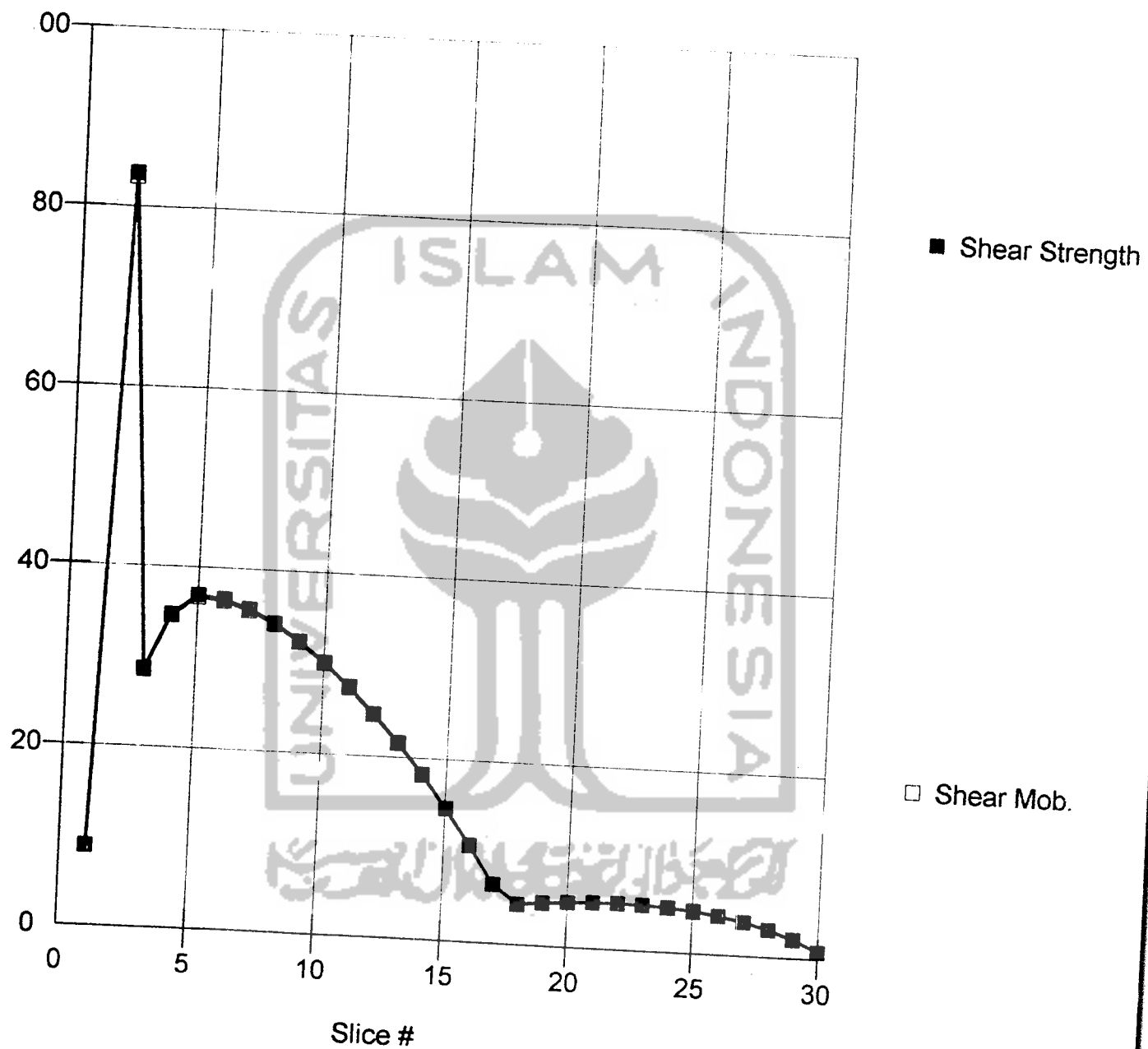


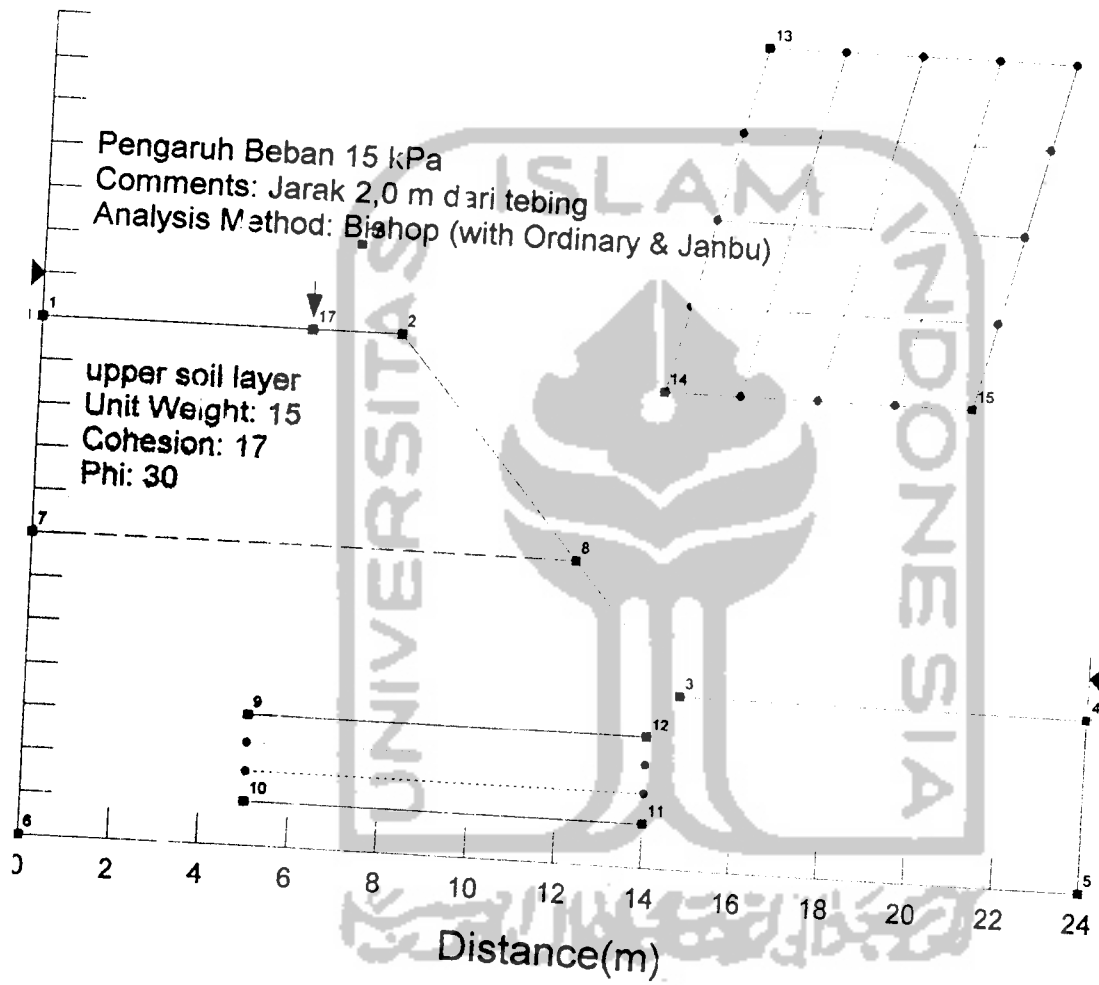
Slice 30 - Bishop Method

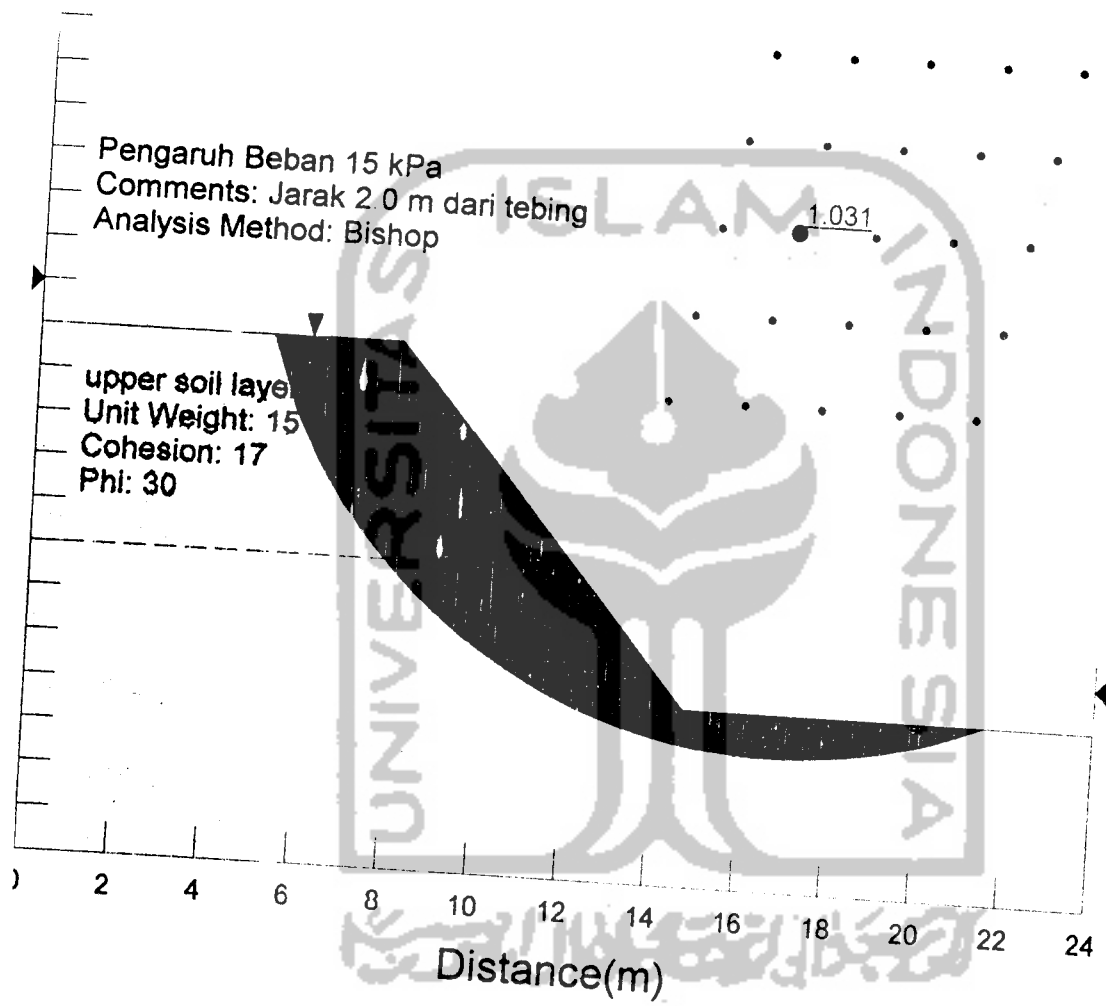
Factor of Safety	1.005
Phi Angle	30
C (Strength)	17
C (Force)	11.051
Pore Water Pressure	31.11
Pore Water Force	20.223
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.55886
Mid-Height	0.17178
Base Length	0.65005
Base Angle	30.716
Polygon Closure Error	0.089253
Anisotropic Strength Modifier	1
Weight	1.44
Base Shear Force	0.51917
Base Normal Force	1.9834
Left Side Normal Force	1.5422



Shear Resistance vs. Slice #



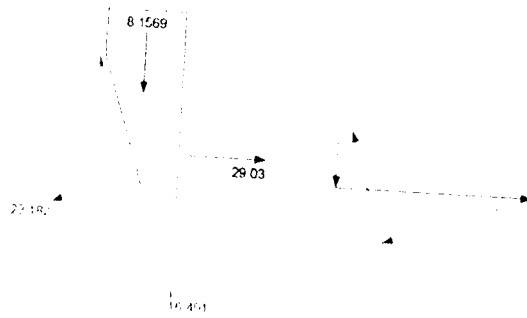




Slice 1 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	30.355
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.57379
Mid-Height	0.94772
Base Length	1.7856
Base Angle	71.256
Polygon Closure Error	2.0321
Anisotropic Strength Modifier	1
Weight	8.1569
Base Shear Force	16.491
Base Normal Force	23.182
Right Side Normal Force	29.03

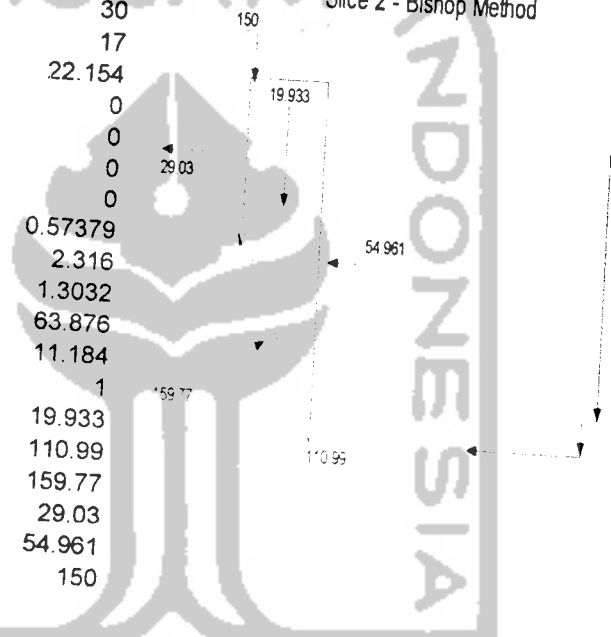
Slice 1 - Bishop Method



Slice 2 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	22.154
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.57379
Mid-Height	2.316
Base Length	1.3032
Base Angle	63.876
Polygon Closure Error	11.184
Anisotropic Strength Modifier	1
Weight	19.933
Base Shear Force	110.99
Base Normal Force	159.77
Left Side Normal Force	29.03
Right Side Normal Force	54.961
Line Load	150

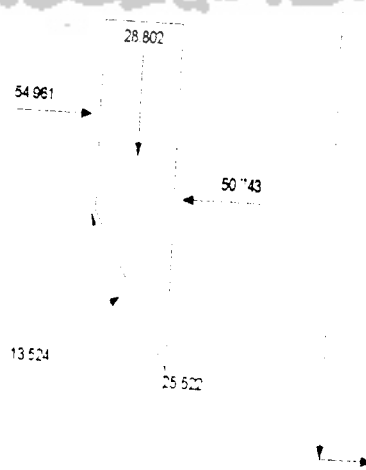
Slice 2 - Bishop Method



Slice 3 - Bishop Method

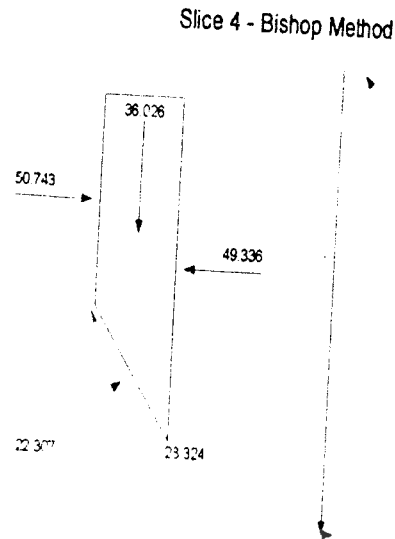
Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	18.493
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.57379
Mid-Height	3.3464
Base Length	1.0878
Base Angle	58.166
Polygon Closure Error	2.1802
Anisotropic Strength Modifier	1
Weight	28.802
Base Shear Force	25.522
Base Normal Force	13.524
Left Side Normal Force	54.961
Right Side Normal Force	50.743

Slice 3 - Bishop Method



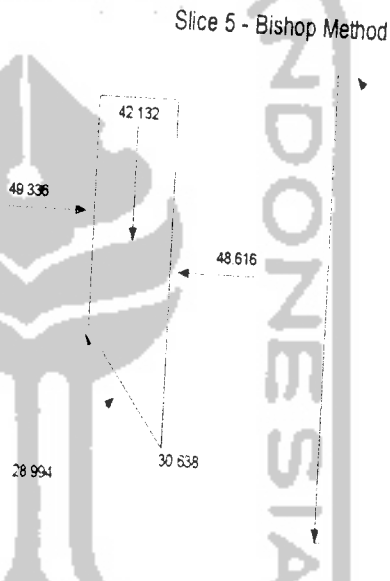
Slice 4 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	16.313
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.57379
Mid-Height	4.1857
Base Length	0.95959
Base Angle	53.277
Polygon Closure Error	2.1616
Anisotropic Strength Modifier	1
Weight	36.026
Base Shear Force	28.324
Base Normal Force	22.307
Left Side Normal Force	50.743
Right Side Normal Force	49.336



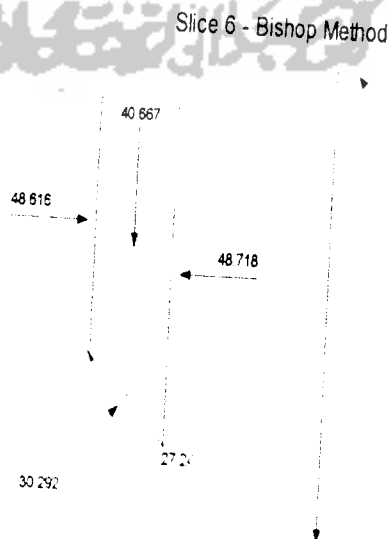
Slice 5 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	14.839
Pore Water Pressure	0
Pore Water Force	0
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.57379
Mid-Height	4.8952
Base Length	0.87286
Base Angle	48.901
Polygon Closure Error	2.3173
Anisotropic Strength Modifier	1
Weight	42.132
Base Shear Force	30.638
Base Normal Force	28.994
Left Side Normal Force	49.336
Right Side Normal Force	48.616



Slice 6 - Bishop Method

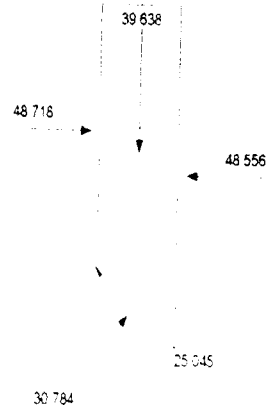
Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	12.617
Pore Water Pressure	4.7351
Pore Water Force	3.5142
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	5.1702
Base Length	0.74216
Base Angle	45.045
Polygon Closure Error	2.2367
Anisotropic Strength Modifier	1
Weight	40.667
Base Shear Force	27.24
Base Normal Force	30.292
Left Side Normal Force	48.616
Right Side Normal Force	48.718



Slice 7 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	11.921
Pore Water Pressure	9.5812
Pore Water Force	6.7184
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	5.0393
Base Length	0.70121
Base Angle	41.598
Polygon Closure Error	1.5855
Anisotropic Strength Modifier	1
Weight	39.638
Base Shear Force	25.045
Base Normal Force	30.784
Left Side Normal Force	48.718
Right Side Normal Force	48.556

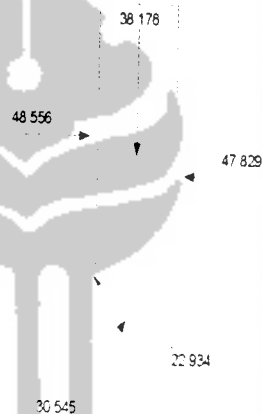
Slice 7 - Bishop Method



Slice 8 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	11.364
Pore Water Pressure	13.888
Pore Water Force	9.2834
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	4.8535
Base Length	0.66844
Base Angle	38.328
Polygon Closure Error	1.527
Anisotropic Strength Modifier	1
Weight	38.176
Base Shear Force	22.934
Base Normal Force	30.545
Left Side Normal Force	48.556
Right Side Normal Force	47.829

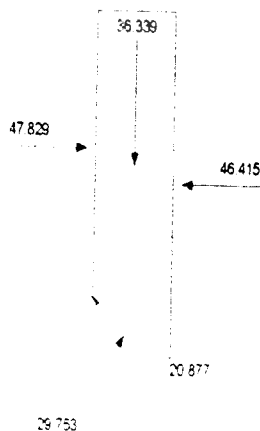
Slice 8 - Bishop Method



Slice 9 - Bishop Method

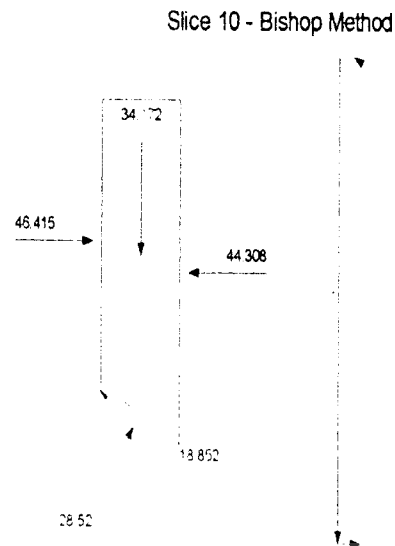
Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	10.909
Pore Water Pressure	17.727
Pore Water Force	11.376
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	4.62
Base Length	0.64171
Base Angle	35.2
Polygon Closure Error	1.2719
Anisotropic Strength Modifier	1
Weight	36.339
Base Shear Force	20.877
Base Normal Force	29.753
Left Side Normal Force	47.829
Right Side Normal Force	46.415

Slice 9 - Bishop Method



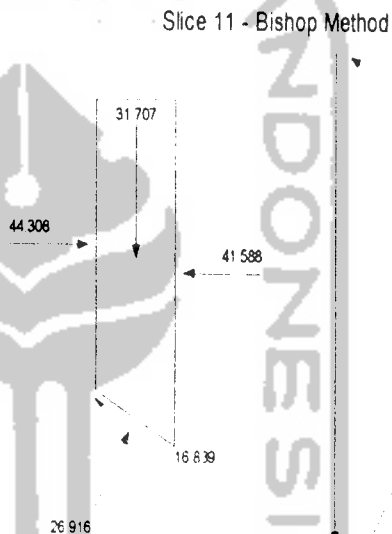
Slice 10 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	10.533
Pore Water Pressure	21.155
Pore Water Force	13.108
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	4.3445
Base Length	0.6196
Base Angle	32.189
Polygon Closure Error	1.196
Anisotropic Strength Modifier	1
Weight	34.172
Base Shear Force	18.852
Base Normal Force	28.52
Left Side Normal Force	46.415
Right Side Normal Force	44.308



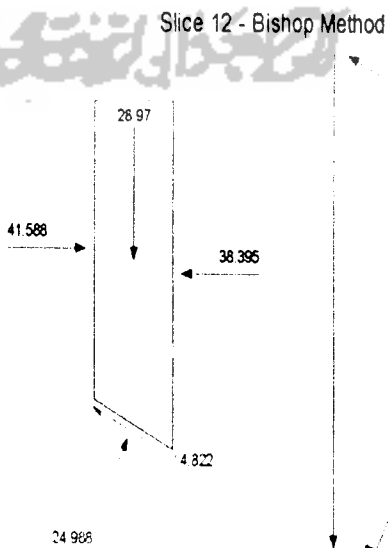
Slice 11 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	10.22
Pore Water Pressure	24.212
Pore Water Force	14.555
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52438
Mid-Height	4.0311
Base Length	0.60115
Base Angle	29.273
Polygon Closure Error	1.1097
Anisotropic Strength Modifier	1
Weight	31.707
Base Shear Force	16.839
Base Normal Force	26.916
Left Side Normal Force	44.308
Right Side Normal Force	41.588



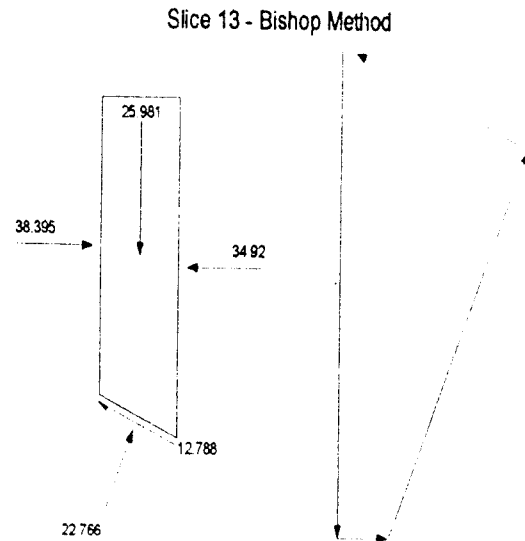
Slice 12 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	9.9557
Pore Water Pressure	26.928
Pore Water Force	15.77
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52437
Mid-Height	3.8831
Base Length	0.58563
Base Angle	26.44
Polygon Closure Error	1.0139
Anisotropic Strength Modifier	1
Weight	28.97
Base Shear Force	14.822
Base Normal Force	24.968
Left Side Normal Force	41.588
Right Side Normal Force	38.395



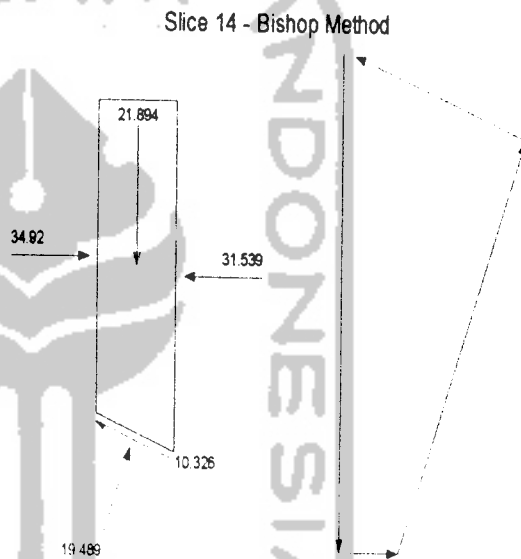
Slice 13 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	9.7336
Pore Water Pressure	29.333
Pore Water Force	16.795
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.52438
Mid-Height	3.3032
Base Length	0.57257
Base Angle	23.675
Polygon Closure Error	0.90934
Anisotropic Strength Modifier	1
Weight	25.981
Base Shear Force	12.788
Base Normal Force	22.766
Left Side Normal Force	38.395
Right Side Normal Force	34.92



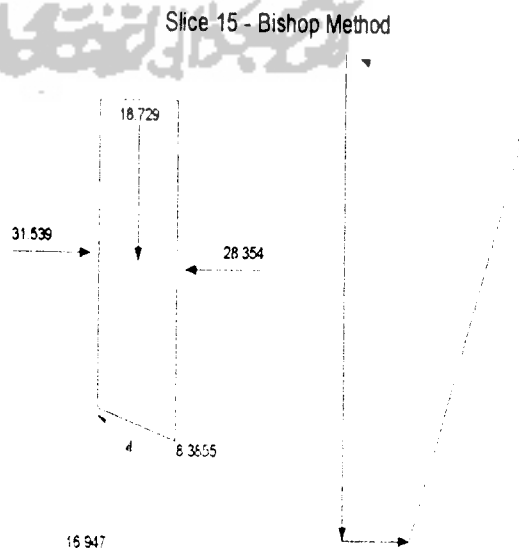
Slice 14 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	9.1607
Pore Water Pressure	31.403
Pore Water Force	16.922
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.9018
Base Length	0.53886
Base Angle	21.021
Polygon Closure Error	0.65682
Anisotropic Strength Modifier	1
Weight	21.894
Base Shear Force	10.326
Base Normal Force	19.489
Left Side Normal Force	34.92
Right Side Normal Force	31.539



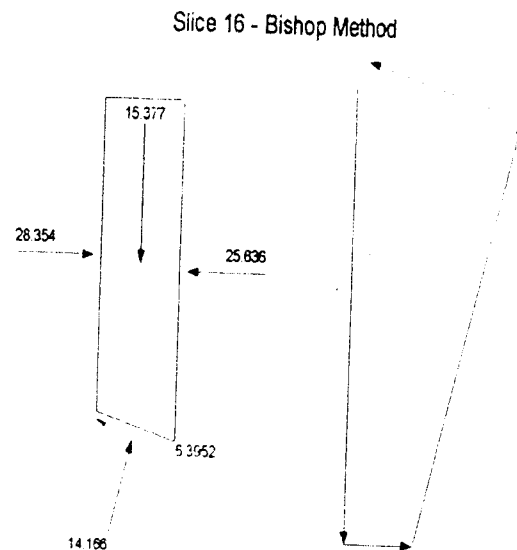
Slice 15 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	9.0153
Pore Water Pressure	33.173
Pore Water Force	17.592
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.4823
Base Length	0.53031
Base Angle	18.469
Polygon Closure Error	0.65552
Anisotropic Strength Modifier	1
Weight	18.729
Base Shear Force	8.3855
Base Normal Force	16.947
Left Side Normal Force	31.539
Right Side Normal Force	28.354



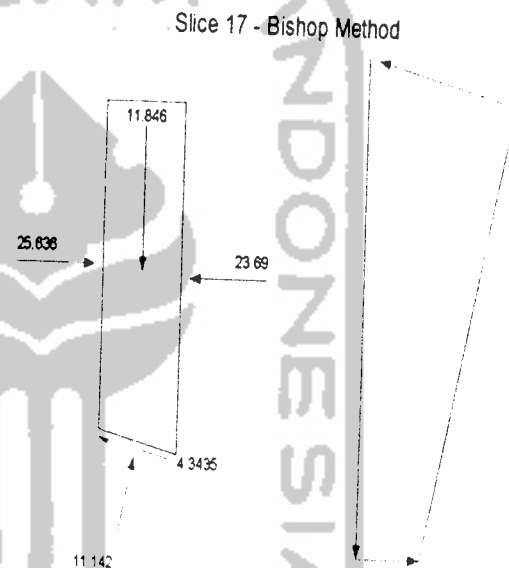
Slice 16 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	8.8935
Pore Water Pressure	34.699
Pore Water Force	18.153
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	2.038
Base Length	0.52315
Base Angle	15.953
Polygon Closure Error	0.46131
Anisotropic Strength Modifier	1
Weight	15.377
Base Shear Force	6.3952
Base Normal Force	14.166
Left Side Normal Force	28.354
Right Side Normal Force	25.636



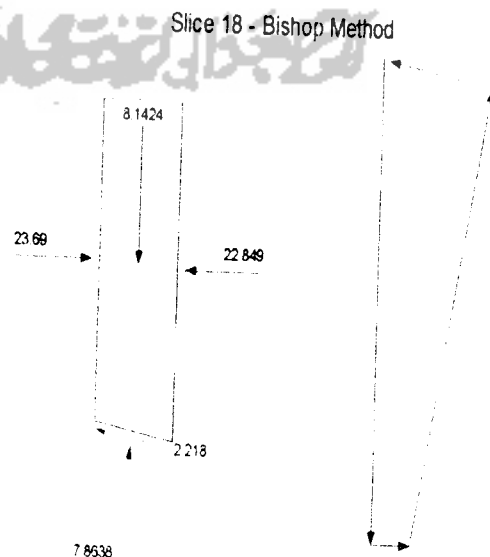
Slice 17 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	8.7928
Pore Water Pressure	35.996
Pore Water Force	18.618
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	1.5701
Base Length	0.51723
Base Angle	13.47
Polygon Closure Error	0.29615
Anisotropic Strength Modifier	1
Weight	11.846
Base Shear Force	4.3435
Base Normal Force	11.142
Left Side Normal Force	25.636
Right Side Normal Force	23.69



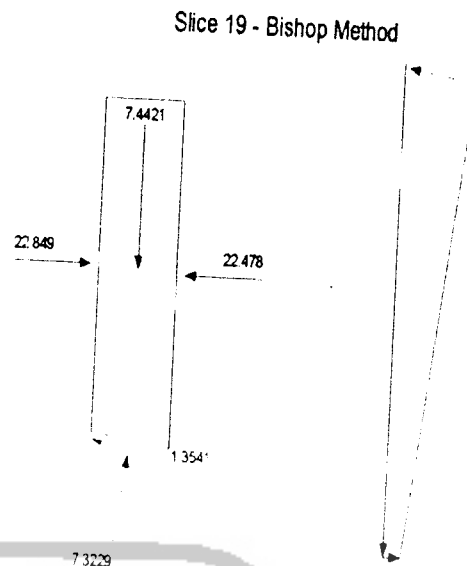
Slice 18 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	8.7114
Pore Water Pressure	37.064
Pore Water Force	18.993
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.503
Mid-Height	1.0792
Base Length	0.51243
Base Angle	11.011
Polygon Closure Error	0.12214
Anisotropic Strength Modifier	1
Weight	8.1424
Base Shear Force	2.218
Base Normal Force	7.8638
Left Side Normal Force	23.69
Right Side Normal Force	22.849



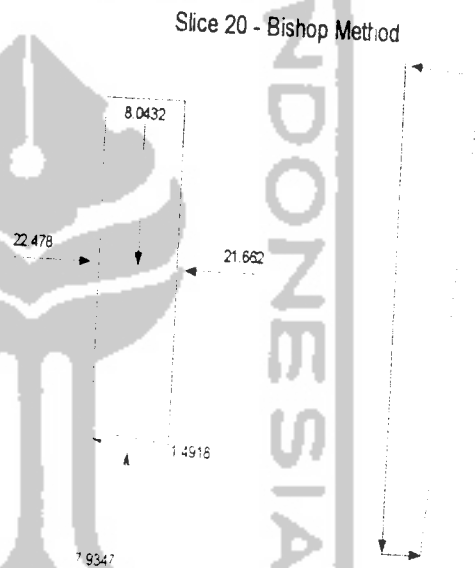
Slice 19 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	9.7894
Pore Water Pressure	37.967
Pore Water Force	21.863
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.56965
Mid-Height	0.87095
Base Length	0.57585
Base Angle	8.4129
Polygon Closure Error	0.074421
Anisotropic Strength Modifier	1
Weight	7.4421
Base Shear Force	1.3541
Base Normal Force	7.3229
Left Side Normal Force	22.849
Right Side Normal Force	22.478



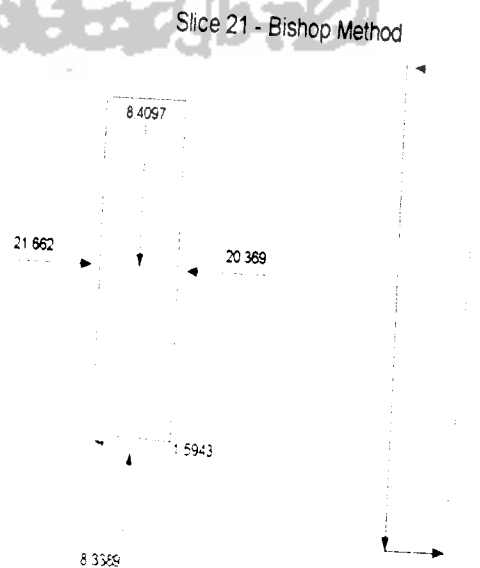
Slice 20 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	9.7319
Pore Water Pressure	38.656
Pore Water Force	22.129
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.56966
Mid-Height	0.9413
Base Length	0.57246
Base Angle	5.6713
Polygon Closure Error	0.12065
Anisotropic Strength Modifier	1
Weight	8.0432
Base Shear Force	1.4918
Base Normal Force	7.9347
Left Side Normal Force	22.478
Right Side Normal Force	21.662

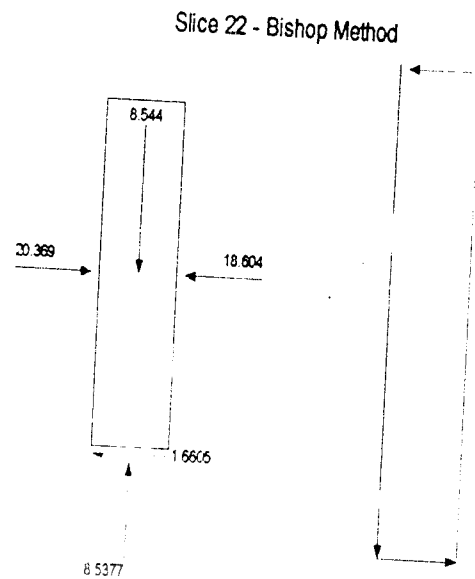


Slice 21 - Bishop Method

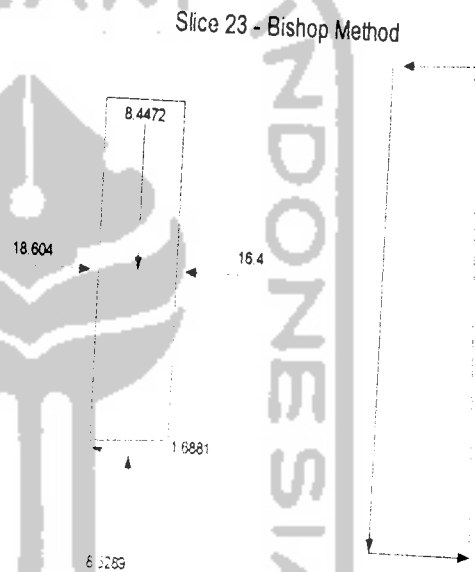
Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	9.6968
Pore Water Pressure	39.078
Pore Water Force	22.29
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.56965
Mid-Height	0.98419
Base Length	0.5704
Base Angle	2.9427
Polygon Closure Error	0.16819
Anisotropic Strength Modifier	1
Weight	8.4097
Base Shear Force	1.5943
Base Normal Force	8.3389
Left Side Normal Force	21.662
Right Side Normal Force	20.369



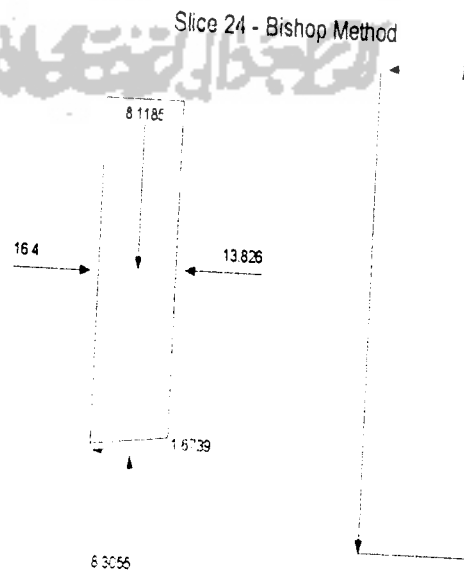
Slice 22 - Bishop Method	
Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	9.6841
Pore Water Pressure	39.231
Pore Water Force	22.348
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.56965
Mid-Height	0.99991
Base Length	0.56965
Base Angle	0.22076
Polygon Closure Error	0.17088
Anisotropic Strength Modifier	1
Weight	8.544
Base Shear Force	1.6605
Base Normal Force	8.5377
Left Side Normal Force	20.369
Right Side Normal Force	18.604



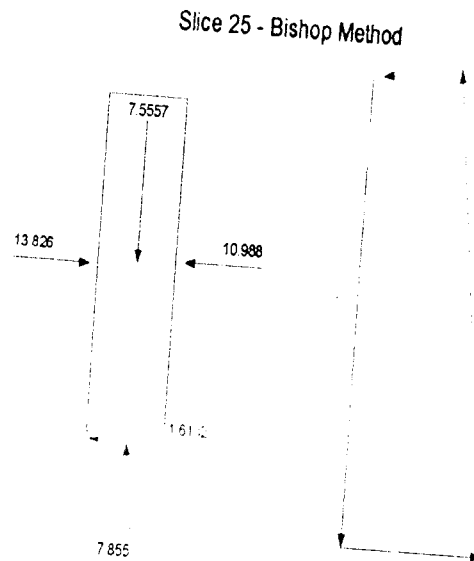
Slice 23 - Bishop Method	
Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	9.6933
Pore Water Pressure	39.12
Pore Water Force	22.306
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.56965
Mid-Height	0.98858
Base Length	0.57019
Base Angle	2.5008
Polygon Closure Error	0.21322
Anisotropic Strength Modifier	1
Weight	8.4472
Base Shear Force	1.6881
Base Normal Force	8.5289
Left Side Normal Force	18.604
Right Side Normal Force	16.4



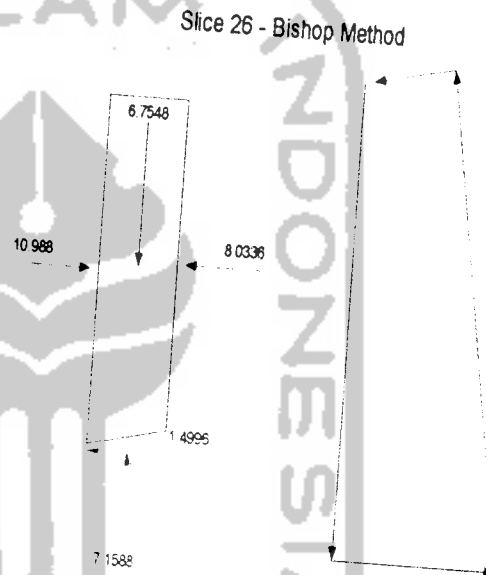
Slice 24 - Bishop Method	
Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	9.7247
Pore Water Pressure	38.742
Pore Water Force	22.162
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.56966
Mid-Height	0.95011
Base Length	0.57204
Base Angle	5.2278
Polygon Closure Error	0.16811
Anisotropic Strength Modifier	1
Weight	8.1185
Base Shear Force	1.6739
Base Normal Force	8.3055
Left Side Normal Force	16.4
Right Side Normal Force	13.825



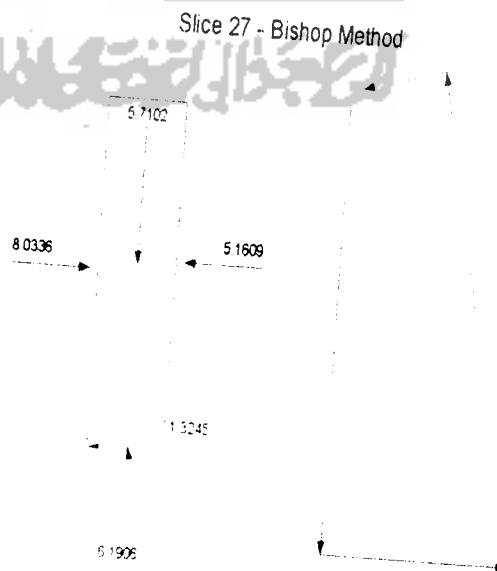
Slice 25 - Bishop Method	
Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	9.7784
Pore Water Pressure	38.096
Pore Water Force	21.913
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.56965
Mid-Height	0.88425
Base Length	0.5752
Base Angle	7.967
Polygon Closure Error	0.19637
Anisotropic Strength Modifier	1
Weight	7.5557
Base Shear Force	1.6132
Base Normal Force	7.855
Left Side Normal Force	13.826
Right Side Normal Force	10.988



Slice 26 - Bishop Method	
Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	9.8562
Pore Water Pressure	37.178
Pore Water Force	21.555
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.56965
Mid-Height	0.79052
Base Length	0.57978
Base Angle	10.725
Polygon Closure Error	0.17897
Anisotropic Strength Modifier	1
Weight	6.7548
Base Shear Force	1.4996
Base Normal Force	7.1588
Left Side Normal Force	10.988
Right Side Normal Force	8.0336

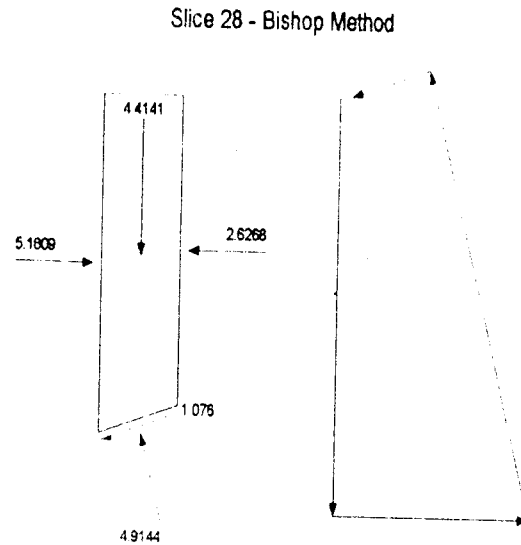


Slice 27 - Bishop Method	
Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	9.9596
Pore Water Pressure	35.978
Pore Water Force	21.078
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.56965
Mid-Height	0.66827
Base Length	0.58586
Base Angle	13.508
Polygon Closure Error	0.18572
Anisotropic Strength Modifier	1
Weight	5.7102
Base Shear Force	1.3245
Base Normal Force	6.1906
Left Side Normal Force	8.0336
Right Side Normal Force	5.1609



Slice 28 - Bishop Method

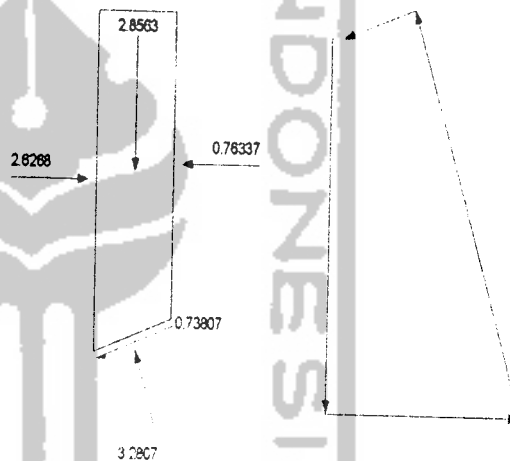
Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	10.091
Pore Water Pressure	34.49
Pore Water Force	20.473
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.56966
Mid-Height	0.51658
Base Length	0.59359
Base Angle	16.323
Polygon Closure Error	0.14743
Anisotropic Strength Modifier	1
Weight	4.4141
Base Shear Force	1.076
Base Normal Force	4.9144
Left Side Normal Force	5.1609
Right Side Normal Force	2.6268



Slice 29 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	10.253
Pore Water Pressure	32.703
Pore Water Force	19.724
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.56965
Mid-Height	0.33427
Base Length	0.60313
Base Angle	19.181
Polygon Closure Error	0.11482
Anisotropic Strength Modifier	1
Weight	2.8563
Base Shear Force	0.73807
Base Normal Force	3.2807
Left Side Normal Force	2.6268
Right Side Normal Force	0.76337

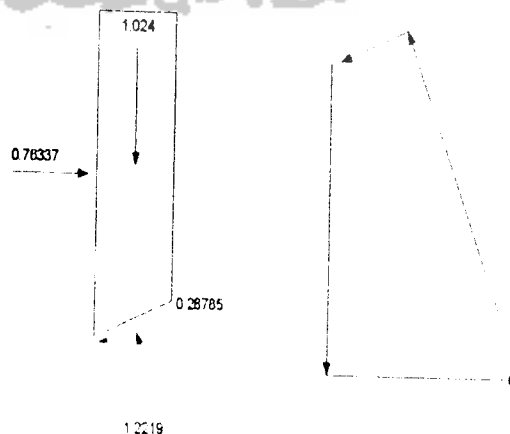
Slice 29 - Bishop Method



Slice 30 - Bishop Method

Factor of Safety	1.031
Phi Angle	30
C (Strength)	17
C (Force)	10.451
Pore Water Pressure	30.6
Pore Water Force	18.812
Pore Air Pressure	0
Pore Air Force	0
Slice Width	0.56965
Mid-Height	0.11984
Base Length	0.61477
Base Angle	22.089
Polygon Closure Error	0.036657
Anisotropic Strength Modifier	1
Weight	1.024
Base Shear Force	0.28785
Base Normal Force	1.2219
Left Side Normal Force	0.76337

Slice 30 - Bishop Method



Shear Resistance vs. Slice #

