BAB VI

KESIMPULAN

6.1. Kesimpulan

Berdasarkan kepada hasil penelitian, analisa dan pembahasan yang dilakukan oleh penulis didapat kesimpulan sebagai berikut:

Runway pada Bandara Tanah Merah mampu didarati pesawat terbang F-27 dan sejenisnya setelah dikembangkan (Gambar 6.1). Adapun data teknis adalah sebagai berikut:

1. Tipe *non-instrument runway* 3 C

	Kondisi Awal	Hasil Rancangan
Dimensi *runway*	1050 m x 20 m	1300 m x 30 m
Dimensi *taxiway*	70 m x 15 m	55 m x 23 m
Dimensi apron	60 m x 40 m	80 m x 50 m

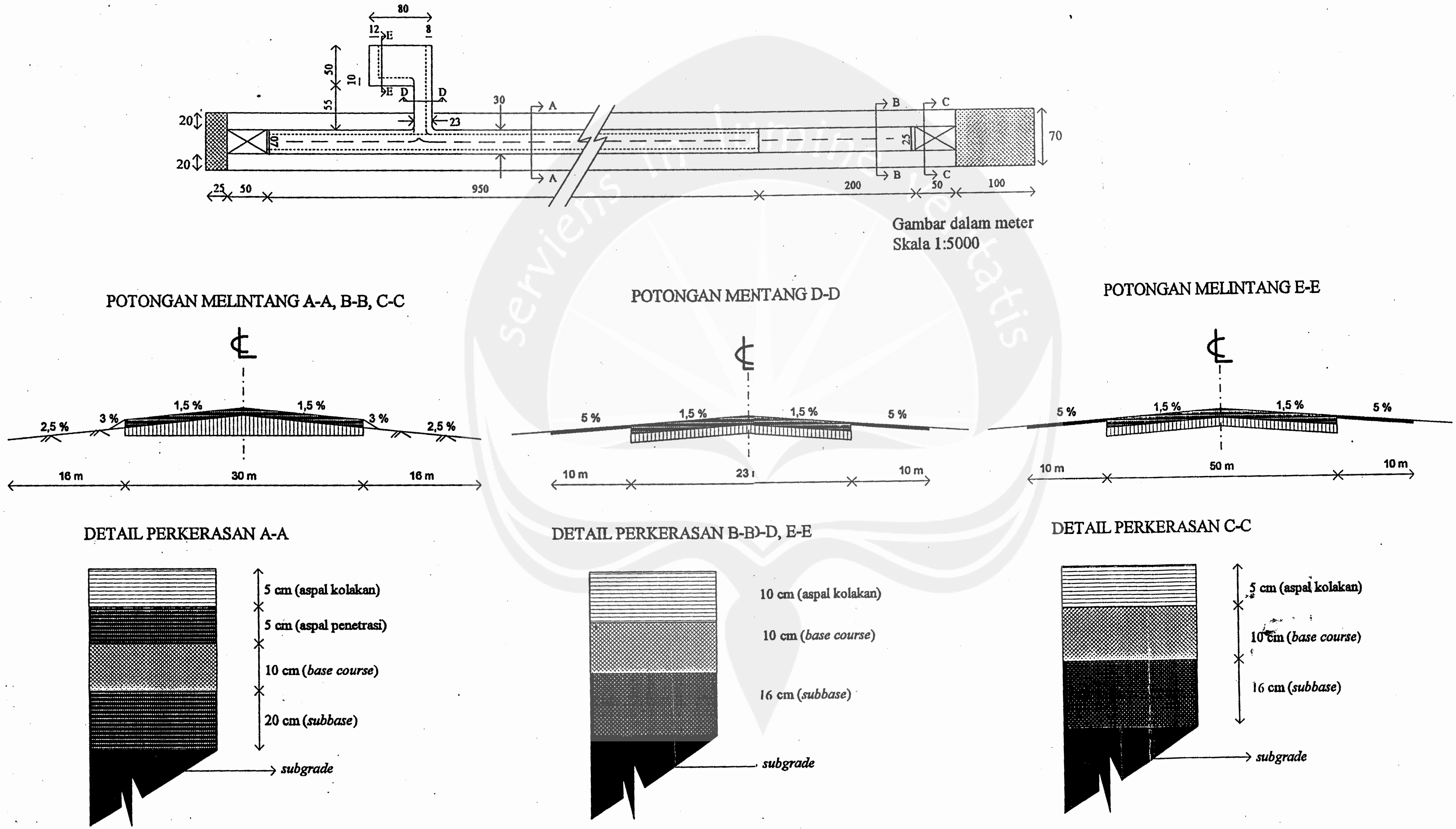
- Overrun 07 : 50 m
- Overrun 25 : 50 m
- Lebar *shoulder* : 20 m (kiri) + 20 m (kanan)
- Lebar strip : 150 m

	Memanjang	Melintang
Kemiringan: *Runway*	0,10 %	1,5 %
Shoulder	0,10 %	2,5 %
Taxiway	0,10 %	1,5 %
Apron	0,5 %	0,5 %

2. Konstruksi perkerasan *runway*, *taxiway* dan apron yang telah ada masih mampu memenuhi persyaratan untuk melayani operasional penerbangan pesawat sejenis F-27.

6.2. Saran

1. Perlunya pemahaman istilah-istilah asing yang berkaitan dengan perencanaan suatu Bandar Udara sehingga akan dihasilkan suatu perencanaan yang mudah dipahami oleh pelaksana pembangunan.
2. Kelengkapan data-data yang diperlukan dalam perhitungan perencanaan suatu Bandar Udara perlu diperhatikan.



Gambar 6.1. *Runway* Bandara Tanah Merah

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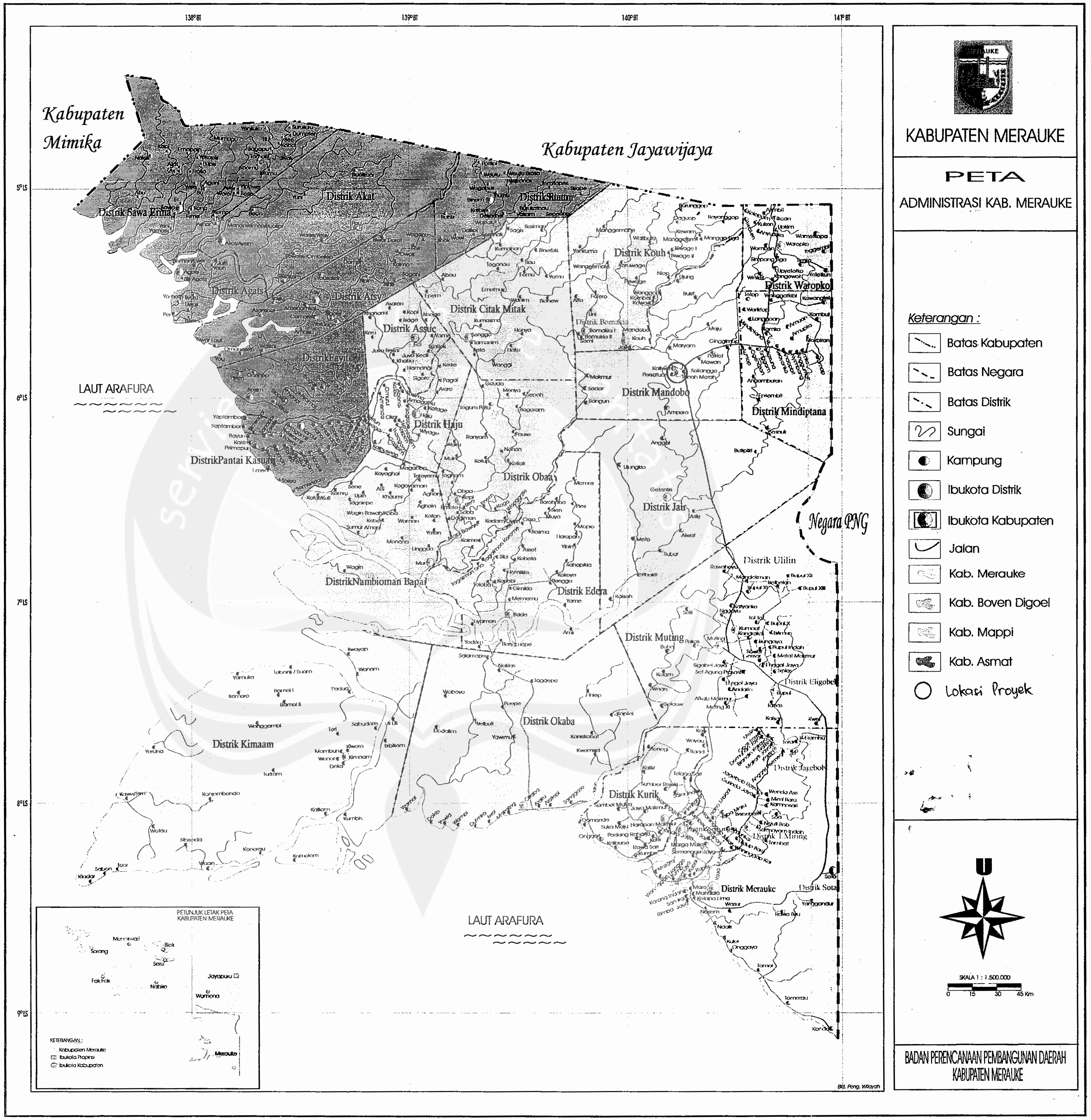
LAY OUT BANDAR UDARA TANAH MERAH PAPUA

1 : 2.000

Lampiran 1
Hal 100



DEPARTEMEN PERHUBUNGAN
DIREKTORAT JENDERAL PERHUBUNGAN UDARA
BANDAR UDARA TANAH MERAH

I . INFORMASI UMUM BANDAR UDARA

. NAMA KOTA : TANAH MERAH
. BANDAR UDARA : TANAH MERAH
. KELAS BANDARA : IV
. PENGELOLA : DITJEN . PERHUBUNGAN UDARA
. JAM OPERASI : 07.00 - 17.00 WIT
. KLASIFIKASI OPERASI : UN ATTENDED
. KEMAMPUAN OPERASI : DHC-6 / HS-748
. PELAYANAN KLLU : TIDAK ADA
. KATEGORI PKP - PK : 1 (satu)
0. KOORDINAT LOKASI : 06.0707 S - 140.16 E
1. ELEVASI : 18 M / 83 FT
2. DPPU : TIDAK ADA
3. METEO : ADA
4.JARAK BANDARA KE KOTA TERDEKAT : DALAM KOTA
5. TERMASUK - PROVINSI : P A P U A
- KABUPATEN : BOVEN DIGOEL
- KECAMATAN : TANAH MERAH

6. ALAMAT : JL. AIRPORT TANAH MERAH
7. KODE :
ICAO : WAKT
IATA : TMH

II . DATA PERSONALIA DAN PERUMAHAN

. **PERSONALIA**

1 . KEPALA BANDAR UDARA : SUTRISNO SUMARDJO
NIP : 120092729
PANGKAT/GOLONGAN : PENATA MUDA TK.1 III/b
INSTANSI : BANDAR UDARA TANAH MERAH
DIREKTORAT JENDERAL PERHUBUNGAN
UDARA

2 . JUMLAH PERSONALIA BANDARA
a . **TENAGA ADMINISTRASI**
1. GOLONGAN IV : - orang
2. GOLONGAN III : - orang
3. GOLONGAN II : - orang
4. GOLONGAN I : - orang

b . **TENAGA TEKNISI**

1. GOLONGAN IV	:	-	orang
2. GOLONGAN III	:	1	orang
3. GOLONGAN II	:	1	orang
4. GOLONGAN I	:	-	orang

c. **TENAGA OPERASIONAL**

1 . GOLONGAN IV	:	-	orang
2 . GOLONGAN III	:	-	orang
3 . GOLONGAN II	:	4	orang
4 . GOLONGANN I	:	1	orang

3 . PENDIDIKAN

a. SARJANA	:	-	orang
b. SARJANA MUDA	:	-	orang
c. SLTA	:	3	orang
d. SLTP	:	1	orang
e. SD	:	4	orang

B . PERUMAHAN

-TYPE 70	:	2	UNIT
- TYPE 50	:	2	UNIT

III . FASILITAS BANDAR UDARA

A . FASILITAS LANDASAN

1. LANDASAN

A . Ukuran	: 1050 m X 20 m
B . Konstruksi	: Aspal Kolakan
C . Arah	: 07 / 25

2 . SHOULDER SISI I	: 1.100 m X 21 m
3 . SHOULDER SISI II	: 1.100 m X 21 m
4 . TAXIWAY	: 70 m X 15 m
5 . APRON	: 60 m X 20 m
6 . OVER RUN	: 50 m X 50 m
7 . KEMAMPUAN	: DHC - 6 TWIN OTTER/ HS- 748

B .FASILITAS BANGUNAN

1. BANGUNAN TERMINAL	: 12 X 10 = 120 m2
2. GEDUNG OPERASIONAL	
GEDUNG KANTOR	: 20 X 6 = 120 m2
3. GEDUNG NDB	: 6 X 4 = 24 m2
4. GEDUNG GENSET	: 8 X 6 = 48 m2
5. GEDUNG PKP - PK	: Tidak ada

EVALUASI DATA & INFORMASI AERONAUTIKA BANDAR UDARA

I. UMUM

1. Nama Derah / Kota / Provinsi : Tanah Merah, Boven Digoel , Papua
2. Nama Bandar Udara : Tanah Merah
3. Kelas Bandar Udara : IV
4. Pengelola : Direktorat Jenderal Perhubungan Udara
5. Jam Operasi : 07.00 - 17.00 WIT
6. Klasifikasi Operasi : UN ATTENDED
7. Kemampuan Operasi : DHC-6 / HS - 748
8. Koordinat ARP : 06.07.07.S - 40.16 E
9. Temperatur Rata-Rata / Tahun : -
10. Elevasi Aerodrome : 18 M / 83 FT
11. Jarak dari Kota : DALAM KOTA
12. Alamat Bandar Udara : JLN. AIRPORT TANAH MERAH
13. Nomor Telepon & Facsimili : (0975) 31097

II. FASILITAS AREA PERGERAKAN PESAWAT

1. Runway (RWY)
   - a. RWY Designation/Azimuth : 07 dan 25
   - b. Dimension (Lenght x Width) : 1050 M X 20 M
   - c. Strength : DHC-6 / HS. 748
   - d. Longitudinal slope dari RWY : -
     - 0 s/d 100 m : -
     - 100 s/d 200 m : -
     - 200 s/d 300 m : -
     - 300 s/d 1400 m : -
     - 1400 s/d 1460 m : -
     - 1600 s/d 1870 m : -
     - 1870 s/d 2220 m : -
   - e. Surface : Aspal Kolakan

2. Stopway (SWY)
   - a. Dimension (lenght x Width) : -
   - b. Longitudinal Slope : -
   - c. Strength : -
   - d. Surface : -

3. Taxiway (TWY)
   - a. Dimension (lenght x Width) : 70 M X 15 M
   - b. Strength : DHC-6
   - c. Surface : Aspal ~~[illegible]~~ Kolakon
   - d. Rapid Exit TWY : -
   - e. TWY on Bridges : -

4. Apron
   a. Dimension (Length x Width) : 60 M x 40 M.
   b. Distance between Edge of RWY and Edge Of Apron : 70 M
   c. Surface : Aspal ~~Penetrasi~~ Kolakan
   d. Strength : DHC-6 / HS - 748

5. RWY Strip
   a. Dimension (lenght x Width) : 1.100 M x 62 M
   b. Surface : Rumput
   c. Slope :

6. RWY Shoulder
   a. Dimension (Lenght x Width) : 2 x (1.100 M x 21 M)
   b. Surface : Rumput

7. Turning Area
   a. Surface : -
   b. Strength : -

III. MARKINGS :

1. RWY Marking
   a. RWY Designation Marking : -
   b. Threshold Marking : -
   c. RWY Center Line Marking : -
   d. RWY Edge Marking : -
   e. Fixed Distance Marking : -
   f. Touch Done Zone Marking : -
   g. RWY Side Strip Marking : -

2. TWY Marking
   a. TWY Center Line Marking / Nosewheel Line Marking : -
   b. Taxi Holding Position Marking : -
   c. Taxiway Intersection Marking : -
   d. Holding Bays and Taxi Holding Position : -

3. Apron :
   a. Apron Edge Line Marking : -
   b. Traffic Line Marking : -
   c. Clearance Distance on Aircraft Stand : -

IV. OBSTRUCTIONS :

1. Obstructions within Take Off/Approach Area :
   a. RWY .... : Distance .... ; Height .... & Slope ....
   b. RWY .... : Distance ....; Height .... & Slope ....

1 . TELEKOMUNIKASI

NO	N A M A	MERK/TYPE	FREQ .	MULAI OPERASI	JML	KONDISI
1.	Single Side Band	SBX-100 EX/KARNA	-6811.2 KHZ -6886 KHZ -5863 KHZ -5782 KHZ	07.00-17.00	1	60 % (BAIK)
2	VHF TRANSCEIVER	DITTEL/ FSG.71.MPC	122.1 MHZ	-	1	RUSAK BERAT

2 . NAVIGASI

NO	N A M A	MERK/TYPE	FREQ .	MULAI OPERASI	J M L	KONDISI
1.	NON DIRECTION BEACON(NDB)	NAUTEL/ ND.200S	295 KHZ	07.00 -17.00	2 UNIT	75 %(BAIK)
2	BEACON MONITOR RECEIVER	NAUTEL	295 KHZ	07.00- 17.00	1 UNIT	75% (BAIK)

3. PERALATAN LISTRIK

NO	N A M A	MERK/TYPE	KAPASITAS	VOLT	MULAI OPERASI	JUMLAH	KONDISI
1	GENSET	YANMAR TF 105 -	5 KVA	220	1994	1 UNIT	65 % (BAIK)
2	SOLAR CELL		-		1991,1994, 1998	3 UNIT	1UNIT RUSAK 2 UNIT BAIK

D . PERALATAN LAIN-LAIN

1 . PERALATAN VISUAL AIDS

NO	NAMA PERALATAN	MERK/TYPE	KAPASITAS	VOLT .	MULAI OPERASI	JUMLAH	KONDISI
1	WIND SOCK	-	-	-	-	1	BAIK

-	-	-	-	-	-

3 . PERALATAN PKP – PK

NO	N A M A	MERK/TYPE	KEMAMPUAN	MULAI OPERASI	JUMLAH	KONDISI
1	FORTABLE	ALPINDO	MULTYPURPOSE	1993	1 BUAH	60 % (BAIK)
2	FORTABLE	YAMATO	MULTYPURPOSE	1997	1 BUAH	60 % (BAIK)

4. PERALATAN PEMELIHARAAN BANDAR UDARA

NO	N A M A	MERK/TYPE	MULAI OPERASI	JUMLAH	KONDISI
1	MOWER TRACTOR	YANMAR	1999	1 UNIT	BAIK
2	MESIN POTONG RUMPUT		1992'1999	5 UNIT	3 RUSAK 2 BAIK

5 . JALAN DAN TEMPAT PARKIR KENDARAAN

NO	JALAN DAN TEMPAT PARKIR	KONSTRUKSI	TAHUN PEMBUATAN	LUAS (M2)	KONDISI
-	-	-	-	-	-

IV .. ANGGARAN PEMBANGUNAN DAN RUTIN

A. PEMBANGUNAN

1. FASILITAS BANDAR UDARA

DIP TAHUN	K E G I A T A N	BIAYA (000)	REALISASI (%)	
			FISIK	KEUANGAN
2000	-	-	-	-
2001	-	-	-	-
2002	-	-	-	-
2003	-	-	-	-

2 FASILITAS KESELAMATAN PENERBANGAN

DIP TAHUN	KEGIATAN	BIAYA (000)	REALISASI (%) FISIK	REALISASI (%) KEUANGAN
2000	-	-	-	-
2001	-	-	-	-
2002	-	-	-	-
2003	-	-	-	-

3 . ARMADA UDARA PERINTIS

DIP TAHUN	KEGIATAN	BIAYA (000)	REALISASI (%) FISIK	REALISASI (%) KEUANGAN
2000	-	-	-	-
2001	-	-	-	-
2002	-	-	-	-
2003	-	-	-	-

RUTIN

NO	URAIAN	2000 PAGU	2000 REALISASI	2001 PAGU	2001 REALISASI	2002 PAGU	2002 REALISASI
1	BELANJA PEGAWAI					128.676.000	200.126.843
2	BELANJA BARANG					34.808.000	34.837.570
3	BELANJA PEMELIHARAAN					42.849.000	42.849.000
4	BELANJA PERJALANAN					5.200.000	5.200.000
	JUMLAH					211.533.000	283.013.413

V . DATA STATISTIK DAN KAPASITAS PELAYANAN

A . DATA STATISTIK

TAHUN	PESAWAT	PENUMPANG	BARANG (Kg)	BAGASI (Kg)	POS (Kg)
2000	-	-	-	-	-
2001	-	-	-	-	-
2002	-	-	-	-	-
2003	118	1.603	-	11.179	99

B . FREKUENSI PERGERAKAN PESAWAT

INTERNASIONAL

PESAWAT	TUJUAN	OPERATOR	FREKUENSI/ MINGGU
2000	. -	. -	-
2001			-
2002	-	-	-
2003	-	-	-
	-		

DOMESTIK

PESAWAT	TUJUAN	OPERATOR	FREKUENSI/ MINGGU
2000	-	-	-
2001	-	-	-
2002	(TANAH MERAH) - (MERAUKE)	-	-
2003	WAKT - WAKK	MNA	3 X SEMINGGU
	WAKT - WAJJ	MNA	2 X SEMINGGU
	(TANAH MERAH) - SENTANI JAYAPURA		

V. PERALATAN NAVIGASI

a. Non Direction Beacon (NDB)

a. Location : TANAH MERAH
b. Coordinate : -
c. Function :
d. Emission :
e. Frequency : 295 KHZ
f. Dual / Single Set : Single
g. Power Out Put : -
h. Coverage : -
i. Main Power Source : Solar Cell
j. Standby Gen Set :
k. Tgl. Commissioning Flight Check berikutnya :
l. Tgl. Periodical Flight Check tearakhir :
m. Operating Hours : 07.00 - 17.00 WIT
n. Instrument Approach Procedure : -

b. D V O R

a. Location : -
b. Coordinate : -
c. Call Sign / Identification : -
d. Frequency : -
e. Coverage : -
f. Dual / Single Set : -
g. Main Power Source : -
h. Power Out Put : -
i. Standby Gen Set : -
j. Tgl. Commissioning Flight Check berikutnya : -
k. Tgl. Periodical Flight Check tearakhir : -
l. Classification Status : -
m. Operating Hours : -
n. Procedure Approach / Take Off : -

c. D M E

a. Location : -
b. Coordinate : -
c. Call Sign / Identification : -
d. Frequency : -
e. Coverage : -
f. Dual / Single Set : -
g. Main Power Source : -
h. Power Out Put : -
i. Standby Gen Set : -
j. Tgl. Commissioning Flight Check berikutnya : -
k. Tgl. Periodical Flight Check tearakhir : -
l. Classification Status : -
m. Operating Hours : -
n. Procedure Approach / Take Off : -

4. ILS (Instrument Landing System)
   a. Location (SEL/LOC 3000 German) Freq. : -
   b. Glide Slope (SEL/GS 3000 German) Freq. : -
   c. Middle Marker(SEL/M 3000 German) Freq. : -
   d. Out Marker (SEL/M 3000 German) Freq. : -

5. Wind Direction Indicator : WIND SOCK

6. Type of Flight Procedure :

VI. LIGHTINGS

1. Signaling Lamp : -
2. Aerodrome Beacon : -
3. Approach Lighting System : -
4. VASI System : -
5. Circling Guidance Light : -
6. RWY Lead-in Lighting System : -
7. RWY Threshold Identification Light : -
8. RWY Edge Light : -
9. RWY Threshold and Wing Bar Light : -
10. RWY Center Line Light : -
11. RWY Touchdown Zone Light : -
12. SWY Light : -
13. TWY Center Line Light : -
14. TWY Edge Light : -
15. Taxi Holding Position Light : -
16. Visual Guidance System : -

VII. FASILITAS KOMUNIKASI

1. Aeronautical Mobile Service) AMS)
   1.1. MWRA (Major World Air Route Area) : -
   1.2. RDARA (Regional Domestic Air Route Area)/FSS (Flight Service Station)
      a. Call Sign : -
      b. Frequency : -
         - Emergency Frequency : -
      c. Operating Hours : -
      d. Coordinate Link : -
         - Direct Link : -
         - Intercom : -
   1.3. AFIS (Aerodrome Flight Information Service) : SSB

2. Aeronautical Fixed Service (AFS)
   2.1 Teletype : -
      a. Operating Hours : -
      b. Main Power Source : -
      c. Standby Power Source : -
      d. Automatic / Manual : -
      e. Network Station : -

2.2. Fixed Voice Radiotelephony (PTP):

a. Operating Hours : -
b. Main Power Source : -
c. Standby Power Source : -
d. Frequency : -
e. Network Station : -

3. Aerodrome Control Tower
   a. Operating Hours : -
   b. VHF A/G COMM : -

4. Area Control Center (ACC)
   a. Operating Hours : -
   b. VHF A/G COMM : -
   c. Standby VHF A/G COMM : -

5. Approach Control Office (APP)
   d. Operating Hours : -
   e. VHF A/G COMM : -
   f. Standby VHF A/G COMM : -

6. APP / ACC RADAR
   a. Operating Hours : -
   b. VHF A/G COMM : -
   c. Standby VHF A/G COMM : -
   d. SSR : -
   e. PSR : -

VIII. FASILITAS METEOROLOGI

1. Jenis Pelayanan : Pelayanan Penerbangan
2. Lokasi Kantor Meteorologi : Tanah Merah

IX. FASILITAS PELAYANAN INFORMASI AERONAUTIKA

1. Briefing Office Equipment :
   a. Flight Plan Sheet : -
   b. Telex : -
   c. Facsimile : -
   d. Telephone : -

2. Pre-Flight Information Service :
   a. Physical Layout of Briefing Room : -
   b. Pre-Flight Information Bulletin (PIB) Type : -
   c. Charts :
      1. Aerodrome Chart : -
      2. En Route Chart : -
      3. Navigation Warning Chart : -
      4. ONC/TPC/JOG/other Base Map : -

3. Coordination (with name of unit)
   a. ATS Unit : -
   b. Military : Koramil
   c. Operator / Airlines : Agen MNA
   d. Meteorology : Meteorologi & Geofisika
   e. Others : Polsek

4. Basic Reference Material : -
   a. AIP Indonesia : -
   b. Others State AIP : -
   c. AIS operating Instruction : -
   d. ANNEX 15 dan UU No.15 : -
   e. ICAO Doc : -
   f. Dokumen lain : -

X. FASILITAS OPERASI PKP-PK

1. Kategori : 1
2. Jenis Fasilitas : Fortable

XI. FASILITAS REFUELING

1. Jenis Fuel : Aftur
2. Kapasitas yang tersedia : 144 Drum (Pengadaan Proyek Perintis)

XII. SUMBER DAYA MANUSIA

1. Jumlah personil yang berdinas/menangani briefing office :
2. Klasifikasi personil :
   a. AIS : -
   b. Non AIS : -

Lokasi : TANAH MERAH, BOVEN DIGOEL, PAPUA

Tgl/Bln/Thn : 21 AGUSTUS 2003

Data Evaluator :

Penanggung Jawab Narasumber : Ka.Bandara Tanah Merah (Sutrisno Sumardjo)
NIP. 120092729.

DEPARTEMEN PERHUBUNGAN ★ PERHUBUNGAN UDARA BANDAR UDARA TANAH MERAH ★ DIREKTORAT JENDERAL

3HC

)REA BELL HELICOPTER COMPANY (Subidlary of United Industries International)

ESIDENT: Kyu S. Rim

Formation of KBHC, by Bell Helicopter Textron Inc (see US section) and Korea Technologies Corporation, was followed on 31 July 1986 by announcement of a memorandum of agreement between Bell, KBHC and SPI (Samsung Precision Industries Company Ltd) to co-produce Bell helicopters in the Republic of Korea. KBHC is already licensed to repair, overhaul and modify Bell types, and to manufacture some components, and SPI's activities include manufacture of turbine engine parts. In support of the new agreement, SPI is building an 11,148 m² (120,000 sq ft) factory, to be completed in early 1987, for component manufacture and assembly of light and medium helicopters for the South Korean armed forces.

NETHERLANDS

)KKER

)KKER BV

IRPORATE HEADQUARTERS: PO Box 12222, 1100 AE Amsterdam-Zuidoost

lephone: (020) 5649111

lex: (General) 10687 FHK NL +,
(Marketing) 11526 FOM NL +

THER FACTORIES AND COMPANIES:

Fokker Schiphol; Fokker Drechtsteden, with plants at Papendrecht and Dordrecht; Fokker Ypenburg at Ypenburg Air Base, near the Hague; Fokker Woensdrecht at Woensdrecht Air Base, near Bergen op Zoom; and Fokker Hoogeveen in the north-east of the Netherlands

Trading Company Avio-Diepen BV

UPERVISORY BOARD:

Mr drs H. Langman (Chairman)
ir A. Meijer (Vice-Chairman)
R. E. Grovert
H. G. Buiter
Prof Dr W. H. J. Reynaerts
drs M. C. van der Harst
ir L. J. van Ameyden

OARD OF MANAGEMENT:

F. Swarttouw (President and Chairman)
D. Krook (Deputy Chairman; Marketing and Sales)
R. C. van den Heuvel (Finance)
F. Nel (Technology)

VICE-PRESIDENT, CORPORATE AFFAIRS: ir P. van Lent

DIRECTOR OF CORPORATE RELATIONS: H. Byvanck

MANAGER, CORPORATE COMMUNICATIONS: G. W. Knook

Fokker, which is a private company without Dutch government financial holdings, forms the main aircraft industry in the Netherlands, with six plants. It employs some 10,000 people, including 1,400 at the corporate headquarters. Fokker delivered its 1,000th short/medium-range transport aircraft, an F27, to Busy Bee of Norway on 7 April 1986.

Fokker has an important share in the European manufacturing programme for the General Dynamics F-16 fighter, being responsible for component production and assembly of F-16s for the Netherlands (213) and Denmark (12). Seventy-two F-16s for Norway were delivered between January 1980 and June 1984 (see earlier editions of *Jane's*). Deliveries to the RNethAF began in June 1979, following the first flight by a Dutch assembled F-16 (J-259) on 3 May 1979. Deliveries to the RNethAF totalled 137 by mid-March 1986, and will begin to the Royal Danish Air Force in December 1987. The 200th Fokker built F-16 was delivered on 24 July 1985. Altogether, Fokker is producing 1,236 centre-fuselages, 1,246 wing moving surfaces, 1,007 main landing gear doors, 506 main landing gear legs, 262 horizontal stabilisers, 658 rudders and 597 fin leading-edges (for Fokker's own assembly line, as well as for a similar line in Belgium and for General Dynamics, which manufactures F-16s for the USAF and for 'third nation' sales).

In September 1986, Fokker joined IPTN of Indonesia, Boeing of USA and MBB of Germany in a joint venture memorandum of understanding study to determine the feasibility of an advanced technology medium-range regional transport in the 100-seat class for marketing in 1992-95.

Some 4,745 people are employed at the Fokker Schiphol plant, Amsterdam, which accommodates the Fokker 50 and 100 and F-16 assembly lines and test flying facilities. Production of the F27 and F28 ended in 1986. Wing moving surfaces are being produced for Airbus Industrie. Also at Schiphol are the design offices, spare parts stores, research and development department, numerically controlled milling department, metal bonding department, electronics division, space division and scientific and administrative computer facilities.

The Drechtsteden plant, formed by the integrated production facilities at Dordrecht and Papendrecht, employs 1,513 people. Most of these are engaged on detail production and component assembly for the Fokker 50 and 100, F-16, Airbus A300/A310 and Shorts 330/360 and Sherpa; other work includes the manufacture of specialised products.

At Ypenburg the installation of F-16 centre-fuselages is carried out by a workforce of 946 people. Composite material components for the Fokker 50, Fokker 100 and Airbus A300/A310, and radomes and fairings for the Westland Lynx helicopter, are manufactured at Ypenburg.

Woensdrecht, which has a current workforce of 953, specialises in the maintenance, overhaul, repair and modification of F27s, F28s, F-16s and a wide variety of other military aircraft, and in the incorporation of customers' requirements in such aircraft. Component production for the Patriot missile began in mid-1985. Also at Woensdrecht the ELMO division produces electrical and electronic systems and cable harnesses.

Hoogeveen is engaged in the manufacture of parts for the aerospace and other industries, including components for the Ariane launch vehicle. Quantity production of aluminium shelters and refurbishing of fuel tanks are also undertaken in this factory. A new facility became operational in 1982, producing carbonfibre composite tail components for the F-16, and Airbus A310 hinge and leg fairing doors. Hoogeveen employs 447 people.

FOKKER F27 FRIENDSHIP

The first of two F27 prototypes made its first flight on 24 November 1955, and the second on 29 January 1957. Deliveries by Fokker began in November 1958, and have been continuous for more than 27 years. Details of the 205 F-27 and FH-227 models produced by Fairchild in the USA can be found in the 1974-75 and earlier editions of *Jane's*. Many other versions have been built by Fokker, full details of the most recent Mks 200, 400M and 500 last appearing in the 1985-86 edition. Production of the F27 came to an end in 1986. An order for two by the Royal Thai Navy, announced on 23 June 1986, brought the overall sales total to 786 at that date, to 168 customers in 63 countries. These last two aircraft were due for delivery in late 1986 and early 1987.

FOKKER 50

At the end of November 1983, coinciding with the 25th anniversary in airline service of the twin-turboprop F27 Friendship, Fokker announced follow-on developments of both the F27 and the twin-turbofan F28 Fellowship, to be known respectively as the Fokker 50 and Fokker 100. Both aircraft build on successfully proven airframes, but with significant design and structural changes, allied to more efficient (and more fuel-efficient) power plants, increased use of composite materials, greater passenger comfort and convenience, advanced digital avionics, and improved airport handling characteristics. In consequence, more than 80 per cent of the component parts of the Fokker 50 are new or modified by comparison with those of the F27.

The two prototypes of the Fokker 50 utilise modified F27 fuselages rather than the redesigned fuselage of the production aircraft. The first of them (PH-OSO) flew for the first time on 28 December 1985, and the second (PH-OSI) on 30 April 1986; certification was expected by November 1986.

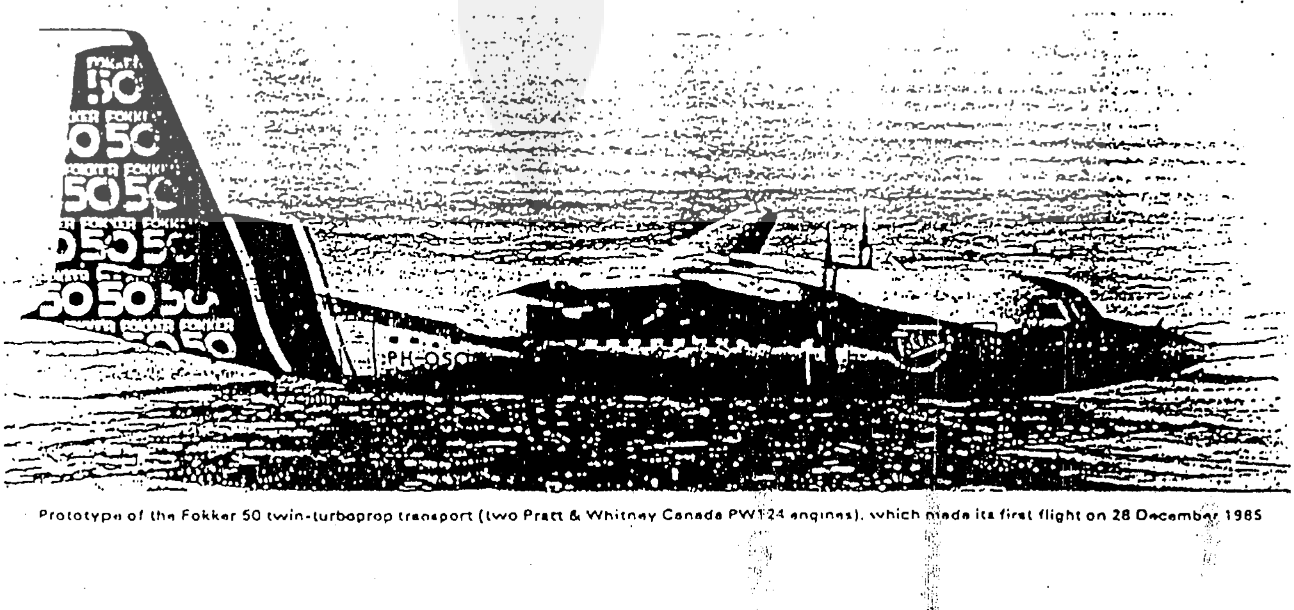
In the production aircraft, differences from the F27 include new-technology engines, in redesigned nacelles, with six-blade propellers; use of carbon, aramid and glassfibre composites in such areas as the wings, tailplane, fin, radome, engine nacelles and propellers; passenger door relocated at the front of the aircraft, and the large cargo door deleted; more windows in the passenger cabin; pneumatic system replaced by a hydraulic system; and a cruising speed some 12 per cent higher than that of the F27. Seating range is 46-58, with 50 as standard, but the cabin offers considerable flexibility for other layouts, including ample accommodation for baggage and freight.

Firm orders for 39 Fokker 50s had been received by September 1986, from Ansett of Australia (15), Austrian Airlines (2), Busy Bee of Norway (4), Corsair of USA (7), DLT of West Germany (7) and Maersk Air of Denmark (4). First delivery, to Ansett, was scheduled for December 1986.

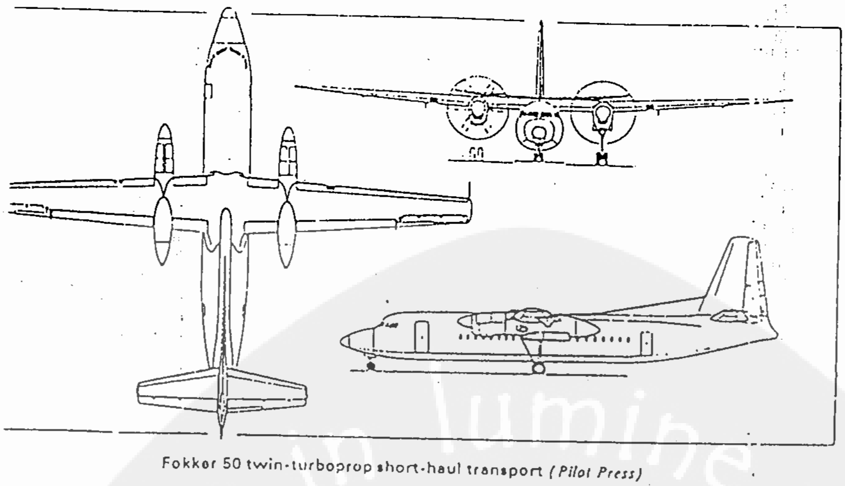
TYPE: Twin-turboprop short-haul transport.

WINGS: Cantilever high-wing monoplane. Wing section NACA 64$_4$-421 (modified) at root, NACA 64$_4$-415 (modified) at tip. Outer panels have 2° 30' dihedral and 2° washout. Incidence 3° 30'. No sweepback. All-metal riveted and metal-bonded two-spar stressed skin primary structure, consisting of centre-section and two detachable outer wings. Detachable AFRP leading-edges with rubber boot de-icers. Trailing-edge skins are of composites material, supported by ribs of composites or metal construction. Single-slotted all-metal trailing-edge flaps (two segments per wing, divided by engine nacelle), operated by spindle/drive-nut. Flaps are actuated hydraulically, with electrical backup system, and are mechanically interconnected. Aileron structure is formed by bonded skin/stringer assemblies riveted to front, centre and rear spars and ribs, with leading-edges of composites material. Ailerons are actuated mechanically via cables. Each has an inboard spring tab and outboard geared/balance tab; starboard balance tab serves also as an electrically operated trim tab. Horn balance, known as Foklet, of metal reinforced composites, at each wingtip to increase lateral stability when turning.

FUSELAGE: All-metal stressed skin primary structure, built to fail-safe principles, with cylindrical portions metal bonded and conical part riveted. Pressurised between rear



Prototype of the Fokker 50 twin-turboprop transport (two Pratt & Whitney Canada PW124 engines), which made its first flight on 28 December 1985



Fokker 50 twin-turboprop short-haul transport *(Pilot Press)*

ulkhead of nosewheel compartment and circular pressure bulkhead aft of baggage compartment. Nosecone, fairings, nosewheel doors, access doors and cabin floor are of composites materials.

L UNIT: Cantilever fin and fixed incidence tailplane of all-metal primary construction. Leading-edges are made of composites and have integral pneumatic de-icing boots; part of dorsal fin also of composites material. Elevators and rudder (both built by Fuji in Japan) are cable actuated. Elevators are mechanically interconnected, with a fixed tab in each elevator and trim tab in starboard elevator. Rudder is provided with a trim tab, geared balance tab and horn balance.

NDING GEAR: Retractable tricycle type of Dowty Rotol manufacture, with twin wheels on all units. Main units are attached to wings, retracting rearward hydraulically into rear extension of engine nacelle; nosewheels retract forward. Long-stroke oleo-pneumatic shock absorber in each unit (single-stage on nose unit, double-acting on main units). Goodyear wheels and tyres on all units. Standard main unit tyres are size 34 × 10·75-16, with pressure of 5·52 bars (80 lb/sq in); size 37 × 11·75-16 low-pressure tyres (4·00 bars; 58 lb/sq in) are optional. Nosewheel tyres are size 24 × 7·7-10, with pressure of 3·10 bars (45 lb/sq in). Goodyear hydraulic brakes, incorporating anti-skid system. Hydraulic nosewheel steering (± 73°); free-castoring angle of ± 130° available for towing.

WER PLANT: Two 1,611 kW (2,160 shp) Pratt & Whitney Canada PW124 turboprop engines, each driving a Dowty Rotol six-blade propeller with spinner. Propellers have all-composite blades and Beta control. Lucas Aerospace 8·2 kW (11 hp) electric motor for engine starting. Composites materials used in construction of engine air intakes and nacelle cowlings. Fuel in two structural tanks located between the two spars of the central spar box outboard of the engine nacelle, with total standard capacity of 5,136 litres (1,130 Imp gallons). Single-point pressure refuelling. Engine air intakes, propeller blades and spinners de-iced electrically.

COMMODATION: Crew of two on flight deck, plus two cabin attendants. Standard commuter layout seats 50 passengers, four-abreast with central aisle, at 81 cm (32 in) pitch. Alternative layouts include 46 business class passengers at 86 cm (34 in) pitch, 54 tourist class at 76 cm (30 in), or 58 in high-density arrangement, also at 76 cm (30 in). All layouts mentioned have overhead stowage bins and forward and rear main baggage/cargo compartments as standard, with toilet and carry-on baggage areas forward and galley at rear of cabin. Downward opening airstair door at front on port side; service door at rear on same side; baggage/cargo door opposite each of these on starboard side. All four doors serve also as Type I emergency exits. Entire accommodation pressurised and air-conditioned. Windscreens anti-iced electrically, flight deck side windows demisted by hot air.

STEMS: Hamilton Standard air-conditioning system. Max pressure differential 0·38 bars (5·47 lb/sq in). Garrett digital cabin pressure control system. Hydraulic system, operating at 207 bars (3,000 lb/sq in) pressure via two engine driven Abex pumps, for landing gear actuation, brakes, nosewheel steering and flap drive. Pneumatic de-icing of wing, fin and tailplane leading-edges, using engine bleed air. Primary electrical system powered by a Sundstrand 30/40kVA integrated drive generator mounted on propeller gearbox of each engine, supplying 115/200V three-phase AC at 400Hz, with two 300A transformer-rectifiers and two 30/40kVA nickel-cadmium batteries for 28V DC power. Optional third (30/40kVA) generator driven by APU. External power socket. 30/40kVA APU optional (in rear cone of starboard engine nacelle), for additional electrical power and bleed air for air-conditioning.

VIONICS: Flight deck has dual Sperry EDZ-801 electronic flight instrument system (EFIS) with CRT displays for primary flight and navigation information, and space provisions for a central multifunction display. Standard avionics include Sperry SPZ-600 AFCS with Cat. 2 landing; Sperry FZ-500 dual flight director systems; dual Bendix Series III VHF com; single Bendix Series III ADF and DME (latter including frequency hold facility); Bendix Series III ATC transponder; Sperry Primus P-650 weather radar with dual presentation on EFIS; dual Bendix Series III VHF nav with VOR, ILS and marker beacon receiver; TRT AHV-530A (ARINC 552A) radio altimeter with dual presentation on EFIS; dual Litton LTR 81-01 AHRS; Sundstrand Mk II GPWS (ARINC 549); Sperry AZ-800 air data computer; Fairchild A100 (ARINC 557) cockpit voice recorder; Collins 346-2B (ARINC 560) PA system; Sundstrand 980-4100 DXUS (ARINC 573) flight data recorder, incl underwater locator beacon and flight data entry panel; and Teledyne Model 70-275 flight data acquisition unit. Full provisions for Cat. II landing on AFCS and single Collins 628T-2A HF com to ARINC 559A2; space provisions for second ADF, second DME, second ATC transponder, Omega/VLF nav system, and Dorne & Margolin ELT.

DIMENSIONS, EXTERNAL:

Wing span	29·00 m (95 ft 1⅞ in)
Wing chord: at root	3·464 m (11 ft 4⅜ in)
at tip	1·40 m (4 ft 7 in)
Wing aspect ratio	12·01
Length overall	25·247 m (82 ft 10 in)
Fuselage: Max width	2·70 m (8 ft 10¼ in)
Height overall (static)	8·317 m (27 ft 3½ in)
Tailplane span	9·746 m (31 ft 11¾ in)
Wheel track	7·20 m (23 ft 7½ in)
Wheelbase	9·70 m (31 ft 10 in)
Propeller diameter	3·66 m (12 ft 0 in)
Propeller ground clearance	1·162 m (3 ft 9¾ in)
Propeller/fuselage clearance	0·593 m (1 ft 11⅜ in)
Passenger door (fwd, port): Height	1·78 m (5 ft 10 in)
Width	0·76 m (2 ft 6 in)
Service door (rear, port) and cargo door (fwd, stbd), each:	
Height	1·27 m (4 ft 2 in)
Width	0·61 m (2 ft 0 in)
Cargo door (rear, stbd): Height	1·27 m (4 ft 2 in)
Width	0·86 m (2 ft 9¾ in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck: Length	15·96 m (52 ft 4 in)
Width at floor	2·11 m (6 ft 11 in)
Max width	2·50 m (8 ft 2½ in)
Max height	1·96 m (6 ft 5¼ in)
Floor area (excl toilet)	30·2 m² (325·0 sq ft)
Baggage/cargo volume (standard commuter version):	
main compartments	7·82 m³ (276 cu ft)
carry-on compartment	0·82 m³ (29 cu ft)
overhead bins	2·22 m³ (78·4 cu ft)

AREA:

Wings, gross	70·0 m² (753·5 sq ft)

WEIGHTS:

Typical operating weight empty	12,633 kg (27,850 lb)
Max fuel load	4,123 kg (9,090 lb)
Max payload	5,670 kg (12,500 lb)
Max ramp weight: standard	19,100 kg (42,110 lb)
optional	20,820 kg (45,900 lb)
Max T-O weight: standard	18,990 kg (41,865 lb)
optional	20,820 kg (45,900 lb)
Max landing weight: standard	18,990 kg (41,865 lb)
optional	19,731 kg (43,500 lb)
Max zero-fuel weight	18,303 kg (40,350 lb)

PERFORMANCE (estimated):

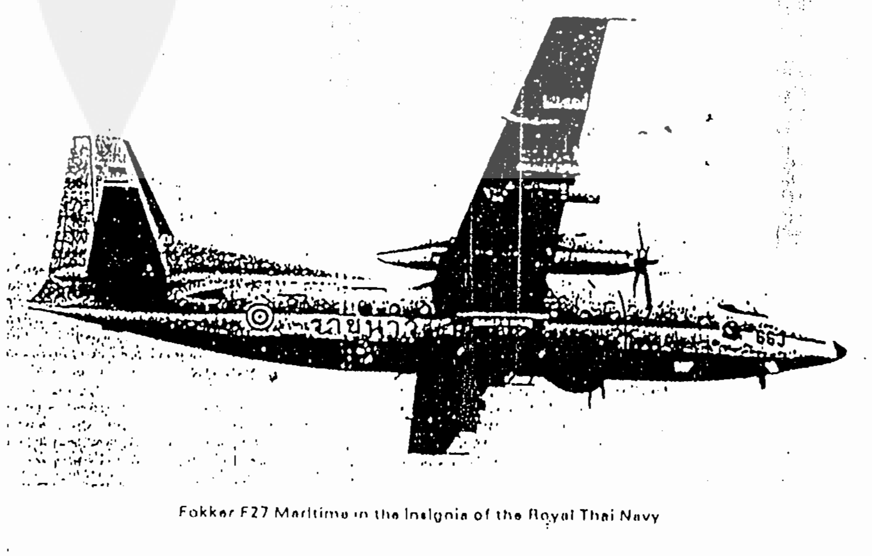
Max operating Mach number	0·507
Typical cruising speed	287 knots (532 km/h; 330 mph)
Typical climb speed	200 knots (370 km/h; 230 mph) IAS
Typical descent speed	227 knots (420 km/h; 261 mph) IAS
Max operating altitude	7,620 m (25,000 ft)
Service ceiling, one engine out, AUW of 18,250 kg (40,234 lb), ISA	4,110 m (13,485 ft)
Min ground turning radius	18·10 m (59 ft 4¾ in)
Runway LCN (51 cm; 20 in flexible pavement):	
standard tyres	17·5
low-pressure tyres	14·2
T-O field length at S/L, ISA:	
standard MTOW, 16·5° flap	1,055 m (3,460 ft)
optional MTOW, 0° flap	1,760 m (5,775 ft)
Landing field length at S/L, ISA:	
standard MLW, 40° flap	1,022 m (3,355 ft)
optional MLW, 40° flap	1,060 m (3,480 ft)
Range with 50 passengers and baggage, reserves 10% flight fuel, 30 min hold at 457 m (1,500 ft) and 130 nm (241 km; 149 mile) diversion:	
at standard MTOW:	
high-speed procedure	498 nm (923 km; 573 miles)
min fuel procedure	603 nm (1,117 km; 694 miles)
at optional MTOW:	
high-speed procedure	1,223 nm (2,266 km; 1,408 miles)
min fuel procedure	1,486 nm (2,753 km; 1,711 miles)

OPERATIONAL NOISE LEVELS (estimated):

T-O	81 EPNdB
Approach	96 EPNdB
Sideline	85 EPNdB

FOKKER 50 MARITIME AND SURVEILLANCE VERSIONS

A maritime patrol version of the **F27, designed to meet the requirements of various coastal agencies throughout the world which require a cost-effective surveillance aircraft** for coastal patrol, fishery protection, search and rescue, and similar offshore duties, was defined in July 1975, and shortly afterwards Fokker began converting an ex-airline F27 to serve as a prototype/demonstration aircraft (PH-FCX). This prototype made its first flight in February 1976. Production F27 Maritime aircraft were ordered by the Peruvian Navy (two), and air forces of Angola (one), Netherlands (two), Nigeria (four), Philippines (three) and Spain (three). Four others, for Royal Thai Navy, are equipped to carry armament, but are not to full Maritime Enforcer standard.



Fokker F27 Maritime in the Insignia of the Royal Thai Navy

Lampiran 4
Hal 116

DATA TEKNIS PESAWAT TERBANG F - 27

1 Operating Weight Empty	12934 kgs	
2 Pay Load	4500 kgs	
3 Maximum Structural Take Off Weight	20410 kgs	
4 Maximum Structural Landing Weight	19730 kgs	
5 Kapasitas Angkut Penumpang Maksimum	52 PAX	
6 Jumlah Crew Pesawat	2 Pilot 2 Pramugari	Standart
7 Kapasitas Angkut Bagasi Kabin	520 kgs	
8 Kapasitas Angkut Bagasi/Cargo	1400 kgs	
9 Jarak Jelajah Maximum	5 hrs	
10 Ketinggian Terbang Pesawat	25000 feet	Max.
11 Kecepatan Pesawat	230 knots	
12 Kebutuhan BBM per mil	1520 lbs	
13 Kapasitas Tangki BBM	4061 kgs	
14 Panjang Badan Pesawat	25,06 meter	
15 Lebar Rentang Sayap Pesawat	29 meter	
16 Jarak Penerbangan antara Eltari Kupang-Mali, Alor	138 NM	
17 Wheel Tread (jarak antara main gear)	23'7,5"	
18 Wheel Base (jarak antara nose gear dengan main gear)	31'11,3"	
19 Maksimum Height (tinggi maksimum badan pesawat)	29" = 8,84 meter	

Kupang, 12 September 2002
Yang Memberikan Informasi

SOVRY AMALO

INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES

CHAPTER 1. GENERAL

Introductory Note.— This Annex contains Standards and Recommended Practices (specifications) that prescribe the physical characteristics and obstacle limitation surfaces to be provided for at aerodromes, and certain facilities and technical services normally provided at an aerodrome. It is not intended that these specifications limit or regulate the operation of an aircraft.

To a great extent, the specifications for individual facilities detailed in Annex 14, Volume I have been interrelated by a reference code system, described in this chapter, and by the designation of the type of runway for which they are to be provided, as specified in the definitions. This not only simplifies the reading of Volume I of this Annex, but in most cases, provides for efficiently proportioned aerodromes when the specifications are followed.

This document sets forth the minimum aerodrome specifications for aircraft which have the characteristics of those which are currently operating or for similar aircraft that are planned for introduction. Accordingly, any additional safeguards that might be considered appropriate to provide for more demanding aircraft are not taken into account. Such matters are left to appropriate authorities to evaluate and take into account as necessary for each particular aerodrome. Guidance on some possible effects of future aircraft on these specifications is given in the Aerodrome Design Manual, *Part 2.*

It is to be noted that the specifications for precision approach runways categories II and III are only applicable to runways intended to be used by aeroplanes in code numbers 3 and 4.

Annex 14, Volume I does not include specifications relating to the over-all planning of aerodromes (such as separation between adjacent aerodromes or capacity of individual aerodromes) or to economic and other non-technical factors that need to be considered in the development of an aerodrome. Information on these subjects is included in the Airport Planning Manual, *Part 1.*

Aviation security is an integral part of aerodrome planning and operations. Annex 14, Volume I contains several specifications aimed at enhancing the level of security at aerodromes. Specifications on other facilities related to security are given in Annex 17 and detailed guidance on the subject is contained in the ICAO Security Manual.

1.1 Definitions

When the following terms are used in this Annex they have the following meanings:

Aerodrome. A defined area on land or water (including any buildings, installations, and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

Aerodrome beacon. Aeronautical beacon used to indicate the location of an aerodrome from the air.

Aerodrome elevation. The elevation of the highest point of the landing area.

Aerodrome identification sign. A sign placed on an aerodrome to aid in identifying the aerodrome from the air.

Aerodrome reference point. The designated geographical location of an aerodrome.

Aeronautical beacon. An aeronautical ground light visible at all azimuths, either continuously or intermittently, to designate a particular point on the surface of the earth.

Aeronautical ground light. Any light specially provided as an aid to air navigation, other than a light displayed on an aircraft.

Aeroplane reference field length. The minimum field length required for take-off at maximum certificated take-off mass, sea level, standard atmospheric conditions, still air and zero runway slope, as shown in the appropriate aeroplane flight manual prescribed by the certificating authority or equivalent data from the aeroplane manufacturer. Field length means balanced field length for aeroplanes, if applicable, or take-off distance in other cases.

Note.— Attachment A, Section 2 provides information on the concept of balanced field length and the Airworthiness

Technical Manual *(Doc 9051) contains detailed guidance on matters related to take-off distance.*

Aircraft classification number (ACN). A number expressing the relative effect of an aircraft on a pavement for a specified standard subgrade category.

Note — The aircraft classification number is calculated with respect to the center of gravity (CG) position which yields the critical loading on the critical gear. Normally the aftmost CG position appropriate to the maximum gross apron (ramp) mass is used to calculate the ACN. In exceptional cases the forwardmost CG position may result in the nose gear loading being more critical.

Aircraft stand. A designated area on an apron intended to be used for parking an aircraft.

Apron. A defined area, on a land aerodrome, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, fuelling, parking or maintenance.

Apron management service. A service provided to regulate the activities and the movement of aircraft and vehicles on an apron.

Barrette. Three or more aeronautical ground lights closely spaced in a transverse line so that from a distance they appear as a short bar of light.

Capacitor discharge light. A lamp in which high-intensity flashes of extremely short duration are produced by the discharge of electricity at high voltage through a gas enclosed in a tube.

Clearway. A defined rectangular area on the ground or water under the control of the appropriate authority, selected or prepared as a suitable area over which an aeroplane may make a portion of its initial climb to a specified height.

Declared distances.

a) *Take-off run available (TORA).* The length of runway declared available and suitable for the ground run of an aeroplane taking off.

b) *Take-off distance available (TODA).* The length of the take-off run available plus the length of the clearway, if provided.

c) *Accelerate-stop distance available (ASDA).* The length of the take-off run available plus the length of the stopway, if provided.

d) *Landing distance available (LDA).* The length of runway which is declared available and suitable for the ground run of an aeroplane landing.

Dependent parallel approaches. Simultaneous approaches t parallel or near-parallel instrument runways where rada separation minima between aircraft on adjacent extende runway centre lines are prescribed.

Displaced threshold. A threshold not located at the extremity of a runway.

Effective intensity. The effective intensity of a flashing light is equal to the intensity of a fixed light of the same colour which will produce the same visual range under identical conditions of observation.

Fixed light. A light having constant luminous intensity when observed from a fixed point.

Frangibility. A characteristic of an object to retain its structural integrity and stiffness up to a desired maximum load, but on impact from a greater load, to break, distort or yield in such a manner as to present the minimum hazard to aircraft.

Hazard beacon. An aeronautical beacon used to designate a danger to air navigation.

Heliport. An aerodrome or a defined area on a structure intended to be used wholly or in part for the arrival, departure and surface movement of helicopters.

Holding bay. A defined area where aircraft can be held, or bypassed, to facilitate efficient surface movement of aircraft.

Identification beacon. An aeronautical beacon emitting a coded signal by means of which a particular point of reference can be identified.

Independent parallel approaches. Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway centre lines are not prescribed.

Independent parallel departures. Simultaneous departures from parallel or near-parallel instrument runways.

Instrument runway. One of the following types of runways intended for the operation of aircraft using instrument approach procedures:

a) *Non-precision approach runway.* An instrument runway served by visual aids and a non-visual aid providing at least directional guidance adequate for a straight-in approach.

b) *Precision approach runway, category I.* An instrument runway served by ILS and visual aids intended for operations down to 60 m (200 ft) decision height and down to an RVR of the order of 800 m.

c) *Precision approach runway, category II.* An instrument runway served by ILS and visual aids intended for operations down to 30 m (100 ft) decision height and down to an RVR of the order of 400 m.

d) *Precision approach runway, category III.* An instrument runway served by ILS to and along the surface of the runway and:

A — intended for operations down to an RVR of the order of 200 m (no decision height being applicable) using visual aids during the final phase of landing;

B — intended for operations down to an RVR of the order of 50 m (no decision height being applicable) using visual aids for taxiing;

C — intended for operations without reliance on visual reference for landing or taxiing.

Note 1.— See Annex 10, Volume I, Part I, Chapter 3, for related ILS specifications.

Note 2.— Visual aids need not necessarily be matched to the scale of non-visual aids provided. The criterion for the selection of visual aids is the conditions in which operations are intended to be conducted.

Landing area. That part of a movement area intended for the landing or take-off of aircraft.

Landing direction indicator. A device to indicate visually the direction currently designated for landing and for take-off.

Light failure. A light shall be considered to have failed when for any reason the average intensity determined using the specified angles of beam elevation, toe-in and spread falls below 50 per cent of the specified average intensity of a new light.

Lighting system reliability. The probability that the complete installation operates within the specified tolerances and that the system is operationally usable.

Manoeuvring area. That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons.

Marker. An object displayed above ground level in order to indicate an obstacle or delineate a boundary.

Marking. A symbol or group of symbols displayed on the surface of the movement area in order to convey aeronautical information.

Movement area. That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, consisting of the manoeuvring area and the apron(s).

Near-parallel runways. Non-intersecting runways whose extended centre lines have an angle of convergence/divergence of 15 degrees or less.

Non-instrument runway. A runway intended for the operation of aircraft using visual approach procedures.

Obstacle. All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.

Obstacle free zone (OFZ). The airspace above the inner approach surface, inner transitional surfaces, and balked landing surface and that portion of the strip bounded by these surfaces, which is not penetrated by any fixed obstacle other than a low-mass and frangibly mounted one required for air navigation purposes.

Pavement classification number (PCN). A number expressing the bearing strength of a pavement for unrestricted operations.

Precision approach runway, see *Instrument runway.*

Primary runway(s). Runway(s) used in preference to others whenever conditions permit.

Runway. A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.

Runway end safety area (RESA). An area symmetrical about the extended runway centre line and adjacent to the end of the strip primarily intended to reduce the risk of damage to an aeroplane undershooting or overrunning the runway.

Runway strip. A defined area including the runway and stopway, if provided, intended:

a) to reduce the risk of damage to aircraft running off a runway; and

b) to protect aircraft flying over it during take-off or landing operations.

Runway visual range (RVR). The range over which the pilot of an aircraft on the centre line of a runway can see the runway surface markings or the lights delineating the runway or identifying its centre line.

Segregated parallel operations. Simultaneous operations on parallel or near-parallel instrument runways in which one runway is used exclusively for approaches and the other runway is used exclusively for departures.

Shoulder. An area adjacent to the edge of a pavement so prepared as to provide a transition between the pavement and the adjacent surface.

Signal area. An area on an aerodrome used for the display of ground signals.

Slush. Water-saturated snow which with a heel-and-toe slap-down motion against the ground will be displaced with a splatter; specific gravity: 0.5 up to 0.8.

Note.— Combinations of ice, snow and/or standing water may, especially when rain, rain and snow, or snow is falling, produce substances with specific gravities in excess of 0.8. These substances, due to their high water/ice content, will have a transparent rather than a cloudy appearance and, at the higher specific gravities, will be readily distinguishable from slush.

Snow (on the ground).

a) *Dry snow.* Snow which can be blown if loose or, if compacted by hand, will fall apart again upon release; specific gravity: up to but not including 0.35.

b) *Wet snow.* Snow which, if compacted by hand, will stick together and tend to or form a snowball; specific gravity: 0.35 up to but not including 0.5.

c) *Compacted snow.* Snow which has been compressed into a solid mass that resists further compression and will hold together or break up into lumps if picked up; specific gravity: 0.5 and over.

Stopway. A defined rectangular area on the ground at the end of take-off run available prepared as a suitable area in which an aircraft can be stopped in the case of an abandoned take-off.

Take-off runway. A runway intended for take-off only.

Taxi-holding position. A designated position at which taxiing aircraft and vehicles may be required to hold in order to provide adequate clearance from a runway.

Taxiway. A defined path on a land aerodrome established for the taxiing of aircraft and intended to provide a link between one part of the aerodrome and another, including:

a) *Aircraft stand taxilane.* A portion of an apron designated as a taxiway and intended to provide access to aircraft stands only.

b) *Apron taxiway.* A portion of a taxiway system located on an apron and intended to provide a through taxi route across the apron.

c) *Rapid exit taxiway.* A taxiway connected to a runway at an acute angle and designed to allow landing aeroplanes to turn off at higher speeds than are achieved on other exit taxiways thereby minimizing runway-occupancy times.

Taxiway intersection. A junction of two or more taxiways.

Taxiway strip. An area including a taxiway intended to protect an aircraft operating on the taxiway and to reduce the risk of damage to an aircraft accidentally running off the taxiway.

Threshold. The beginning of that portion of the runway usable for landing.

Touchdown zone. The portion of a runway, beyond the threshold, where it is intended landing aeroplanes first contact the runway.

Usability factor. The percentage of time during which the use of a runway or system of runways is not restricted because of the cross-wind component.

Note.— Cross-wind component means the surface wind component at right angles to the runway centre line.

1.2 Applicability

1.2.1 The interpretation of some of the specifications in the Annex expressly requires the exercising of discretion, the taking of a decision or the performance of a function by the appropriate authority. In other specifications, the expression appropriate authority does not actually appear although its inclusion is implied. In both cases, the responsibility for whatever determination or action is necessary shall rest with the State having jurisdiction over the aerodrome.

1.2.2 The specifications, unless otherwise indicated in a particular context, shall apply to all aerodromes open to public use in accordance with the requirements of Article 15 of the Convention. The specifications of Annex 14, Volume I, Chapter 3 shall apply only to land aerodromes. The specifications in this volume shall apply, where appropriate, to heliports but shall not apply to stolports.

Note.— Although there are at present no specifications relating to stolports, it is intended that specifications for these aerodromes will be included as they are developed. In the interim, guidance material on stolports is given in the Stolport Manual.

1.2.3 Wherever a colour is referred to in this Annex, the specifications for that colour given in Appendix 1 shall apply.

1.3 Reference code

Introductory Note.— The intent of the reference code is to provide a simple method for interrelating the numerous specifications concerning the characteristics of aerodromes so as to provide a series of aerodrome facilities that are suitable for the *aeroplanes that are intended to operate at the aerodrome. The code is not intended to be used for determining runway length or pavement strength requirements. The code is composed of two elements which are related to the aeroplane performance characteristics and dimensions. Element 1 is a number based on the aeroplane reference field length and element 2 is a letter based on the aeroplane wing span and outer main gear wheel span. A particular specification is related to the more appropriate of the two elements of the code or to an appropriate combination of the two code elements. The code letter or number within an element selected for design purposes is related to the critical aeroplane characteristics for which the facility is provided. When applying Annex 14, Volume I, the aeroplanes which the aerodrome is intended to serve are first identified and then the two elements of the code.*

1.3.1 An aerodrome reference code — code number and letter — which is selected for aerodrome planning purposes shall be determined in accordance with the characteristics of the aeroplane for which an aerodrome facility is intended.

1.3.2 The aerodrome reference code numbers and letters shall have the meanings assigned to them in Table 1-1.

1.3.3 The code number for element 1 shall be determined from Table 1-1, column 1, selecting the code number corresponding to the highest value of the aeroplane reference field lengths of the aeroplanes for which the runway is intended.

Note.— The determination of the aeroplane reference field length is solely for the selection of a code number and is not intended to influence the actual runway length provided.

1.3.4 The code letter for element 2 shall be determined from Table 1-1, column 3, by selecting the code letter which corresponds to the greatest wing span, or the greatest outer main gear wheel span, whichever gives the more demanding code letter of the aeroplanes for which the facility is intended.

Note.— Guidance to assist the appropriate authority in determining the aerodrome reference code is given in the Aerodrome Design Manual, *Parts 1 and 2.*

Table 1-1. Aerodrome reference code
(see 1.3.2 to 1.3.4)

Code element 1		Code element 2		
Code number (1)	Aeroplane reference field length (2)	Code letter (3)	Wing span (4)	Outer main gear wheel span[a] (5)
1	Less than 800 m	A	Up to but not including 15 m	Up to but not including 4.5 m
2	800 m up to but not including 1 200 m	B	15 m up to but not including 24 m	4.5 m up to but not including 6 m
3	1 200 m up to but not including 1 800 m	C	24 m up to but not including 36 m	6 m up to but not including 9 m
4	1 800 m and over	D	36 m up to but not including 52 m	9 m up to but not including 14 m
		E	52 m up to but not including 65 m	9 m up to but not including 14 m

a. Distance between the outside edges of the main gear wheels.

CHAPTER 2. AERODROME DATA

Introductory Note.— This chapter contains specifications relating to the provision of data about aerodromes to be determined and reported to the appropriate aeronautical information service unless specified otherwise. Specifications concerning the manner in which the data are to be published and the services to which they are to be made available are prescribed in Annexes 4 and 15.

2.1 Aerodrome reference point

2.1.1 An aerodrome reference point shall be established for an aerodrome.

2.1.2 The aerodrome reference point shall be located near the initial or planned geometric centre of the aerodrome and shall normally remain where first established.

2.1.3 The position of the aerodrome reference point shall be measured and given to the nearest second of latitude and longitude.

2.2 Aerodrome and runway elevations

2.2.1 The aerodrome elevation shall be measured and given to the nearest metre or foot.

2.2.2 For an aerodrome used by international civil aviation, the elevation of each threshold, the elevation of the runway end and any significant high and low intermediate points along the runway, and the highest elevation of the touchdown zone of a precision approach runway shall be given to the nearest metre or foot.

2.3 Aerodrome reference temperature

2.3.1 An aerodrome reference temperature shall be determined for an aerodrome in degrees Celsius.

2.3.2 **Recommendation.**— *The aerodrome reference temperature should be the monthly mean of the daily maximum temperatures for the hottest month of the year (the hottest month being that which has the highest monthly mean temperature). This temperature should be averaged over a period of years.*

2.4 Aerodrome dimensions and related information

2.4.1 The following data shall be measured or described, as appropriate, for each facility provided on an aerodrome:

a) runway — true bearing, designation number, length, width, displaced threshold location, slope, surface type, type of runway and, for a precision approach runway category I, the existence of an obstacle free zone when provided;

b) strip, runway end safety area, stopway — length, width, surface type;

c) taxiway — designation, width, surface type;

d) apron — surface type, aircraft stands;

e) the boundaries of the air traffic control service;

f) clearway — length, ground profile;

g) significant obstacles on and in the vicinity of the aerodrome — location, top elevation to the nearest (next higher) metre or foot, type;

h) visual aids for approach procedures, marking and lighting of runways, taxiways and aprons, other visual guidance and control aids on taxiways and aprons, including taxi-holding positions and stopbars, and location and type of visual docking guidance systems;

i) location and radio frequency of any VOR aerodrome check-point; and

j) location and designation of standard taxi-routes.

2.4.2 The geographical coordinates of each threshold shall be measured and given to the nearest second.

2.4.3 The geographical coordinates of each aircraft stand shall be measured and given to at least one-tenth of a minute.

Note.— This information may best be shown in the form of charts such as those required for the preparation of aeronautical publications as specified in Annexes 4 and 15.

2.5 Strength of pavements

2.5.1 The bearing strength of a pavement shall be determined.

2.5.2 The bearing strength of a pavement intended for aircraft of apron (ramp) mass greater than 5 700 kg shall be made available using the aircraft classification number — pavement classification number (ACN-PCN) method by reporting all of the following information:

a) the pavement classification number (PCN);

b) pavement type for ACN-PCN determination;

c) subgrade strength category;

d) maximum allowable tire pressure category or maximum allowable tire pressure value; and

e) evaluation method.

Note.— If necessary, PCNs may be published to an accuracy of one-tenth of a whole number.

2.5.3 The pavement classification number (PCN) reported shall indicate that an aircraft with an aircraft classification number (ACN) equal to or less than the reported PCN can operate on the pavement subject to any limitation on the tire pressure, or aircraft all-up mass for specified aircraft type(s).

Note.— Different PCNs may be reported if the strength of the pavement is subject to significant seasonal variation.

2.5.4 The ACN of an aircraft shall be determined in accordance with the standard procedures associated with the ACN-PCN method.

Note.— The standard procedures for determining the ACN of an aircraft are given in the Aerodrome Design Manual, *Part 3. For convenience several aircraft types currently in use have been evaluated on rigid and flexible pavements founded on the four subgrade categories in 2.5.6 b) below and the results tabulated in that manual.*

2.5.5 For the purposes of determining the ACN, the behaviour of a pavement shall be classified as equivalent to a rigid or flexible construction.

2.5.6 Information on pavement type for ACN-PCN determination, subgrade strength category, maximum allowable tire pressure category and evaluation method shall be reported using the following codes:

a) *Pavement type for ACN-PCN determination:*

Pavement type	*Code*
Rigid pavement	R
Flexible pavement	F

Note.— If the actual construction is composite or non-standard, include a note to that effect (see example 2 below).

b) *Subgrade strength category:*

Subgrade strength category	*Code*
High strength: characterized by K = 150 MN/m³ and representing all K values above 120 MN/m³ for rigid pavements, and by CBR = 15 and representing all CBR values above 13 for flexible pavements.	A
Medium strength: characterized by K = 80 MN/m³ and representing a range in K of 60 to 120 MN/m³ for rigid pavements, and by CBR = 10 and representing a range in CBR of 8 to 13 for flexible pavements.	B
Low strength: characterized by K = 40 MN/m³ and representing a range in K of 25 to 60 MN/m³ for rigid pavements, and by CBR = 6 and representing a range in CBR of 4 to 8 for flexible pavements.	C
Ultra low strength: characterized by K = 20 MN/m³ and representing all K values below 25 MN/m³ for rigid pavements, and by CBR = 3 and representing all CBR values below 4 for flexible pavements.	D

c) *Maximum allowable tire pressure category:*

Tire pressure category	*Code*
High: no pressure limit	W
Medium: pressure limited to 1.50 MPa	X
Low: pressure limited to 1.00 MPa	Y
Very low: pressure limited to 0.50 MPa	Z

d) *Evaluation method:*

Evaluation method	*Code*
Technical evaluation: representing a specific study of the pavement characteristics and application of pavement behaviour technology.	T
Using aircraft experience: representing a knowledge of the specific type and mass of aircraft satisfactorily being supported under regular use.	U

Note.— The following examples illustrate how pavement strength data are reported under the ACN-PCN method.

Example 1.— If the bearing strength of a rigid pavement, resting on a medium strength subgrade, has been assessed by technical evaluation to be PCN 80 and there is no tire pressure limitation, then the reported information would be:

PCN 80 / R / B / W / T

Example 2.— If the bearing strength of a composite pavement, behaving like a flexible pavement and resting on a high strength subgrade, has been assessed by using aircraft experience to be PCN 50 and the maximum tire pressure allowable is 1.00 MPa, then the reported information would be:

PCN 50 / F / A / Y / U

Note.— Composite construction.

Example 3.— If the bearing strength of a flexible pavement, resting on a medium strength subgrade, has been assessed by technical evaluation to be PCN 40 and the maximum allowable tire pressure is 0.80 MPa, then the reported information would be:

PCN 40 / F / B / 0.80 MPa /T

Example 4.— If a pavement is subject to a B747-400 all-up mass limitation of 390 000 kg, then the reported information would include the following note.

Note.— The reported PCN is subject to a B747-400 all-up mass limitation of 390 000 kg.

2.5.7 **Recommendation.**— *Criteria should be established to regulate the use of a pavement by an aircraft with an ACN higher than the PCN reported for that pavement in accordance with 2.5.2 and 2.5.3.*

Note.— Attachment A, Section 19 details a simple method for regulating overload operations while the Aerodrome Design Manual, *Part 3 includes the descriptions of more detailed procedures for evaluation of pavements and their suitability for restricted overload operations,*

2.5.8 The bearing strength of a pavement intended for aircraft of apron (ramp) mass equal to or less than 5 700 kg shall be made available by reporting the following information:

a) maximum allowable aircraft mass; and

b) maximum allowable tire pressure.

Example: 4 000 kg/0.50 MPa.

2.6 Pre-flight altimeter check location

2.6.1 One or more pre-flight altimeter check locations shall be established for an aerodrome.

2.6.2 **Recommendation.**— *A pre-flight check location should be located on an apron.*

Note 1.— Locating a pre-flight altimeter check location on an apron enables an altimeter check to be made prior to obtaining taxi clearance and eliminates the need for stopping for that purpose after leaving the apron.

Note 2.— Normally an entire apron can serve as a satisfactory altimeter check location.

2.6.3 The elevation of a pre-flight altimeter check location shall be given as the average elevation, rounded to the nearest metre or foot, of the area on which it is located. The elevation of any portion of a pre-flight altimeter check location shall be within 3 m (10 ft) of the average elevation for that location.

2.7 Declared distances

The following distances shall be calculated for a runway intended for use by international commercial air transport:

a) take-off run available;

b) take-off distance available;

c) accelerate-stop distance available; and

d) landing distance available.

Note.— Guidance on calculation of declared distances is given in Attachment A, Section 3.

2.8 Condition of the movement area and related facilities

2.8.1 Information on the condition of the movement area and the operational status of related facilities shall be provided to the appropriate aeronautical information service units, and similar information of operational significance to the air traffic services units, to enable those units to provide the necessary information to arriving and departing aircraft. The information shall be kept up to date and changes in conditions reported without delay.

2.8.2 The condition of the movement area and the operational status of related facilities shall be monitored and reports on matters of operational significance or affecting aircraft performance given, particularly in respect of the following:

a) construction or maintenance work;

b) rough or broken surfaces on a runway, a taxiway or an apron;

c) snow, slush or ice on a runway, a taxiway or an apron;

d) water on a runway, a taxiway or an apron;

e) snow banks or drifts adjacent to a runway, a taxiway or an apron;

f) anti-icing or de-icing liquid chemicals on a runway or a taxiway;

g) other temporary hazards, including parked aircraft;

h) failure or irregular operation of part or all of the aerodrome visual aids; and

i) failure of the normal or secondary power supply.

2.8.3 **Recommendation.**— *To facilitate compliance with 2.8.1 and 2.8.2 inspections of the movement area should be carried out each day at least once where the code number is 1 or 2 and at least twice where the code number is 3 or 4.*

Note.— Guidance on carrying out daily inspections of the movement area is given in the Airport Services Manual, Part 8 *and in the* Manual of Surface Movement Guidance and Control Systems (SMGCS).

Water on a runway

2.8.4 **Recommendation.**— *Whenever water is present on a runway, a description of the runway surface conditions on the centre half of the width of the runway, including the possible assessment of water depth, where applicable, should be made available using the following terms:*

DAMP — the surface shows a change of colour due to moisture.
WET — the surface is soaked but there is no standing water.
WATER PATCHES — significant patches of standing water are visible.
FLOODED — extensive standing water is visible.

2.8.5 Information that a runway or portion thereof may be slippery when wet shall be made available.

2.8.6 **Recommendation.**— *A runway or portion thereof should be determined as being slippery when wet when the measurements specified in 9.4.4 show that the runway surface friction characteristics as measured by a continuous friction measuring device are below the minimum friction level specified by the State.*

2.8.7 **Recommendation.**— *Information on the minimum friction level specified by the State for reporting slippery runway conditions and the type of friction measuring device used should be made available.*

2.8.8 **Recommendation.**— *When it is suspected that a runway may become slippery under unusual conditions, then additional measurements should be made when such conditions occur, and information on the runway surface friction characteristics made available when these additional measurements show that the runway or a portion thereof has become slippery.*

Snow, slush or ice on a runway

Note 1.— The intent of these specifications is to satisfy the SNOWTAM and NOTAM promulgation requirements contained in Annex 15.

Note 2.— Runway surface condition sensors may be used to detect and continuously display current or predicted information on surface conditions such as the presence of moisture, or imminent formation of ice on pavements.

2.8.9 **Recommendation.**— *Whenever a runway is affected by snow, slush or ice, and it has not been possible to clear the precipitant fully, the condition of the runway should be assessed, and the friction coefficient measured.*

2.8.10 **Recommendation.**— *The readings of the friction measuring device on snow-, slush-, or ice-covered surfaces should adequately correlate with the readings of one other such device.*

Note.— The principal aim is to measure surface friction in a manner that is relevant to the friction experienced by an aircraft tire, thereby providing correlation between the friction measuring device and aircraft braking performance.

2.8.11 **Recommendation.**— *Whenever dry snow, wet snow or slush is present on a runway, an assessment of the mean depth over each third of the runway should be made to an accuracy of approximately 2 cm for dry snow, 1 cm for wet snow and 0.3 cm for slush.*

2.9 Disabled aircraft removal

Note.— See 9.3 for information on disabled aircraft removal services.

2.9.1 **Recommendation.**— *The telephone/telex number(s) of the office of the aerodrome co-ordinator of operations for the removal of an aircraft disabled on or adjacent to the movement area should be made available, on request, to aircraft operators.*

2.9.2 **Recommendation.**— *Information concerning the capability to remove an aircraft disabled on or adjacent to the movement area should be made available.*

Note.— The capability to remove a disabled aircraft may be expressed in terms of the largest type of aircraft which the aerodrome is equipped to remove.

2.10 Rescue and fire fighting

Note.— See 9.2 for information on rescue and fire fighting services.

2.10.1 Information concerning the level of protection provided at an aerodrome for aircraft rescue and fire fighting purposes shall be made available.

2.10.2 **Recommendation.—** *The level of protection normally available at an aerodrome should be expressed in terms of the category of the rescue and fire fighting services as described in 9.2 and in accordance with the types and amounts of extinguishing agents normally available at the aerodrome.*

2.10.3 Significant changes in the level of protection normally available at an aerodrome for rescue and fire fighting shall be notified to the appropriate air traffic services units and aeronautical information units to enable those units to provide the necessary information to arriving and departing aircraft. When such a change has been corrected, the above units shall be advised accordingly.

Note.— A significant change in the level of protection is considered to be a change in the category of the rescue and fire fighting service from the category normally available at the aerodrome, resulting from a change in availability of extinguishing agents, equipment to deliver the agents or personnel to operate the equipment, etc.

2.10.4 **Recommendation.—** *A significant change should be expressed in terms of the new category of the rescue and fire fighting service available at the aerodrome.*

2.11 Visual approach slope indicator systems

The following information concerning a visual approach slope indicator system installation shall be made available:

a) associated runway designation number;

b) type of system according to 5.3.6.2. For an AVASIS and 3-BAR AVASIS installation, the number of light units shall be given and additionally for an asymmetrical AVASIS and 3-BAR AVASIS installation, and for an AT-VASIS, PAPI or APAPI installation, the side of the runway on which the lights are installed, i.e. left or right, shall be given;

c) where the axis of the system is not parallel to the runway centre line, the angle of displacement and the direction of displacement, i.e. left or right shall be indicated;

d) nominal approach slope angle(s). For a VASIS or an AVASIS this shall be angle (A + D) ÷ 2 and for a 3-BAR VASIS or 3-BAR AVASIS this shall also include the angle (F + C) ÷ 2, according to the formulae in Figure 5-10. For a T-VASIS or an AT-VASIS this shall be angle θ according to the formula in Figure 5-13 and for a PAPI and an APAPI this shall be angle (B + C) ÷ 2 and (A + B) ÷ 2, respectively as in Figure 5-15; and

e) minimum eye height(s) over the threshold of the on-slope signal(s). For a VASIS or an AVASIS this height shall be the top of the red signal from the downwind wing bar(s), that is, angle B. For a 3-BAR VASIS or 3-BAR AVASIS this shall also include the height of the top of the red signal from the middle wing bar(s), that is angle D. For a T-VASIS or an AT-VASIS this shall be the lowest height at which only the wing bar(s) are visible; however, the additional heights at which the wing bar(s) plus one, two or three fly down light units come into view may also be reported if such information would be of benefit to aircraft using the approach. For a PAPI this shall be the setting angle of the third unit from the runway minus 2′, i.e. angle B minus 2′, and for an APAPI this shall be the setting angle of the unit farther from the runway minus 2′, i.e. angle A minus 2′.

Note.— When computing c) or d) for slotted-type VASIS, AVASIS, 3-BAR VASIS or 3-BAR AVASIS, attention is drawn to the 1/8° difference between the angles as seen in space and the setting angles seen on the ground. See the guidance material in the Aerodrome Design Manual, *Part 4, Chapter 8.*

CHAPTER 3. PHYSICAL CHARACTERISTICS

3.1 Runways

Number and orientation of runways

Introductory Note.— Many factors affect the determination of the orientation, siting and number of runways.

One important factor is the usability factor, as determined by the wind distribution, which is specified hereunder. Another important factor is the alignment of the runway to facilitate the provision of approaches conforming to the approach surface specifications of Chapter 4. In Attachment A, Section 1, information is given concerning these and other factors.

When a new instrument runway is being located, particular attention needs to be given to areas over which aeroplanes will be required to fly when following instrument approach and missed approach procedures, so as to ensure that obstacles in these areas or other factors will not restrict the operation of the aeroplanes for which the runway is intended.

3.1.1 **Recommendation.**— *The number and orientation of runways at an aerodrome should be such that the usability factor of the aerodrome is not less than 95 per cent for the aeroplanes that the aerodrome is intended to serve.*

3.1.2 Choice of maximum permissible cross-wind components

Recommendation.— *In the application of 3.1.1 it should be assumed that landing or take-off of aeroplanes is, in normal circumstances, precluded when the cross-wind component exceeds:*

- *37 km/h (20 kt) in the case of aeroplanes whose reference field length is 1 500 m or over, except that when poor runway braking action owing to an insufficient longitudinal coefficient of friction is experienced with some frequency, a cross-wind component not exceeding 24 km/h (13 kt) should be assumed;*
- *24 km/h (13 kt) in the case of aeroplanes whose reference field length is 1 200 m or up to but not including 1 500 m; and*
- *19 km/h (10 kt) in the case of aeroplanes whose reference field length is less than 1 200 m.*

Note.— In Attachment A, Section 1, guidance is given on factors affecting the calculation of the estimate of the usability factor and allowances which may have to be made to take account of the effect of unusual circumstances.

3.1.3 Data to be used

Recommendation.— *The selection of data to be used for the calculation of the usability factor should be based on reliable wind distribution statistics that extend over as long a period as possible, preferably of not less than five years. The observations used should be made at least eight times daily and spaced at equal intervals of time.*

Note.— These winds are mean winds. Reference to the need for some allowance for gusty conditions is made in Attachment A, Section 1.

Location of threshold

3.1.4 **Recommendation.**— *A threshold should normally be located at the extremity of a runway unless operational considerations justify the choice of another location.*

Note.— Guidance on the siting of the threshold is given in Attachment A, Section 10.

3.1.5 **Recommendation.**— *When it is necessary to displace a threshold, either permanently or temporarily, from its normal location, account should be taken of the various factors which may have a bearing on the location of the threshold. Where this displacement is due to an unserviceable runway condition, a cleared and graded area of at least 60 m in length should be available between the unserviceable area and the displaced threshold. Additional distance should also be provided to meet the requirements of the runway end safety area as appropriate.*

Note.— Guidance on factors which may be considered in the determination of the location of a displaced threshold is given in Attachment A, Section 10.

Actual length of runways

3.1.6 Primary runway

Recommendation.— *Except as provided in 3.1.8, the actual runway length to be provided for a primary runway* should be adequate to meet the operational requirements of the aeroplanes for which the runway is intended and should be not less than the longest length determined by applying the corrections for local conditions to the operations and performance characteristics of the relevant aeroplanes.

Note 1.— This specification [illegible] necessarily mean providing for operations [illegible] at aeroplane at its maximum mass.

Note 2.— Both take-off and landing requirements need to be considered when determining the length of runway to be provided and the need for operations to be conducted in both directions of the runway.

Note 3.— Local conditions that may need to be considered include elevation, temperature, runway slope, humidity and the runway surface characteristics.

Note 4.— When performance data on aeroplanes for which the runway is intended are not known, guidance on the determination of the actual length of a primary runway by application of general correction factors is given in the Aerodrome Design Manual, *Part 1.*

3.1.7 Secondary runway

Recommendation.— *The length of a secondary runway should be determined similarly to primary runways except that it needs only to be adequate for those aeroplanes which require to use that secondary runway in addition to the other runway or runways in order to obtain a usability factor of at least 95 per cent.*

3.1.8 Runways with stopways or clearways

Recommendation.— *Where a runway is associated with a stopway or clearway, an actual runway length less than that resulting from application of 3.1.6 or 3.1.7, as appropriate, may be considered satisfactory, but in such a case any combination of runway, stopway and clearway provided should permit compliance with the operational requirements for take-off and landing of the aeroplanes the runway is intended to serve.*

Note.— Guidance on use of stopways and clearways is given in Attachment A, Section 2.

Width of runways

3.1.9 **Recommendation.—** *The width of a runway should be not less than the appropriate dimension specified in the following tabulation:*

Code number	Code letter A	B	C	D	E
1[a]	18 m	18 m	23 m	–	–
2[a]	23 m	23 m	30 m	–	–
3	30 m	30 m	30 m	45 m	–
4	–	–	45 m	45 m	45 m

a. The width of a precision approach runway should be not less than 30 m where the code number is 1 or 2.

Note.— The combinations of code numbers and letters for which widths are specified have been developed for typical aeroplane characteristics.

Separation of parallel runways

3.1.10 **Recommendation.—** *Where parallel runways are provided for simultaneous use under visual meteorological conditions only, the minimum distance between their centre lines should be:*

— 210 m where the higher code number is 3 or 4;

— 150 m where the higher code number is 2; and

— 120 m where the higher code number is 1.

3.1.11 **Recommendation.—** *Where parallel runways are provided for simultaneous operations under instrument meteorological conditions, the minimum separation distance between their centre lines should be:*

— 1 525 m for independent parallel approaches;

— 915 m for dependent parallel approaches;

— 760 m for independent parallel departures;

— 760 m for segregated parallel operations;

except that:

a) for segregated parallel operations the specified separation distance:

1) may be decreased by 30 m for each 150 m that the arrival runway is staggered toward the arriving aircraft, to a minimum of 300 m; and

2) should be increased by 30 m for each 150 m that the arrival runway is staggered away from the arriving aircraft;

b) lower separation distances than those specified above may be applied if, after aeronautical study it is determined that such lower separation distances would not affect the safety of operations of aircraft.

Note.— Guidance on planning and conducting simultaneous operations on parallel or near-parallel instrument runways is contained in Circular 207 — Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR).

Slopes on runways

3.1.12 Longitudinal slopes

Recommendation.— *The slope computed by dividing the difference between the maximum and minimum elevation along the runway centre line by the runway length should not exceed:*

— *1 per cent where the code number is 3 or 4; and*

— *2 per cent where the code number is 1 or 2.*

3.1.13 **Recommendation.—** *Along no portion of a runway should the longitudinal slope exceed:*

— *1.25 per cent where the code number is 4, except that for the first and last quarter of the length of the runway the longitudinal slope should not exceed 0.8 per cent;*

— *1.5 per cent where the code number is 3, except that for the first and last quarter of the length of a precision approach runway category II or III the longitudinal slope should not exceed 0.8 per cent; and*

— *2 per cent where the code number is 1 or 2.*

3.1.14 Longitudinal slope changes

Recommendation.— *Where slope changes cannot be avoided, a slope change between two consecutive slopes should not exceed:*

— *1.5 per cent where the code number is 3 or 4; and*

— *2 per cent where the code number is 1 or 2.*

Note.— Guidance on slope changes before a runway is given in Attachment A, Section 4.

3.1.15 **Recommendation.—** *The transition from one slope to another should be accomplished by a curved surface with a rate of change not exceeding:*

— *0.1 per cent per 30 m (minimum radius of curvature of 30 000 m) where the code number is 4;*

— *0.2 per cent per 30 m (minimum radius of curvature of 15 000 m) where the code number is 3; and*

— *0.4 per cent per 30 m (minimum radius of curvature of 7 500 m) where the code number is 1 or 2.*

3.1.16 Sight distance

Recommendation.— *Where slope changes cannot be avoided, they should be such that there will be an unobstructed line of sight from:*

— *any point 3 m above a runway to all other points 3 m above the runway within a distance of at least half the length of the runway where the code letter is C, D or E;*

— *any point 2 m above a runway to all other points 2 m above the runway within a distance of at least half the length of the runway where the code letter is B; and*

— *any point 1.5 m above a runway to all other points 1.5 m above the runway within a distance of at least half the length of the runway where the code letter is A.*

3.1.17 Distance between slope changes

Recommendation.— *Undulations or appreciable changes in slopes located close together along a runway should be avoided. The distance between the points of intersection of two successive curves should not be less than:*

a) the sum of the absolute numerical values of the corresponding slope changes multiplied by the appropriate value as follows:

— *30 000 m where the code number is 4;*

— *15 000 m where the code number is 3; and*

— *5 000 m where the code number is 1 or 2; or*

b) 45 m;

whichever is greater.

Note.— Guidance on implementing this specification is given in Attachment A, Section 4.

3.1.18 Transverse slopes

Recommendation.— *To promote the most rapid drainage of water, the runway surface should, if practicable, be cambered except where a single crossfall from high to low in the direction of the wind most frequently associated with rain would ensure rapid drainage. The transverse slope should ideally be:*

— 1.5 per cent where the code letter is C, D or E; and

— 2 per cent where the code letter is A or B;

but in any event should not exceed 1.5 per cent or 2 per cent, as applicable, nor be less than 1 per cent except at runway or taxiway intersections where flatter slopes may be necessary.

For a cambered surface the transverse slope on each side of the centre line should be symmetrical.

Note.—On wet runways with cross-wind conditions the problem of aquaplaning from poor drainage is apt to be accentuated. In Attachment A, Section 7, information is given concerning this problem and other relevant factors.

3.1.19 **Recommendation.—** *The transverse slope should be substantially the same throughout the length of a runway except at an intersection with another runway or a taxiway where an even transition should be provided taking account of the need for adequate drainage.*

Note.— Guidance on transverse slope is given in the Aerodrome Design Manual, *Part 3.*

Strength of runways

3.1.20 **Recommendation.—** *A runway should be capable of withstanding the traffic of aeroplanes the runway is intended to serve.*

Surface of runways

3.1.21 The surface of a runway shall be constructed without irregularities that would result in loss in friction characteristics or otherwise adversely affect the take-off or landing of an aeroplane.

Note 1.— Surface irregularities may adversely affect the take-off or landing of an aeroplane by causing excessive bouncing, pitching, vibration, or other difficulties in the control of an aeroplane.

Note 2.— Guidance on design tolerances and other information is given in Attachment A, Section 5. Additional guidance is included in the Aerodrome Design Manual, *Part 3.*

3.1.22 The surface of a paved runway shall be so constructed as to provide good friction characteristics when the runway is wet.

3.1.23 **Recommendation.—** *Measurements of the friction characteristics of a new or resurfaced runway should be made with a continuous friction measuring device using self-wetting features in order to assure that the design objectives with respect to its friction characteristics have been achieved.*

Note.— Guidance on friction characteristics of new runway surfaces is given in Attachment A, Section i Additional guidance is included in the Airport Servic Manual, *Part 2.*

3.1.24 **Recommendation.—** *The average surface textu depth of a new surface should be not less than 1.0 mm.*

Note 1.— This normally requires some form of speci surface treatment.

Note 2.— Guidance on methods used to measure surfa texture is given in the Airport Services Manual, *Part 2.*

3.1.25 **Recommendation.—** *When the surface is groov or scored, the grooves or scorings should be either perpendic lar to the runway centre line or parallel to non-perpendicul transverse joints, where applicable.*

Note.— Guidance on methods for improving the runw surface texture is given in the Aerodrome Design Manu *Part 3.*

3.2 Runway shoulders

General

Note.— Guidance on characteristics and treatment runway shoulders is given in Attachment A, Section 8, and the Aerodrome Design Manual, *Part 2.*

3.2.1 **Recommendation.—** *Runway shoulders should provided for a runway where the code letter is D or E, and t runway width is less than 60 m.*

Width of runway shoulders

3.2.2 **Recommendation.—** *The runway shoulders shou extend symmetrically on each side of the runway so that t over-all width of the runway and its shoulders is not less th 60 m.*

Slopes on runway shoulders

3.2.3 **Recommendation.—** *The surface of the should that abuts the runway should be flush with the surface of t runway and its transverse slope should not exceed 2.5 per cen*

Strength of runway shoulders

3.2.4 **Recommendation.—** *A runway shoulder should prepared or constructed so as to be capable, in the event of aeroplane running off the runway, of supporting the aer* *plane without inducing structural damage to the aeroplane and of supporting ground vehicles which may operate on the shoulder.*

3.3 Runway strips

General

3.3.1 A runway and any associated stopways shall be included in a strip.

Length of runway strips

3.3.2 **Recommendation.—** *A strip should extend before the threshold and beyond the end of the runway or stopway for a distance of at least:*

— 60 m where the code number is 2, 3 or 4;

— 60 m where the code number is 1 and the runway is an instrument one; and

— 30 m where the code number is 1 and the runway is a non-instrument one.

Width of runway strips

3.3.3 A strip including a precision approach runway shall, wherever practicable, extend laterally to a distance of at least:

— 150 m where the code number is 3 or 4; and

— 75 m where the code number is 1 or 2;

on each side of the centre line of the runway and its extended centre line throughout the length of the strip.

3.3.4 **Recommendation.—** *A strip including a non-precision approach runway should extend laterally to a distance of at least:*

— 150 m where the code number is 3 or 4; and

— 75 m where the code number is 1 or 2;

on each side of the centre line of the runway and its extended centre line throughout the length of the strip.

3.3.5 **Recommendation.—** *A strip including a non-instrument runway should extend on each side of the centre line of the runway and its extended centre line throughout the length of the strip, to a distance of at least:*

— 75 m where the code number is 3 or 4;

— 40 m where the code number is 2; and

— 30 m where the code number is 1.

Objects on runway strips

Note.— See 8.6 for information regarding siting and construction of equipment and installations on runway strips.

3.3.6 **Recommendation.—** *An object situated on a runway strip which may endanger aeroplanes should be regarded as an obstacle and should, as far as practicable, be removed.*

3.3.7 No fixed object, other than visual aids required for air navigation purposes and satisfying the relevant frangibility requirement in Chapter 5, shall be permitted on a runway strip:

a) within 60 m of the runway centre line of a precision approach runway category I, II or III where the code number is 3 or 4; or

b) within 45 m of the runway centre line of a precision approach runway category I where the code number is 1 or 2.

No mobile object shall be permitted on this part of the runway strip during the use of the runway for landing or take-off.

Grading of runway strips

3.3.8 **Recommendation.—** *That portion of a strip of an instrument runway within a distance of at least:*

— 75 m where the code number is 3 or 4; and

— 40 m where the code number is 1 or 2;

from the centre line of the runway and its extended centre line should provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

Note.— Guidance on grading of a greater area of a strip including a precision approach runway where the code number is 3 or 4 is given in Attachment A, Section 8.

3.3.9 **Recommendation.—** *That portion of a strip of a non-instrument runway within a distance of at least:*

— 75 m where the code number is 3 or 4;

— 40 m where the code number is 2; and

— 30 m where the code number is 1;

from the centre line of the runway and its extended centre line should provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

3.3.10 The surface of that portion of a strip that abuts a runway, shoulder or stopway shall be flush with the surface of the runway, shoulder or stopway.

3.3.11 **Recommendation.—** *That portion of a strip to at least 30 m before a threshold should be prepared against blast erosion in order to protect a landing aeroplane from the danger of an exposed edge.*

Slopes on runway strips

3.3.12 Longitudinal slopes

Recommendation.— *A longitudinal slope along that portion of a strip to be graded should not exceed:*

— 1.5 per cent where the code number is 4;

— 1.75 per cent where the code number is 3; and

— 2 per cent where the code number is 1 or 2.

3.3.13 Longitudinal slope changes

Recommendation.— *Slope changes on that portion of a strip to be graded should be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided.*

3.3.14 **Recommendation.—** *Slope changes before the threshold of a precision approach runway should be avoided or kept to a minimum on that portion of the strip within a distance of at least 30 m on each side of the extended centre line of the runway. Where slope changes cannot be avoided on this portion, the rate of change between two consecutive slopes should not exceed 2 per cent per 30 m.*

Note.— Guidance on slope changes before the threshold is given in Attachment A, Section 4.

3.3.15 Transverse slopes

Recommendation.— *Transverse slopes on that portion of a strip to be graded should be adequate to prevent the accumulation of water on the surface but should not exceed:*

— 2.5 per cent where the code number is 3 or 4; and

— 3 per cent where the code number is 1 or 2;

except that to facilitate drainage the slope for the first 3 m outward from the runway, shoulder or stopway edge should be negative as measured in the direction away from the runway and may be as great as 5 per cent.

3.3.16 **Recommendation.—** *The transverse slopes of any portion of a strip beyond that to be graded should not exceed an upward slope of 5 per cent as measured in the direction away from the runway.*

Strength of runway strips

3.3.17 **Recommendation.—** *That portion of a strip of an instrument runway within a distance of at least:*

— 75 m where the code number is 3 or 4; and

— 40 m where the code number is 1 or 2;

from the centre line of the runway and its extended centre line should be so prepared or constructed as to minimize hazards arising from differences in load bearing capacity to aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

3.3.18 **Recommendation.—** *That portion of a strip containing a non-instrument runway within a distance of at least:*

— 75 m where the code number is 3 or 4;

— 40 m where the code number is 2; and

— 30 m where the code number is 1;

from the centre line of the runway and its extended centre line should be so prepared or constructed as to minimize hazards arising from differences in load bearing capacity to aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

3.4 Runway end safety areas

General

3.4.1 **Recommendation.—** *A runway end safety area should be provided at each end of a runway strip where:*

— the code number is 3 or 4; and

— the code number is 1 or 2 and the runway is an instrument one.

Note.— Guidance on runway end safety areas is given in Attachment A, Section 9.

Dimensions of runway end safety areas

3.4.2 **Recommendation.**— *A runway end safety area should extend from the end of a runway strip for as great a distance as practicable, but at least 90 m.*

3.4.3 **Recommendation.**— *The width of a runway end safety area should be at least twice that of the associated runway.*

Objects on runway end safety areas

Note.— See 8.6 for information regarding siting and construction of equipment and installations on runway end safety areas.

3.4.4 **Recommendation.**— *An object situated on a runway end safety area which may endanger aeroplanes should be regarded as an obstacle and should, as far as practicable, be removed.*

Clearing and grading of runway end safety areas

3.4.5 **Recommendation.**— *A runway end safety area should provide a cleared and graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane undershooting or overrunning the runway.*

Note.— The surface of the ground in the runway end safety area does not need to be prepared to the same quality as the runway strip. See, however, 3.4.9.

Slopes on runway end safety areas

3.4.6 General

Recommendation.— *The slopes of a runway end safety area should be such that no part of the runway end safety area penetrates the approach or take-off climb surface.*

3.4.7 Longitudinal slopes

Recommendation.— *The longitudinal slopes of a runway end safety area should not exceed a downward slope of 5 per cent. Longitudinal slope changes should be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided.*

3.4.8 Transverse slopes

Recommendation.— *The transverse slopes of a runway end safety area should not exceed an upward or downward slope of 5 per cent. Transitions between differing slopes should be as gradual as practicable.*

Strength of runway end safety areas

3.4.9 **Recommendation.**— *A runway end safety area should be so prepared or constructed as to reduce the risk of damage to an aeroplane undershooting or overrunning the runway and facilitate the movement of rescue and fire fighting vehicles.*

3.5 Clearways

Note.— The inclusion of detailed specifications for clearways in this section is not intended to imply that a clearway has to be provided. Attachment A, Section 2 provides information on the use of clearways.

Location of clearways

3.5.1 **Recommendation.**— *The origin of a clearway should be at the end of the take-off run available.*

Length of clearways

3.5.2 **Recommendation.**— *The length of a clearway should not exceed half the length of the take-off run available.*

Width of clearways

3.5.3 **Recommendation.**— *A clearway should extend laterally to a distance of at least 75 m on each side of the extended centre line of the runway.*

Slopes on clearways

3.5.4 **Recommendation.**— *The ground in a clearway should not project above a plane having an upward slope of 1.25 per cent, the lower limit of this plane being a horizontal line which:*

a) is perpendicular to the vertical plane containing the runway centre line; and

b) passes through a point located on the runway centre line at the end of the take-off run available.

Note.— Because of transverse or longitudinal slopes on a runway, shoulder or strip, in certain cases the lower limit of the clearway plane specified above may be below the corresponding elevation of the runway, shoulder or strip. It is not intended that these surfaces be graded to conform with the lower limit of the clearway plane nor is it intended that terrain or objects which are above the clearway plane beyond the end of the strip but below the level of the strip be removed unless it is considered they may endanger aeroplanes.

3.5.5 **Recommendation.**— *Abrupt upward changes in slope should be avoided when the slope on the ground in a clearway is relatively small or when the mean slope is upward. In such situations, in that portion of the clearway within a distance of 22.5 m on each side of the extended centre line, the slopes, slope changes and the transition from runway to clearway should generally conform with those of the runway with which the clearway is associated except that isolated depressions such as ditches running across the clearway may be permitted.*

Objects on clearways

Note.— See 8.6 for information regarding siting and construction of equipment and installations on clearways.

3.5.6 **Recommendation.**— *An object situated on a clearway which may endanger aeroplanes in the air should be regarded as an obstacle and should be removed.*

3.6 Stopways

Note.— The inclusion of detailed specifications for stopways in this section is not intended to imply that a stopway has to be provided. Attachment A, Section 2 provides information on the use of stopways.

Width of stopways

3.6.1 A stopway shall have the same width as the runway with which it is associated.

Slopes on stopways

3.6.2 **Recommendation.**— *Slopes and changes in slope on a stopway, and the transition from a runway to a stopway, should comply with the specifications of 3.1.12 to 3.1.18 for the runway with which the stopway is associated except that:*

a) the limitation in 3.1.13 of a 0.8 per cent slope for the first and last quarter of the length of a runway need not be applied to the stopway; and

b) at the junction of the stopway and runway and along the stopway the maximum rate of slope change may be 0.3 per cent per 30 m (minimum radius of curvature of 10 000 m) for a runway where the code number is 3 or 4.

Strength of stopways

3.6.3 **Recommendation.**— *A stopway should be prepared or constructed so as to be capable, in the event of an abandoned take-off, of supporting the aeroplane which the stopway is intended to serve without inducing structural damage to the aeroplane.*

Note.— Attachment A, Section 2 presents guidance relative to the support capability of a stopway.

Surface of stopways

3.6.4 **Recommendation.**— *The surface of a paved stopway should be so constructed as to provide a good coefficient of friction when the stopway is wet.*

3.6.5 **Recommendation.**— *The friction characteristics of an unpaved stopway should not be substantially less than that of the runway with which the stopway is associated.*

3.7 Taxiways

Note.— Unless otherwise indicated the requirements in this section are applicable to all types of taxiways.

General

3.7.1 **Recommendation.**— *Taxiways should be provided to permit the safe and expeditious surface movement of aircraft.*

Note.— Guidance on layout of taxiways is given in the Aerodrome Design Manual, *Part 2.*

3.7.2 **Recommendation.**— *Sufficient entrance and exit taxiways for a runway should be provided to expedite the movement of aeroplanes to and from the runway and provision of rapid exit taxiways considered when traffic volumes are high.*

Note.— Where the end of a runway is not served by a taxiway, it may be necessary to provide additional pavement at the end of the runway for the turning of aeroplanes. Such areas may also be useful along the runway to reduce taxiing time and distance for some aeroplanes.

3.7.3 **Recommendation.**— *The design of a taxiway should be such that, when the cockpit of the aeroplane for which the taxiway is intended remains over the taxiway centre line markings, the clearance distance between the outer main wheel of the aeroplane and the edge of the taxiway should be not less than that given by the following tabulation:*

Code letter	Clearance
A	1.5 m
B	2.25 m
C	3 m if the taxiway is intended to be used by aeroplanes with a wheel base less than 18 m; 4.5 m if the taxiway is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m.
D	4.5 m
E	4.5 m

Note.— Wheel base means the distance from the nose gear to the geometric centre of the main gear.

Width of taxiways

3.7.4 **Recommendation.**— *A straight portion of a taxiway should have a width of not less than that given by the following tabulation:*

Code letter	Taxiway width
A	7.5 m
B	10.5 m
C	15 m if the taxiway is intended to be used by aeroplanes with a wheel base less than 18 m; 18 m if the taxiway is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m.
D	18 m if the taxiway is intended to be used by aeroplanes with an outer main gear wheel span of less than 9 m; 23 m if the taxiway is intended to be used by aeroplanes with an outer main gear wheel span equal to or greater than 9 m.
E	23 m

Taxiway curves

3.7.5 **Recommendation.**— *Changes in direction of taxiways should be as few and small as possible. The radii of the curves should be compatible with the manoeuvring capability and normal taxiing speeds of the aeroplanes for which the taxiway is intended. The design of the curve should be such that, when the cockpit of the aeroplane remains over the taxiway centre line markings, the clearance distance between the outer main wheels of the aeroplane and the edge of the taxiway should not be less than those specified in 3.7.3.*

Note 1.— An example of widening taxiways to achieve the wheel clearance specified is illustrated in Figure 3-1. Guidance on the values of suitable dimensions is given in the Aerodrome Design Manual, *Part 2.*

Note 2.— The location of taxiway centre line markings and lights is specified in 5.2.8.3 and 5.3.16.6.

Note 3.— Compound curves may reduce or eliminate the need for extra taxiway width.

Junctions and intersections

3.7.6 **Recommendation.**— *To facilitate the movement of aeroplanes, fillets should be provided at junctions and intersections of taxiways with runways, aprons and other taxiways. The design of the fillets should ensure that the minimum wheel clearances specified in 3.7.3 are maintained when aeroplanes are manoeuvring through the junctions or intersections.*

Note.— Guidance on the design of fillets is given in the Aerodrome Design Manual, *Part 2.*

Taxiway minimum separation distances

3.7.7 **Recommendation.**— *The separation distance between the centre line of a taxiway and the centre line of a runway, the centre line of a parallel taxiway or an object should not be less than the appropriate dimension specified in Table 3-1, except that it may be permissible to operate with lower separation distances at an existing aerodrome if an aeronautical study indicates that such lower separation distances would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*

Note 1.— Guidance on factors which may be considered in the aeronautical study is given in the Aerodrome Design Manual, *Part 2.*

Note 2.— ILS installations may also influence the location of taxiways due to interferences to ILS signals by a taxiing or stopped aircraft. Information on critical and sensitive areas surrounding ILS installation is contained in Annex 10, Volume I, Attachment C to Part 1.

Note 3.— The separation distances of Table 3-1, column 10, do not necessarily provide the capability of making a normal turn from one taxiway to another parallel taxiway.

Guidance for this condition is given in the Aerodrome Design Manual, *Part 2.*

Note 4.— The separation distance between the centre line of an aircraft stand taxilane and an object shown in Table 3-1, column 12 may need to be increased when jet exhaust wake velocity may cause hazardous conditions for ground servicing.

Slopes on taxiways

3.7.8 Longitudinal slopes

Recommendation.— *The longitudinal slope of a taxiway should not exceed:*

— 1.5 per cent where the code letter is C, D or E; and

— 3 per cent where the code letter is A or B.

3.7.9 Longitudinal slope changes

Recommendation.— *Where slope changes on a taxiway cannot be avoided, the transition from one slope to another slope should be accomplished by a curved surface with a rate of change not exceeding:*

— 1 per cent per 30 m (minimum radius of curvature of 3 000 m) where the code letter is C, D or E; and

— 1 per cent per 25 m (minimum radius of curvature of 2 500 m) where the code letter is A or B.

3.7.10 Sight distance

Recommendation.— *Where a change in slope on a taxiway cannot be avoided, the change should be such that, from any point:*

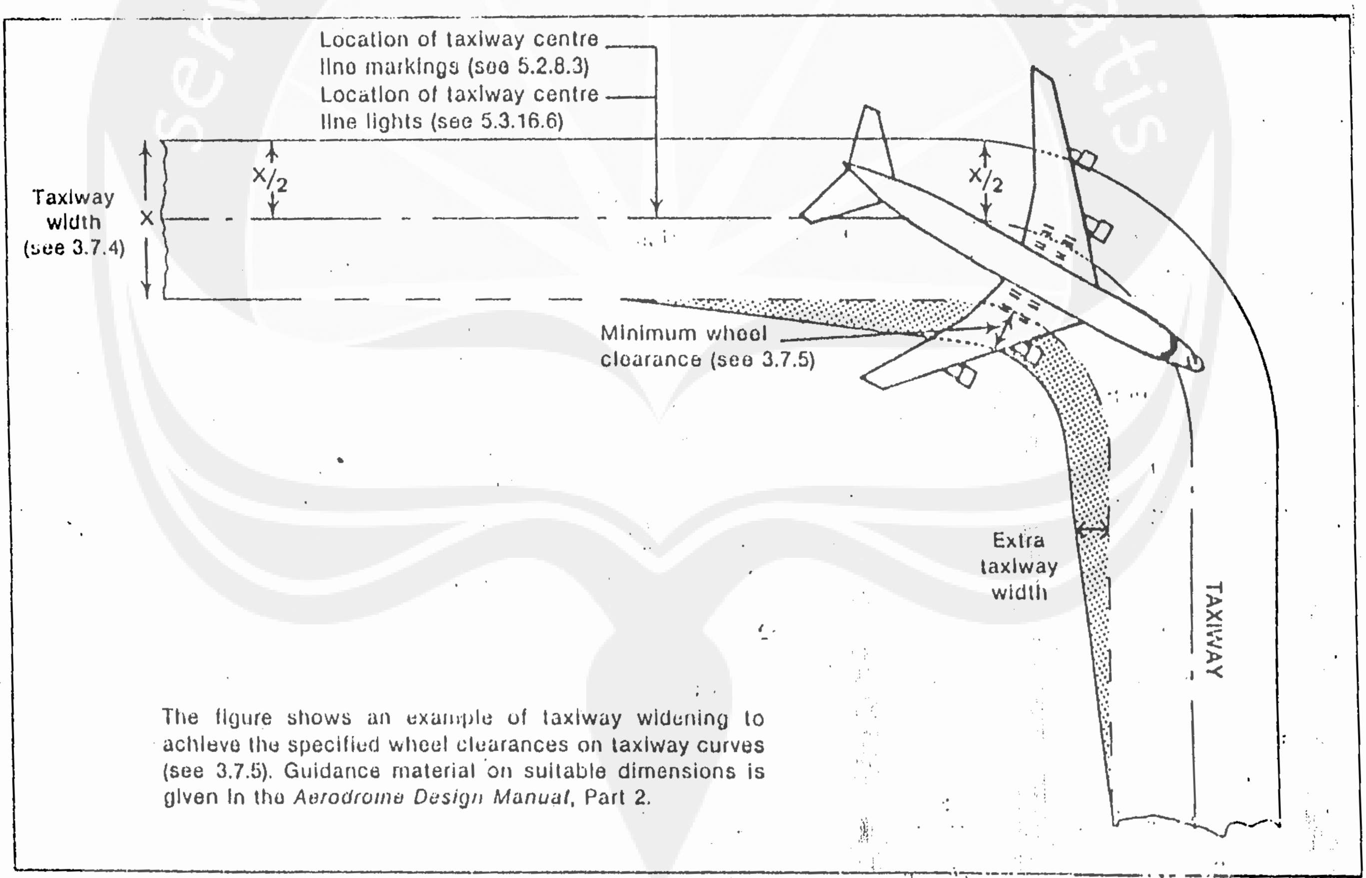


Figure 3-1. Taxiway curve

— *3 m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 300 m from that point, where the code letter is C, D or E;*

— *2 m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 200 m from that point, where the code letter is B; and*

— *1.5 m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 150 m from that point, where the code letter is A.*

3.7.11 Transverse slopes

Recommendation.— *The transverse slopes of a taxiway should be sufficient to prevent the accumulation of water on the surface of the taxiway but should not exceed:*

— *1.5 per cent where the code letter is C, D or E; and*

— *2 per cent where the code letter is A or B.*

Note.— See 3.11.4 regarding transverse slopes on an aircraft stand taxilane.

Strength of taxiways

3.7.12 **Recommendation.—** *The strength of a taxiway should be at least equal to that of the runway it serves, due consideration being given to the fact that a taxiway will be subjected to a greater density of traffic and, as a result of slow moving and stationary aeroplanes, to higher stresses than the runway it serves.*

Note.— Guidance on the relation of the strength of taxiways to the strength of runways is given in the Aerodrome Design Manual, *Part 3.*

Surface of taxiways

3.7.13 **Recommendation.—** *The surface of a taxiway should not have irregularities that cause damage to aeroplane structures.*

3.7.14 **Recommendation.—** *The surface of a paved taxiway should be so constructed as to provide good friction characteristics when the taxiway is wet.*

Table 3-1. Taxiway minimum separation distances

Code letter	Distance between taxiway centre line and runway centre line (metres) — Instrument runways — Code number 1	2	3	4	Non-instrument runways — Code number 1	2	3	4	Taxiway centre line to taxiway centre line (metres)	Taxiway, other than aircraft stand taxilane, centre line to object (metres)	Aircraft stand taxilane centre line to object (metres)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
A	82.5	82.5	–	–	37.5	47.5	–	–	23.75	16.25	12
B	87	87	–	–	42	52	–	–	33.5	21.5	16.5
C	–	–	168	–	–	–	93	–	44	26	24.5
D	–	–	176	176	–	–	101	101	66.5	40.5	36
E	–	–	–	182.5	–	–	–	107.5	80	47.5	42.5

Note.— The separation distances shown in columns (2) to (9) represent ordinary combinations of runways and taxiways. The basis for development of these distances is given in the Aerodrome Design Manual, *Part 2.*

Rapid exit taxiways

Note.— The following specifications detail requirements particular to rapid exit taxiways. See Figure 3-2. General requirements for taxiways also apply to this type of taxiway. Guidance on the provision, location and design of rapid exit taxiways is included in the Aerodrome Design Manual, *Part 2.*

3.7.15 **Recommendation.—** *A rapid exit taxiway should be designed with a radius of turn-off curve of at least:*

— 550 m where the code number is 3 or 4; and

— 275 m where the code number is 1 or 2;

to enable exit speeds under wet conditions of:

— 93 km/h where the code number is 3 or 4; and

— 65 km/h where the code number is 1 or 2.

Note.— The locations of rapid exit taxiways along a runway are based on several criteria described in the Aerodrome Design Manual, *Part 2, in addition to different speed criteria.*

3.7.16 **Recommendation.—** *The radius of the fillet on the inside of the curve at a rapid exit taxiway should be sufficient to provide a widened taxiway throat in order to facilitate recognition of the entrance and turn-off onto the taxiw*

3.7.17 **Recommendation.—** *A rapid exit taxiway sh include a straight distance after the turn-off curve suffi for an exiting aircraft to come to a full stop clear of any i secting taxiway.*

3.7.18 **Recommendation.—** *The intersection angle rapid exit taxiway with the runway should not be greater 45° nor less than 25° and preferably should be 30°.*

Taxiways on bridges

3.7.19 The width of that portion of a taxiway bi capable of supporting aeroplanes, as measured perpend larly to the taxiway centre line, shall not be less than the w of the graded area of the strip provided for that taxi unless a proven method of lateral restraint is provided w shall not be hazardous for aeroplanes for which the taxi is intended.

Note 1.— When a width less than the width of the gr area of the strip is provided, consideration will have t given to access by rescue and fire fighting vehicles.

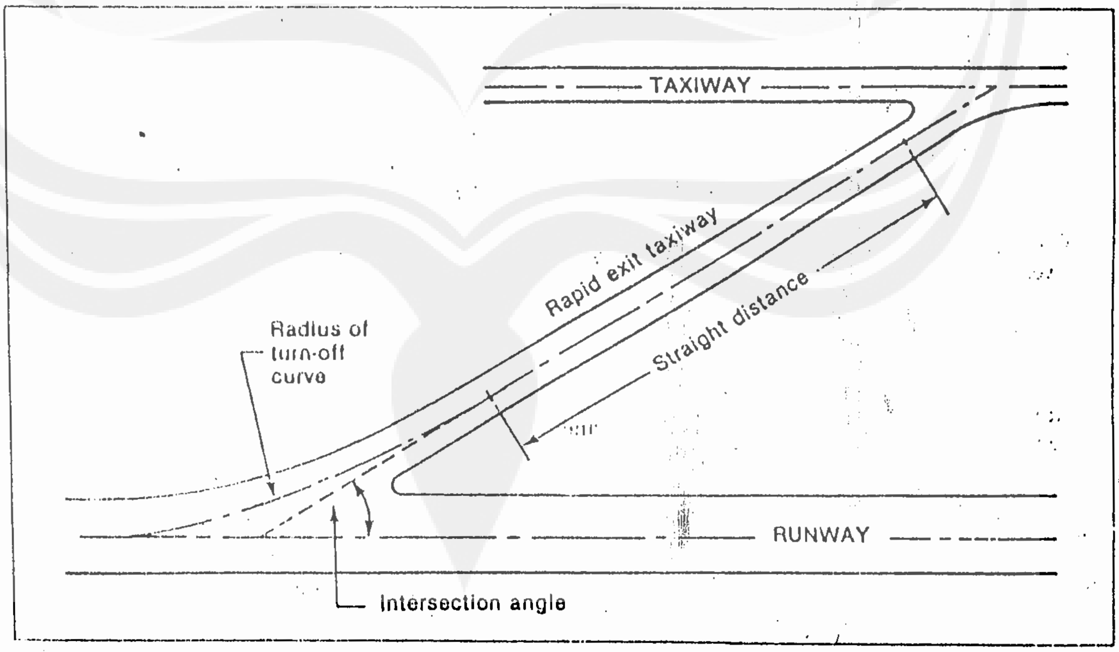


Figure 3-2. Rapid exit taxiway

Note 2.— If aeroplane engines overhang the bridge structure, protection of adjacent areas below the bridge from engine blast may be required.

3.7.20 **Recommendation.—** *A bridge should be constructed on a straight section of the taxiway with a straight section on both ends of the bridge to facilitate the alignment of aeroplanes approaching the bridge.*

3.8 Taxiway shoulders

Note.— Guidance on characteristics of taxiway shoulders and on shoulder treatment is given in the Aerodrome Design Manual, *Part 2.*

3.8.1 **Recommendation.—** *Straight portions of a taxiway where the code letter is C, D or E should be provided with shoulders which extend symmetrically on each side of the taxiway so that the over-all width of the taxiway and its shoulders on straight portions is not less than:*

— 44 m where the code letter is E;

— 38 m where the code letter is D; and

— 25 m where the code letter is C.

On taxiway curves and on junctions or intersections where increased pavement is provided, the shoulder width should be not less than that on the adjacent straight portions of the taxiway.

3.8.2 **Recommendation.—** *When a taxiway is intended to be used by turbine-engined aeroplanes, the surface of the taxiway shoulder should be so prepared as to resist erosion and the ingestion of the surface material by aeroplane engines.*

3.9 Taxiway strips

Note.— Guidance on characteristics of taxiway strips is given in the Aerodrome Design Manual, *Part 2.*

General

3.9.1 A taxiway, other than an aircraft stand taxilane, shall be included in a strip.

Width of taxiway strips

3.9.2 **Recommendation.—** *A taxiway strip should extend symmetrically on each side of the centre line of the taxiway throughout the length of the taxiway to at least the distance from the centre line given in Table 3-1, column 11.*

Objects on taxiway strips

Note.— See 8.6 for information regarding siting and construction of equipment and installations on taxiway strips.

3.9.3 **Recommendation.—** *The taxiway strip should provide an area clear of objects which may endanger taxiing aeroplanes.*

Grading of taxiway strips

3.9.4 **Recommendation.—** *The centre portion of a taxiway strip should provide a graded area to a distance from the centre line of the taxiway of at least:*

— 11 m where the code letter is A;

— 12.5 m where the code letter is B or C;

— 19 m where the code letter is D; and

— 22 m where the code letter is E.

Slopes on taxiway strips

3.9.5 **Recommendation.—** *The surface of the strip should be flush at the edge of the taxiway or shoulder, if provided, and the graded portion should not have an upward transverse slope exceeding:*

— 2.5 per cent for strips of taxiways where the code letter is C, D or E; and

— 3 per cent for strips of taxiways where the code letter is A or B;

the upward slope being measured with reference to the transverse slope of the adjacent taxiway surface and not the horizontal. The downward transverse slope should not exceed 5 per cent measured with reference to the horizontal.

3.9.6 **Recommendation.—** *The transverse slopes on any portion of a taxiway strip beyond that to be graded should not exceed an upward slope of 5 per cent as measured in the direction away from the taxiway.*

3.10 Holding bays and taxi-holding positions

General

3.10.1 **Recommendation.—** *Holding bay(s) should be provided when the traffic volume is high.*

3.10.2 A taxi-holding position or positions shall be established at an intersection of a taxiway with a runway.

Location

3.10.3 The distance between a holding bay or a taxi-holding position and the centre line of a runway shall be in accordance with Table 3-2 and, in the case of a precision approach runway, such that a holding aircraft will not interfere with the operation of radio aids.

3.10.4 **Recommendation.**— *At elevations greater than 700 m (2 300 ft) the distance of 90 m specified in Table 3-2 for a precision approach runway code number 4 should be increased as follows:*

a) up to an elevation of 2 000 m (6 600 ft); 1 m for every 100 m (330 ft) in excess of 700 m (2 300 ft);

b) elevation in excess of 2 000 m (6 600 ft) and up to 4 000 m (13 320 ft); 13 m plus 1.5 m for every 100 m (330 ft) in excess of 2 000 m (6 600 ft); and

c) elevation in excess of 4 000 m (13 320 ft) and up to 5 000 m (16 650 ft); 43 m plus 2 m for every 100 m (330 ft) in excess of 4 000 m (13 320 ft).

3.10.5 **Recommendation.**— *If a holding bay or taxi-holding position for a precision approach runway code number 4 is at a greater elevation compared to the threshold, the distance of 90 m specified in Table 3-2 should be further increased 5 m for every metre the bay or position is higher than the threshold.*

3.11 Aprons

General

3.11.1 **Recommendation.**— *Aprons should be provided where necessary to permit the on- and off-loading of passengers, cargo or mail as well as the servicing of aircraft without interfering with the aerodrome traffic.*

Size of aprons

3.11.2 **Recommendation.**— *The total apron area should be adequate to permit expeditious handling of the aerodrome traffic at its maximum anticipated density.*

Table 3-2. Minimum distance from the runway centre line to a holding bay or taxi-holding position

	Code number			
Type of runway	1	2	3	4
Non-instrument	30 m	40 m	75 m	75 m
Non-precision approach	40 m	40 m	75 m	75 m
Precision approach category I	60 m[b]	60 m[b]	90 m[a,b]	90 m[a,b]
Precision approach categories II and III	–	–	90 m[a,b]	90 m[a,b]
Take-off runway	30 m	40 m	75 m	75 m

a. If a holding bay or taxi-holding position is at a lower elevation compared to the threshold the distance may be decreased 5 m for every metre the bay or holding position is lower than the threshold, contingent upon not infringing the inner transitional surface.

b. This distance may need to be increased to avoid interference with radio aids; for a precision approach runway category III the increase may be of the order of 50 m.

Note 1.— The distance of 90 m for code number 3 or 4 is based on an aircraft with a tail height of 20 m, a distance from the nose to the highest part of the tail of 52.7 m and a nose height of 10 m holding at an angle of 45° or more with respect to the runway centre line, being clear of the obstacle free zone and not accountable for the calculation of OCA/H.

Note 2.— The distance of 60 m for code number 2 is based on an aircraft with a tail height of 8 m, a distance from the nose to the highest part of the tail of 24.6 m and a nose height of 5.2 m holding at an angle of 45° or more with respect to the runway centre line, being clear of the obstacle free zone.

Strength of aprons

3.11.3 **Recommendation.**— *Each part of an apron should be capable of withstanding the traffic of the aircraft it is intended to serve, due consideration being given to the fact that some portions of the apron will be subjected to a higher density of traffic and, as a result of slow moving or stationary aircraft, to higher stresses than a runway.*

Slopes on aprons

3.11.4 **Recommendation.**— *Slopes on an apron, including those on an aircraft stand taxilane, should be sufficient to prevent accumulation of water on the surface of the apron but should be kept as level as drainage requirements permit.*

3.11.5 **Recommendation.**— *On an aircraft stand the maximum slope should not exceed 1 per cent.*

Clearance distances on aircraft stands

3.11.6 **Recommendation.**— *An aircraft stand should provide the following minimum clearances between an aircraft using the stand and any adjacent building, aircraft on another stand and other objects:*

Code letter	Clearance
A	*3 m*
B	*3 m*
C	*4.5 m*
D	*7.5 m*
E	*7.5 m*

When special circumstances so warrant, these clearances m be reduced at a nose-in aircraft stand, where the code letter D or E:

a) between the terminal, including any fixed passeng bridge, and the nose of an aircraft; and

b) over any portion of the stand provided with azimu guidance by a visual docking guidance system.

Note.— On aprons, consideration also has to be given the provision of service roads and to manoeuvring and stor area for ground equipment.

3.12 Isolated aircraft parking position

3.12.1 An isolated aircraft parking position shall t designated or the aerodrome control tower shall be advised o an area or areas suitable for the parking of an aircraft whic is known or believed to be the subject of unlawf interference, or which for other reasons needs isolation fro normal aerodrome activities.

3.12.2 **Recommendation.**— *The isolated aircraft parkin position should be located at the maximum distance practi cable and in any case never less than 100 m from other parkin positions, buildings or public areas, etc. Care should be take to ensure that the position is not located over undergroun utilities such as gas and aviation fuel and, to the exten feasible, electrical or communication cables.*

CHAPTER 4. OBSTACLE RESTRICTION AND REMOVAL

Note 1.— The objectives of the specifications in this chapter are to define the airspace around aerodromes to be maintained free from obstacles so as to permit the intended aeroplane operations at the aerodromes to be conducted safely and to prevent the aerodromes from becoming unusable by the growth of obstacles around the aerodromes. This is achieved by establishing a series of obstacle limitation surfaces that define the limits to which objects may project into the airspace.

Note 2.— Objects which penetrate the obstacle limitation surfaces contained in this chapter may in certain circumstances cause an increase in the obstacle clearance altitude/height for an instrument approach procedure or any associated visual circling procedure. Criteria for evaluating obstacles are contained in Procedures for Air Navigation Services — Aircraft Operations (PANS-OPS) *(Doc 8168).*

Note 3.— The establishment of, and requirements for, an obstacle protection surface for visual approach slope indicator systems are specified in 5.3.6.70 to 5.3.6.74.

4.1 Obstacle limitation surfaces

Note.— See Figure 4-1.

Outer horizontal surface

Note.— Guidance on the need to provide an outer horizontal surface and its characteristics is contained in the Airport Services Manual, *Part 6.*

Conical surface

4.1.1 *Description.— Conical surface.* A surface sloping upwards and outwards from the periphery of the inner horizontal surface.

4.1.2 *Characteristics.*— The limits of the conical surface shall comprise:

a) a lower edge coincident with the periphery of the inner horizontal surface; and

b) an upper edge located at a specified height above the inner horizontal surface.

4.1.3 The slope of the conical surface shall be measured in a vertical plane perpendicular to the periphery of the inner horizontal surface.

Inner horizontal surface

4.1.4 *Description.— Inner horizontal surface.* A surface located in a horizontal plane above an aerodrome and its environs.

4.1.5 *Characteristics.—* The radius or outer limits of the inner horizontal surface shall be measured from a reference point or points established for such purpose.

Note.— The shape of the inner horizontal surface need not necessarily be circular. Guidance on determining the extent of the inner horizontal surface is contained in the Airport Services Manual, *Part 6.*

4.1.6 The height of the inner horizontal surface shall be measured above an elevation datum established for such purpose.

Note.— Guidance on determining the elevation datum is contained in the Airport Services Manual, *Part 6.*

Approach surface

4.1.7 *Description.— Approach surface.* An inclined plane or combination of planes preceding the threshold.

4.1.8 *Characteristics.—* The limits of the approach surface shall comprise:

a) an inner edge of specified length, horizontal and perpendicular to the extended centre line of the runway and located at a specified distance before the threshold;

b) two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended centre line of the runway; and

c) an outer edge parallel to the inner edge.

4.1.9 The elevation of the inner edge shall be equal to the elevation of the mid-point of the threshold.

4.1.10 The slope(s) of the approach surface shall be measured in the vertical plane containing the centre line of the runway.

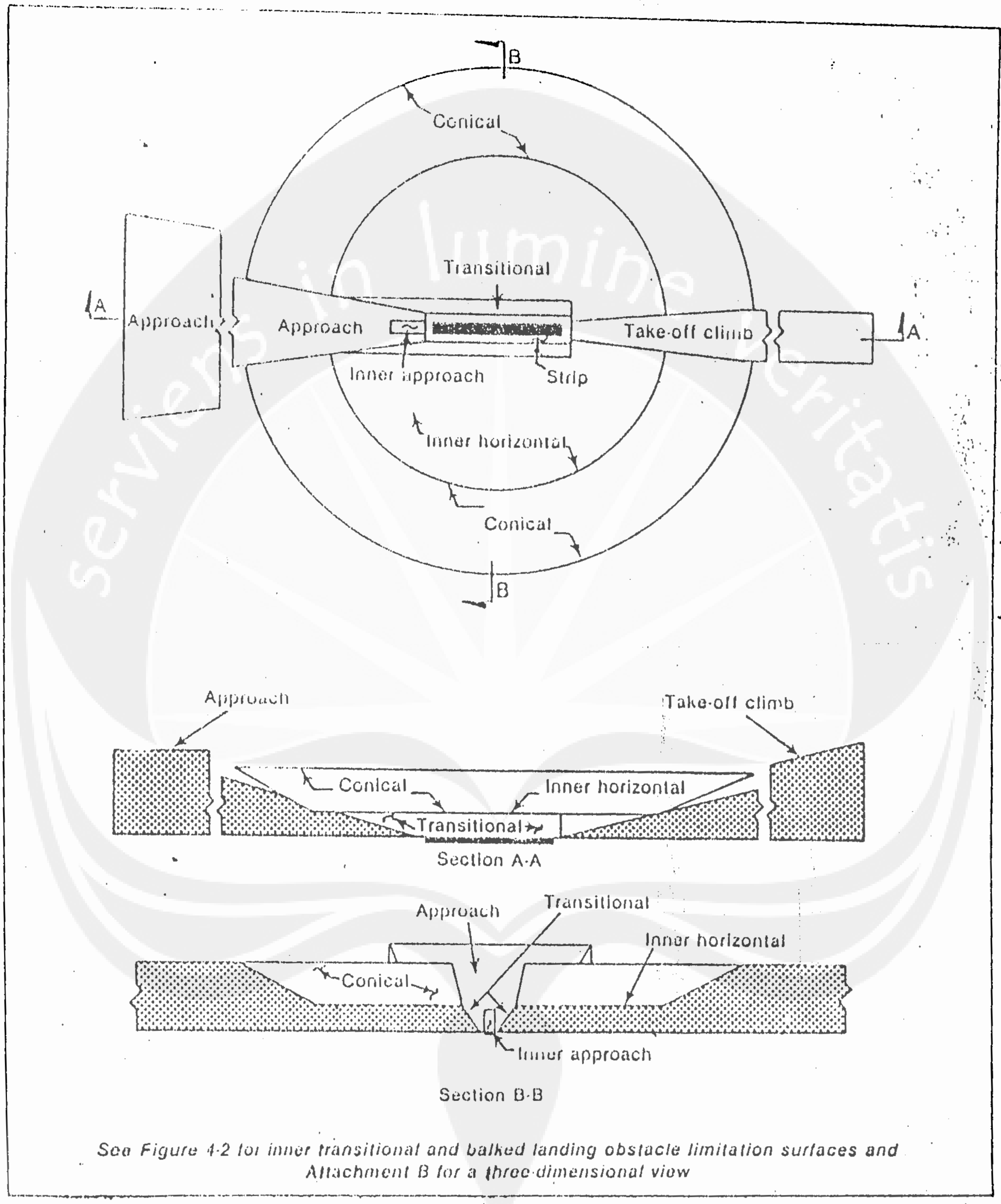


Figure 4-1. Obstacle limitation surfaces

Inner approach surface

4.1.11 *Description.— Inner approach surface.* A rectangular portion of the approach surface immediately preceding the theshold.

4.1.12 *Characteristics.*— The limits of the inner approach surface shall comprise:

a) an inner edge coincident with the location of the inner edge of the approach surface but of its own specified length;

b) two sides originating at the ends of the inner edge and extending parallel to the vertical plane containing the centre line of the runway; and

c) an outer edge parallel to the inner edge.

Transitional surface

4.1.13 *Description.— Transitional surface.* A complex surface along the side of the strip and part of the side of the approach surface, that slopes upwards and outwards to the inner horizontal surface.

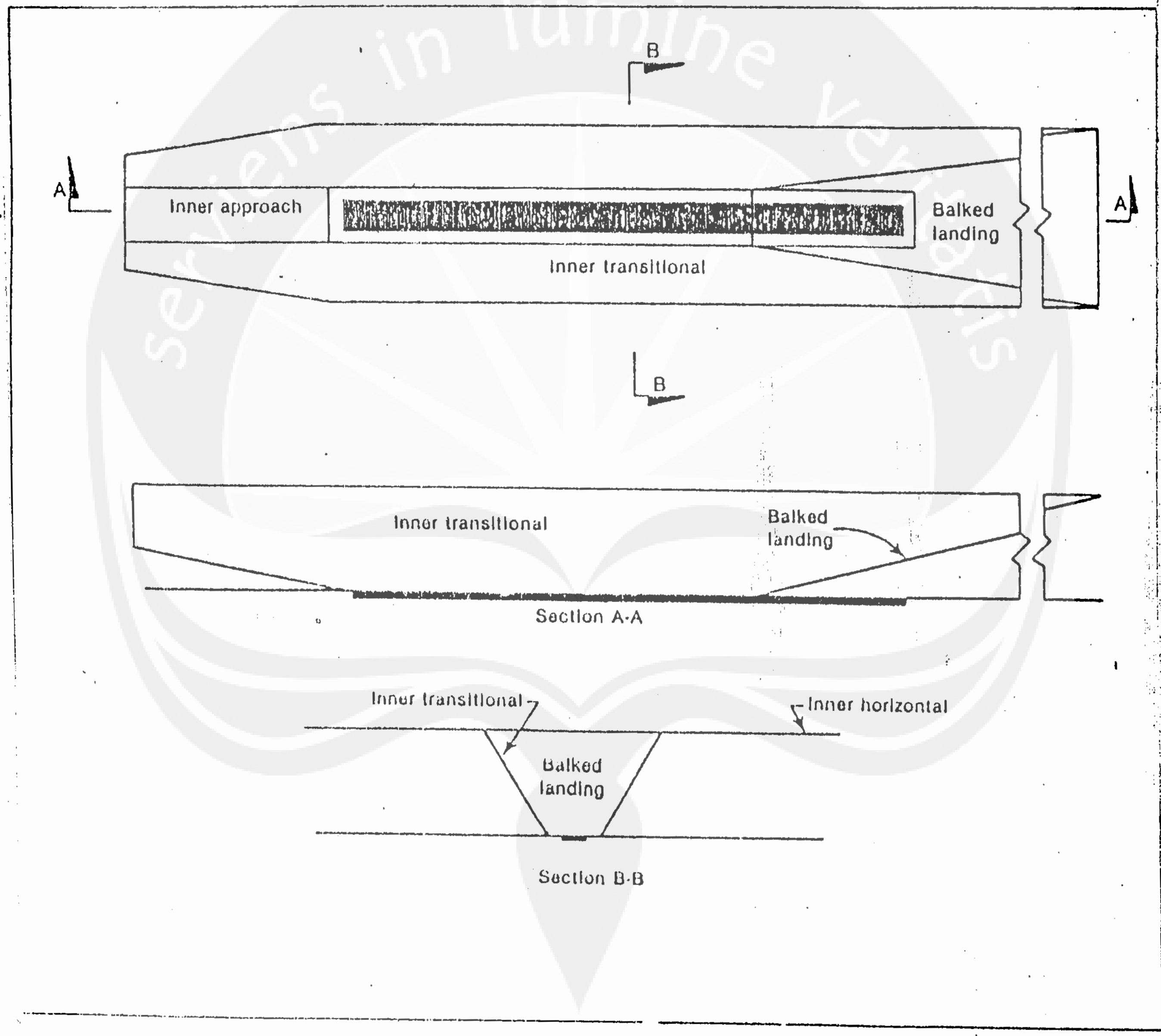


Figure 4-2. Inner approach, inner transitional and balked landing obstacle limitation surfaces

Table 4-1. Dimensions and slopes of obstacle limitation surfaces — Approach runways

APPROACH RUNWAYS

	RUNWAY CLASSIFICATION									
	Non-instrument				Non-precision approach			Precision approach category I		Precision approach category II or III
	Code number				Code number			Code number		Code number
Surface and dimensions[a]	1	2	3	4	1,2	3	4	1,2	3,4	3,4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
CONICAL										
Slope	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Height	35 m	55 m	75 m	100 m	60 m	75 m	100 m	60 m	100 m	100 m
INNER HORIZONTAL										
Height	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m
Radius	2 000 m	2 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m
INNER APPROACH										
Width	-	-	-	-	-	-	-	90 m	120 m	120 m
Distance from threshold	-	-	-	-	-	-	-	60 m	60 m	60 m
Length	-	-	-	-	-	-	-	900 m	900 m	900 m
Slope								2.5%	2%	2%
APPROACH										
Length of inner edge	60 m	80 m	150 m	150 m	150 m	300 m	300 m	150 m	300 m	300 m
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
First section										
Length	1 600 m	2 500 m	3 000 m	3 000 m	2 500 m	3 000 m	3 000 m	3 000 m	3 000 m	3 000 m
Slope	5%	4%	3.33%	2.5%	3.33%	2%	2%	2.5%	2%	2%
Second section										
Length	-	-	-	-	-	3 600 m[b]	3 600 m[b]	12 000 m	3 600 m[b]	3 600 m[b]
Slope	-	-	-	-	-	2.5%	2.5%	3%	2.5%	2.5%
Horizontal section										
Length	-	-	-	-	-	8 400 m[b]	8 400 m[b]	-	8 400 m[b]	8 400 m[b]
Total length	-	-	-	-	-	15 000 m	15 000 m	15 000 m	15 000 m	15 000 m
TRANSITIONAL										
Slope	20%	20%	14.3%	14.3%	20%	14.3%	14.3%	14.3%	14.3%	14.3%
INNER TRANSITIONAL										
Slope	-	-	-	-	-	-	-	40%	33.3%	33.3%
BALKED LANDING SURFACE										
Length of inner edge	-	-	-	-	-	-	-	90 m	120 m	120 m
Distance from threshold	-	-	-	-	-	-	-	c	1 800 m[d]	1 800 m[d]
Divergence (each side)	-	-	-	-	-	-	-	10%	10%	10%
Slope	-	-	-	-	-	-	-	4%	3.33%	3.33%

a. All dimensions are measured horizontally unless specified otherwise.
b. Variable length (see 4.2.9 or 4.2.17).
c. Distance to the end of strip.
d. Or end of runway whichever is less.

specified in Table 4-1, except in the case of the horizontal section of the approach surface (see 4.2.9).

4.2.9 The approach surface shall be horizontal beyond the point at which the 2.5 per cent slope intersects:

a) a horizontal plane 150 m above the threshold elevation; or

b) the horizontal plane passing through the top of any object that governs the obstacle clearance altitude/height (OCA/H);

whichever is the higher.

4.2.10 New objects or extensions of existing objects shall not be permitted above an approach surface within 3 000 m of the inner edge or above a transitional surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

Note.— Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual, *Part 6.*

4.2.11 **Recommendation.—** *New objects or extensions of existing objects should not be permitted above the approach surface beyond 3 000 m from the inner edge, the conical surface or inner horizontal surface except when, in the opinion of the appropriate authority, the object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*

4.2.12 **Recommendation.—** *Existing objects above any of the surfaces required by 4.2.7 should as far as practicable be removed except when, in the opinion of the appropriate authority, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*

Note.— Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger aeroplanes.

Precision approach runways

Note 1.— See 8.6 for information regarding siting and construction of equipment and installations on operational areas.

Note 2.— Guidance on obstacle limitation surfaces for precision approach runways is given in the Airport Services Manual, *Part 6.*

4.2.13 The following obstacle limitation surfaces shall be established for a precision approach runway category I:

— conical surface;
— inner horizontal surface;
— approach surface; and
— transitional surfaces.

4.2.14 **Recommendation.—** *The following obstacle limitation surfaces should be established for a precision approach runway category I:*

— inner approach surface;
— inner transitional surfaces; and
— balked landing surface.

4.2.15 The following obstacle limitation surfaces shall be established for a precision approach runway category II or III:

— conical surface;
— inner horizontal surface;
— approach surface and inner approach surface;
— transitional surfaces;
— inner transitional surfaces; and
— balked landing surface.

4.2.16 The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 4-1, except in the case of the horizontal section of the approach surface (see 4.2.17).

4.2.17 The approach surface shall be horizontal beyond the point at which the 2.5 per cent slope intersects:

a) a horizontal plane 150 m above the threshold elevation; or

b) the horizontal plane passing through the top of any object that governs the obstacle clearance limit;

whichever is the higher.

4.2.18 Fixed objects shall not be permitted above the inner approach surface, the inner transitional surface or the balked landing surface, except for frangibly mounted objects which because of their function must be located on the strip. Mobile objects shall not be permitted above these surfaces during the use of the runway for landing

4.2.19 New objects or extensions of existing objects shall not be permitted above an approach surface or a transitional surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

Note.— Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual, *Part 6.*

4.2.20 **Recommendation.**— *New objects or extensions of existing objects should not be permitted above the conical surface and the inner horizontal surface except when, in the opinion of the appropriate authority, an object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*

4.2.21 **Recommendation.**— *Existing objects above an approach surface, a transitional surface, the conical surface and inner horizontal surface should as far as practicable be removed except when, in the opinion of the appropriate authority, an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*

Note.— Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger aeroplanes.

Take-off runways

4.2.22 The following obstacle limitation surface shall be established for a take-off runway:

— take-off climb surface.

4.2.23 The dimensions of the surface shall be not less than the dimensions specified in Table 4-2, except that a lesser length may be adopted for the take-off climb surface where such lesser length would be consistent with procedural measures adopted to govern the outward flight of aeroplanes.

4.2.24 **Recommendation.**— *The operational characteristics of aeroplanes for which the runway is intended should be examined to see if it is desirable to reduce the slope specified in Table 4-2 when critical operating conditions are to be catered to. If the specified slope is reduced, corresponding adjustment in the length of take-off climb surface should be made so as to provide protection to a height of 300 m.*

Table 4-2. Dimensions and slopes of obstacle limitation surfaces

TAKE-OFF RUNWAYS

Surface and dimensions[a]	Code number		
	1	2	3 or 4
(1)	(2)	(3)	(4)
TAKE-OFF CLIMB			
Length of inner edge	60 m	80 m	180 m
Distance from runway end[b]	30 m	60 m	60 m
Divergence (each side)	10%	10%	12.5%
Final width	380 m	580 m	1 200 m 1 800 m[c]
Length	1 600 m	2 500 m	15 000 m
Slope	5%	4%	2%[d]

a. All dimensions are measured horizontally unless specified otherwise.
b. The take-off climb surface starts at the end of the clearway if the clearway length exceeds the specified distance.
c. 1 800 m when the intended track includes changes of heading greater than 15° for operations conducted in IMC, VMC by night.
4.2.24 and 4.2.26

Note.— When local conditions differ widely from sea level standard atmospheric conditions, it may be advisable for the slope specified in Table 4-2 to be reduced. The degree of this reduction depends on the divergence between local conditions and sea level standard atmospheric conditions, and on the performance characteristics and operational requirements of the aeroplanes for which the runway is intended.

4.2.25 New objects or extensions of existing objects shall not be permitted above a take-off climb surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

Note.— Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual, *Part 6.*

4.2.26 **Recommendation.—** *If no object reaches the 2 per cent (1:50) take-off climb surface, new objects should be limited to preserve the existing obstacle free surface or a surface down to a slope of 1.6 per cent (1:62.5).*

4.2.27 **Recommendation.—** *Existing objects that extend above a take-off climb surface should as far as practicable be removed except when, in the opinion of the appropriate authority, an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*

Note.— Because of transverse slopes on a strip or clearway, in certain cases portions of the inner edge of the take-off climb surface may be below the corresponding elevation of the strip or clearway. It is not intended that the strip or clearway be graded to conform with the inner edge of the take-off climb surface, nor is it intended that terrain or objects which are above the take-off climb surface beyond the end of the strip or clearway, but below the level of the strip or clearway, be removed unless it is considered they may endanger aeroplanes. Similar considerations apply at the junction of a clearway and strip where differences in transverse slopes exist.

4.3 Objects outside the obstacle limitation surfaces

4.3.1 **Recommendation.—** *Arrangements should be ma[de] to enable the appropriate authority to be consulted concern[ing] proposed construction beyond the limits of the obsta[cle] limitation surfaces that extend above a height established [by] that authority, in order to permit an aeronautical study of [the] effect of such construction on the operation of aeroplane[s].*

4.3.2 **Recommendation.—** *In areas beyond the limits [of] the obstacle limitation surfaces, at least those objects wh[ich] extend to a height of 150 m or more above ground elevat[ion] should be regarded as obstacles, unless a special aeronaut[ical] study indicates that they do not constitute a hazard [to] aeroplanes.*

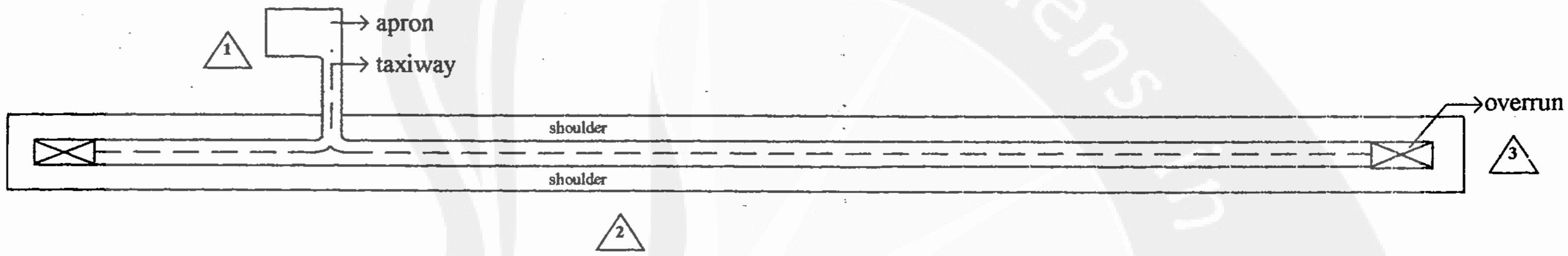
Note.— This study may have regard to the nature of op[era]tions concerned and may distinguish between day and ni[ght] operations.

4.4 Other objects

4.4.1 **Recommendation.—** *Objects which do not proj[ect] through the approach surface but which would neverthe[less] adversely affect the optimum siting or performance of vis[ual] or non-visual aids should, as far as practicable, be remov[ed].*

4.4.2 **Recommendation.—** *Anything which may, in [the] opinion of the appropriate authority after aeronautical stu[dy] endanger aeroplanes on the movement area or in the air wi[thin] the limits of the inner horizontal and conical surfaces sho[uld] be regarded as an obstacle and should be removed in so far [as] practicable.*

Note.— In certain circumstances, objects that do [not] project above any of the surfaces enumerated in 4.1 may co[n]stitute a hazard to aeroplanes as, for example, where there [are] one or more isolated objects in the vicinity of an aerodrom[e].



Keterangan:

△ = titik-titik pengambilan sampel tanah untuk keperluan uji CBR

FAKULTAS TEKNIK
UNIVERSITAS ATMA JAYA YOGYAKARTA
LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Hasil Pemeriksaan Kadar Air Tanah

Asal tanah : Tanah merah, Papua Tanggal : 25 Januari 2005 Jenis tanah : tanah lepas (*disturbed*)					
1	No cawan timbang		4	36	Bs2
2	Berat cawan kosong	W_1 gram	22,94	22,77	20,635
3	Berat cawan + tanah kosong	W_2 gram	64,31	66,25	63,75
4	Berat cawan + tanah kering	W_3 gram	62,92	64,72	62,26
5	Berat air	(W_2-W_3) gram	1,39	1,53	1,49
6	Berat tanah kering	(W_3-W_1) gram	39,98	41,95	41,625
7	Kadar air	$\frac{(W_2-W_3)}{(W_3-W_1)}x100\%$	3,477	3,647	3,579
8	Kadar air rata-rata (w)		3,568 %		

Mengetahui,

(Sumiyati Gunawan, ST, MT.)
Kepala Lab. Mekanika Tanah

FAKULTAS TEKNIK
UNIVERSITAS ATMA JAYA YOGYAKARTA
LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Hasil Pemeriksaan Berat Jenis Tanah

Asal tanah : Tanah Merah, Papua
Tanggal : 25 Januari 2005
Jenis tanah : Tanah lepas (*disturbed*)

1	No piknometer		Ib	IIb
2	Berat piknometer kosong	W_1 gram	22,45	23,8
3	Berat piknometer + tanah kering	W_2 gram	40,57	40,16
4	Berat piknometer + tanah + air	W_3 gram	84,12	83
5	Berat piknometer + air	W_4 gram	73,42	72,86
6	Temperatur t° C		27,5	27,5
7	A= W_2-W_1, gram		18,12	16,36
8	B= W_3-W_4, gram		10,7	10,14
9	C= A-B , gram		7,42	6,22
10	Berat jenis, $G_1 = \frac{A}{C}$		2,442	2,63
11	Rata-rata harga G_1		2,536	
12	G untuk 27,5° = $G_t \frac{bj\_air\_t^{o}}{bj\_air\_27,5^{o}}$		$2,536 x \frac{0,9964}{0,9964} = 2,536$	

Mengetahui,

(Sumiyati Gunawan, ST, MT.)
Kepala Lab. Mekanika Tanah

FAKULTAS TEKNIK
UNIVERSITAS ATMA JAYA YOGYAKARTA
LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Pemeriksaan distribusi ukuran butir
(Untuk tanah berdiameter < 2mm)

Asal tanah : Tanah Merah, Papua
Tanggal : 27 Januari 2005
Jenis tanah : Tanah lepas *(disturbed)*

1	Berat total tanah basah/lembab yang akan diperiksa	Bo = 50 gram
2	Kadar air contoh tanah	w = 3,568 %
3	Berat total contoh tanah kering oven yang diperiksa	$W = \frac{Bo}{1+w} = 48,278$
4	Berat total contoh tanah kering oven ø > 0,075 mm	$B_1 = (W-B_2) = 42,378$
5	Berat tanah berdiameter < 0,075	$B_2 = 5,9$

PEMERIKSAAN KADAR AIR CONTOH TANAH YANG DIPERIKSA

No. cawan timbang		4	36	Bs2
Berat cawan kosong	W_1, gram	22,94	22,77	20,635
Berat cawan + tanah basah	W_2, gram	64,31	66,25	63,75
Berat cawan + tanah kering	W_3 gram	62,92	64,72	62,26
Kadar air	$\frac{W_2 - W_3}{W_3 - W_1} x100\%$	3,477 %	3,647 %	3,579 %
Kadar air rata-rata, w%			3,568 %	

FAKULTAS TEKNIK
UNIVERSITAS ATMA JAYA YOGYAKARTA
LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Pemeriksaan distribusi ukuran butir
(Untuk tanah berdiameter < 2mm)

ANALISA SARINGAN BUTIR PASIR (SETELAH ANALISA PENGENDAPAN)				
Berat benda uji yang diperiksa	Bo = 50 gram			
Kadar air benda uji	w = 3,5678 %			
Berat benda uji kering oven	$W = \frac{Bo}{1+w} = 48,278$			
Saringan	Ukuran butir (mm)	Berat tertahan saringan (gr)	Berat lewat saringan (gr)	Persen lewat saringan $\frac{\ldots}{W} \times 100\%$
No. 200	0,075	$b_6 = 2,9$	$c_6 = 39,628$	82,083
No. 140	0,106	$b_5 = 4,17$	$c_5 = 42,528$	88,0898
No. 60	0,250	$b_4 = 0,54$	$c_4 = 46,698$	96,727
No. 40	0,425	$b_3 = 0,56$	$c_3 = 47,238$	97,846
No. 20	0,850	$b_2 = 0,26$	$c_2 = 47,798$	99,006
No. 10	2,000	$b_1 = 0,22$	$c_1 = 48,658$	99,544
		$\Sigma = 8,65$		
Jumlah = W − Σ tanah		39,628		

Catatan: $c_6 = B_2$ $c_3 = c_4 + B_4$
$c_5 = c_6 + B_6$ $c_2 = c_3 + B_3$
$c_4 = c_5 + B_5$ $c_1 = c_2 + B_2$

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LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Analisa Pengendapan/Hidrometer

Tipe hidrometer = 152 H
Koreksi meniskus hidrometer (m) = 1
Berat jenis tanah (G) = 2,536
Koreksi hidrometer 152 H (a) = 1,0228
Reagen = Na_2SiO_3
Banyak reagen = 1,5 ml/gram

Berat total tanah kering oven yang diperiksa
W = 48,278 gram

Untuk hidrometer 152 H, $K_2 = \frac{a}{W} x100 = 2,1186$

TGL	Jam	Waktu T (menit)	Pembacaan hidrometer dlm suspensi, R_1	Pembacaan hidrometer dlm cairan, R_2	Temperatur t °C	Pembacaan hidrometer terkoreksi meniskus, $R' = R_1 + m$	Kedalaman L*) (cm)	Konstan K**)	Diameter butir, $D = K\sqrt{\frac{L}{T}}$ (mm)	Pembacaan hidrometer terkoreksi $R = R_1 - R_2$	Persen berat lebih kecil, p***) (%)
030205	16.10	2	13	-2	28° C	14	14	0,01288	0,0341	15	31,779
030205	16.15	5	10	-2	28° C	11	14,5	0,01288	0,0219	12	25,4232
030205	16.45	30	9	-2	28° C	10	14,7	0,01288	0,009016	11	23,3046
030205	17.45	60	5	-2	28° C	6	15,3	0,01288	0,006504	7	14,8302
030205	20.05	250	4	-2	28° C	5	15,5	0,01288	0,003207	6	14,7116
040205	20.05	1440	3	-2	28° C	4	15,6	0,01288	0,001306	5	10,593

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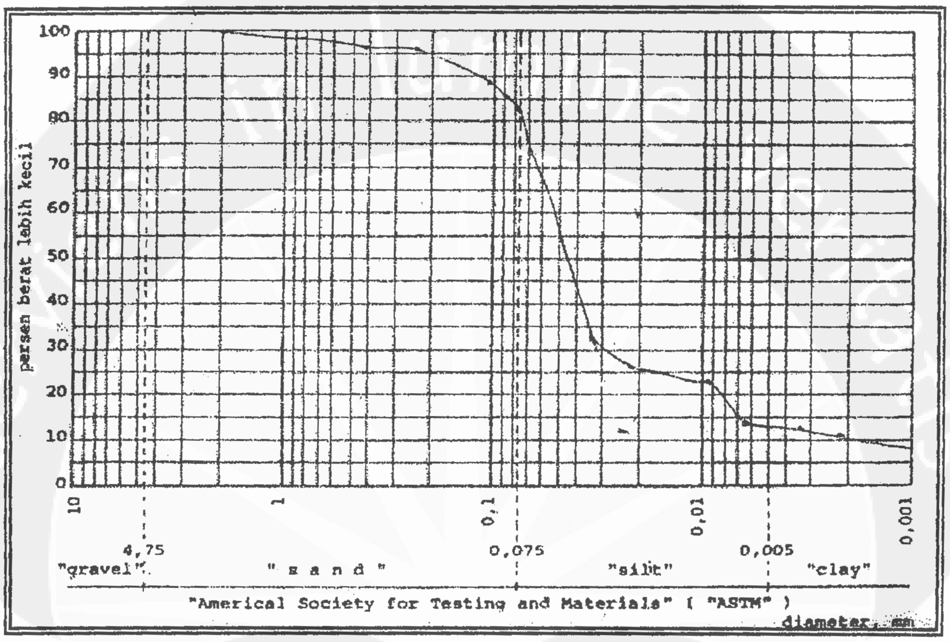
DIKERJAKAN : RINANDA PUTRI (9752)

Grafik Pengujian Analisis Butiran



Mengetahui,

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LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Hasil Pemeriksaan Batas Cair Tanah

1	Percobaan no		1		2		3		4	
2	Jumlah pukulan		17 x		21 x		31 x		40 x	
3	No cawan timbang		4a	4b	7a	7b	8a	8b	9a	9b
4	Berat cawan kosong	W_1 gram	20,66	19,7	23,8	23,0	22,45	23,2	20,26	21,19
5	Berat cawan + tanah basah	W_2 gram	95,3	93,82	94,67	92,78	76,53	78,31	77,32	78,69
6	Berat cawan + tanah kering	W_3 gram	66,34	64,95	6,825	65,77	57,94	58,3	58,44	59,02
7	Berat air	$A = (W_2 - W_3)$ gram	28,96	28,87	25,845	27,01	18,23	20,01	18,88	16,67
8	Berat tanah kering	$A = (W_3 - W_1)$ gram	45,68	45,25	45,025	42,77	35,49	35,1	38,18	37,83
9	Kadar air	$w = \frac{A}{B} x100\%$	63,39	63,8	57,4	63,15	51,37	57	49,15	52
10	Kadar air rata-rata, w %		63,6		60,275		54,185		50,725	
	BATAS CAIR = LL = 57,84 %		FLOW INDEX = If = ($w_{n=10} - w_{=100}$) = 34 %							

Lampiran 7
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FAKULTAS TEKNIK
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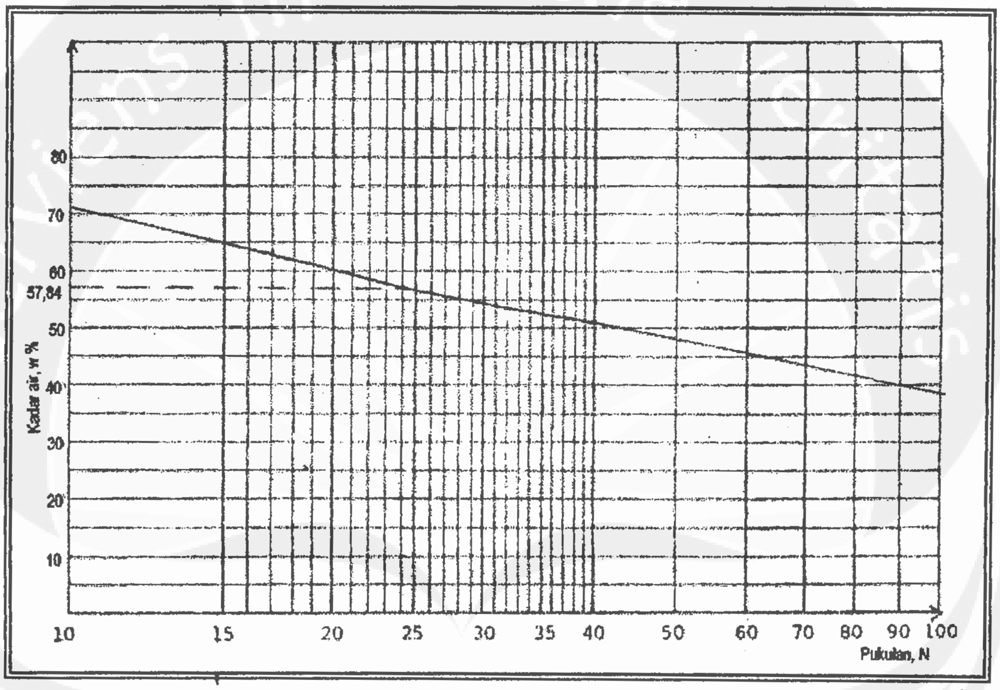
LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Asal tanah : Tanah Merah, Papua
Tanggal : 27 Januari 2005
Jenis tanah : Tanah lepas (*disturbed*)

Grafik Pemeriksaan Batas cair



Mengetahui,

(Sumiyati Gunawan, ST, MT.)
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LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Pemeriksaan Batas Plastis Tanah Lepas

Asal tanah : Tanah Merah **Tanggal : 1 Februari 2005** **Jenis tanah : Tanah lepas (*disturbed*)**				
1	No. Cawan Kosong		I	II
2	Berat Cawan Kosong	W_1 gram	15,77	15,84
3	Berat Cawan + tanah basah	W_2 gram	16,96	16,92
4	Berat Cawen + tanah kering	W_3 gram	16,67	16,64
5	Berat air	$A=(W_2-W_1)$ gram	0,29	0,28
6	Berat tanah kering	$B=(W_3-W_1)$ gram	0,9	0,8
7	Kadar air	$w = \frac{A}{B} x100\%$	32,22 %	35 %
8	Kadar air rata-rata, w (%)		33,61 %	
9	Batas plastis (PL) = 33,611 %			

Batas Plastis = PL = 33,61 %
Batas Cair = LL = 57,84 %
Index Plastisitas = IP = LL – PL
= 57,4 % - 33,61 % = 24,23 %

Mengetahui,

(Sumiyati Gunawan, ST, MT.)
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LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Percobaan Pemadatan

No.		1		2		3		4		5		6	
Berat silinder + tanah padat, gram		3361		3450		3500		3700		3675		3700	
Berat silinder, gram		1834		1955		1834		1955		1834		1955	
Berat tanah padat, A gram		1527		1495		1666		1745		1841		1745	
Berat volume basah, $\gamma = \frac{A}{V}$, gram/cm^2		1,656		1,605		1,807		1,874		1,997		1,74	
No. Cawan timbang		Bs2	10a	21	72	26c	40a	4	10b	36	17	17a	16
Berat cawan kosong	W_1, gr	22,91	22,8	23,205	21,48	20,65	22,73	21,265	22,33	20,22	20,45	20,77	21,2
Berat cawan + tanah basah	W_2, gr	82,53	79,305	88,61	73,46	76,88	77,57	73,76	77,26	68,16	70,8	62,75	67,12
Berat cawan + tanah kering	W_3, gr	78,5	75,53	82,64	68,79	70,65	71,8	64,84	68,04	59,5	61,25	53,66	57,12
Berat air	$A' = (W_2 - W_3)$	4,03	3,775	5,97	4,67	6,23	5,77	8,92	9,22	8,66	9,55	9,09	10
Berat tanah kering	$B = (W_3 - W_1)$	55,59	52,73	59,435	47,31	50	49,07	43,575	45,71	39,28	40,8	32,89	35,92
Kadar air	$w = \frac{A'}{B} x100\%$	7,25	7,16	10,64	9,87	12,46	11,76	20,47	20,17	22,05	23,41	27,64	27,84
Kadar air rata-rata, w %		7,205		9,955		12,11		20,32		22,73		27,74	
Berat volume kering, $\gamma d = \frac{\gamma}{1+w}$		1,545		1,46		1,612		1,5575		1,27		1,467	

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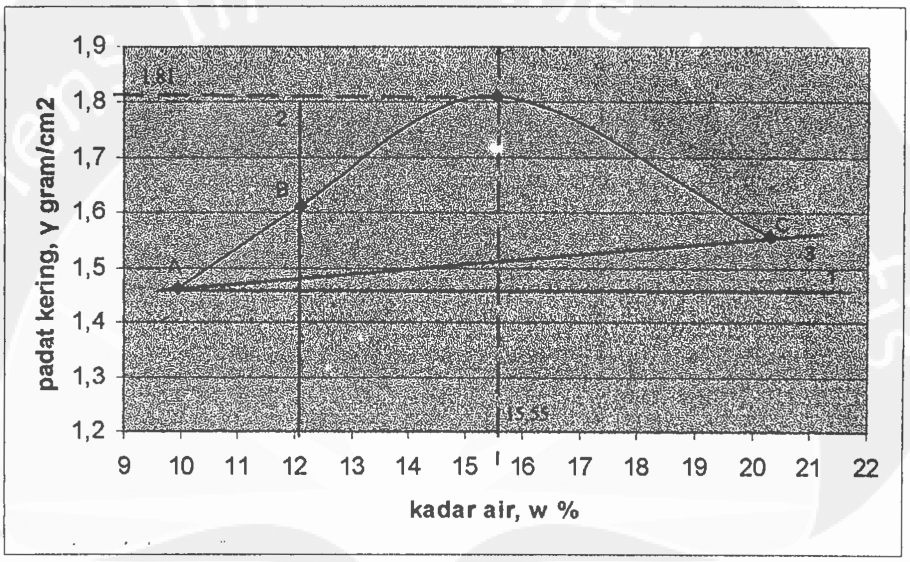
LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Asal tanah : Tanah Merah, Papua
Tanggal : 31 Januari 2005
Jenis tanah : Tanah lepas (*disturbed*)

Grafik pemadatan



Mengetahui,

(Sumiyati Gunawan, ST, MT.)
Kepala Lab. Mekanika Tanah

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LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Asal tanah : Tanah Merah, Papua
Tanggal : 1 Februari 2005
Jenis tanah : Tanah lepas (*disturbed*)

Tabel Pemeriksaan CBR

a. Kadar air asal

1	No cawan timbang		4	36	Bs2
2	Berat cawan kosong	W_1 gram	22,94	22,77	20,635
3	Berat cawan + tanah kosong	W_2 gram	64,31	66,25	63,75
4	Berat cawan + tanah kering	W_3 gram	62,92	64,72	62,26
5	Berat air	(W_2-W_3) gram	1,39	1,53	1,49
6	Berat tanah kering	(W_3-W_1) gram	39,98	41,95	41,625
7	Kadar air	$\frac{(W_2-W_3)}{(W_3-W_1)}x100\%$	3,477	3,647	3,579
8	Kadar air rata-rata (w)			3,568 %	

b. Kadar air rencana

1	No cawan timbang		Bs2	36	4
2	Berat cawan kosong	W_1 gram	20,62	22,765	22,98
3	Berat cawan + tanah kosong	W_2 gram	65,91	63,87	60,53
4	Berat cawan + tanah kering	W_3 gram	59,49	58,15	55,17
5	Berat air	(W_2-W_3) gram	6,42	5,72	5,36
6	Berat tanah kering	(W_3-W_1) gram	38,7	35,385	32,185
7	Kadar air	$\frac{(W_2-W_3)}{(W_3-W_1)}x100\%$	16,52	16,17	16,654
8	Kadar air rata-rata (w)%			16,448 %	

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LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

c. Banyaknya Air Yang Diserap

1	Kadar air tanah (rencana), w %	16,448
2	Berat siinder + tanah basah, gram	7923
3	Berat silinder, gram	4086
4	Berat tanah basah, W_1 gram	3837
5	$\gamma_{basah} = \frac{W_1}{V}$, gram/cm^3	1,652
6	$\gamma_{kering} = \frac{\gamma}{(1+w)}$, gram/cm^3	1,419
7	Berat tanah kering ($W_{statemen}$) = V x γk, gram	3287,77

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LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Pemeriksaan CBR Titik satu

Penetrasi		Beban			Tekanan	Tekanan terkoreksi
mm	inchi	Pembacaan arloji	P_1 (kg)	$P_2 = 1/0{,}454.P_1$ (lbs)	$P = \frac{P_2}{3}$	Dari grafik (psi)
0,64	0,025	21	35,86	78,98678	26,32893	22,32893
1,27	0,050	29	59,35	130,7269	43,57562	39,57562
1,91	0,075	35	74,18	163,3921	54,46402	50,46402
2,54	0,100	40	86,55	190,6388	63,54626	59,54626
3,18	0,125	46	97,68	215,1542	71,71806	67,71806
3,81	0,150	51	108,8	239,6476	79,88253	75,88253
4,45	0,175	56	118,69	261,4317	87,14391	83,14391
5,08	**0,200**	60	127,35	280,5066	93,5022	**89,5022**
5,72	0,225	65	134,77	296,8502	98,95007	94,95007
6,36	0,250	70	140,95	310,4626	103,4875	99,48752
7,00	0,275	74	147,13	324,0749	108,025	104,025
7,62	0,300	78	152,08	334,978	111,6593	107,6593
8,26	0,325	82	157,03	345,8811	115,2937	111,2937
8,90	0,350	86	160,74	354,0529	118,0176	114,0176
9,54	0,375	89	164,45	362,2247	120,7416	116,7416
10,16	0,400	92	166,92	367,6652	122,5551	118,5551
10,80	0,425	95	169,39	373,1057	124,3686	120,3686
11,43	0,450	98	171,87	378,5683	126,1894	122,1894
12,07	0,475	101	174,34	384,0088	128,0029	124,0029
12,70	0,500	104	175,58	386,7401	128,9134	124,9134

Keterangan: P_1 (kg) didapat dari "Tabel Konvesi Pembacaan Arloji" pada pengujian penetrasi.

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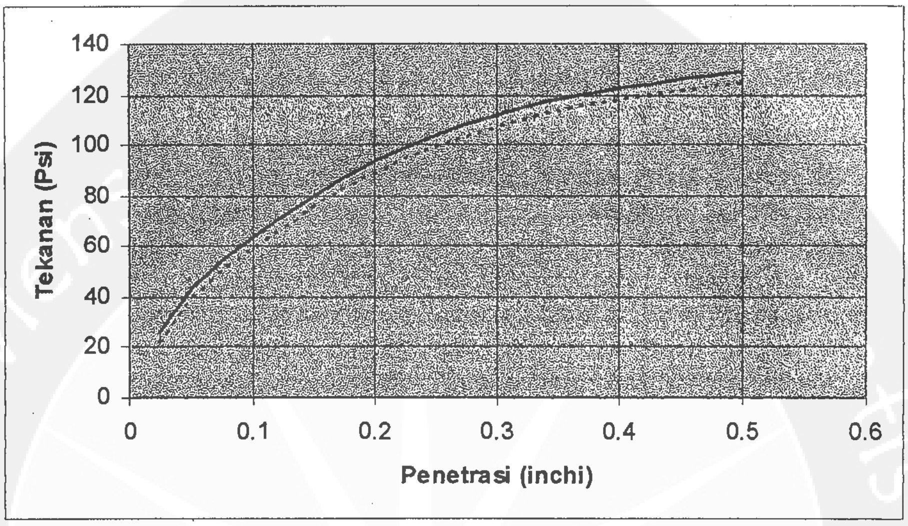
LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Kurva CBR Titik Satu



Kurva awal = ————————
Kurva koreksi = - - - - - - - - - - - -

Penetrasi 0,2 $= \frac{89{,}5022}{1500} x100 = 5{,}967\,\%$

Mengetahui,

(Sumiyati Gunawan, ST, MT.)
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LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Pemeriksaan CBR Titik Dua

Penetrasi		Beban			Tekanan	Tekanan terkoreksi
mm	inchi	Pembacaan arloji	P_1 (kg)	$P_2 = 0,454.P_1$ (lbs)	$P = \frac{P_2}{3}$	Dari grafik (psi)
0,64	0,025	16	37,09	81,69604	27,23201	23,68201
1,27	0,050	19	60,82	133,9648	44,65492	41,10492
1,91	0,075	22	74,18	163,3921	54,46402	50,91402
2,54	**0,100**	25	85,55	188,4361	62,81204	**59,26204**
3,18	0,125	29	95,2	209,6916	69,89721	66,34721
3,81	0,150	34	103,86	228,7665	76,25551	72,70551
4,45	0,175	39	112,51	247,8194	82,60646	79,05646
5,08	0,200	44	119,93	264,163	88,05433	84,50433
5,72	0,225	48	127,35	280,5066	93,5022	89,9522
6,36	0,250	52	133,53	294,1189	98,03965	94,48965
7,00	0,275	55	139,71	307,7313	102,5771	99,02709
7,62	0,300	58	145,9	321,3656	107,1219	103,5719
8,26	0,325	61	150,84	332,2467	110,7489	107,1989
8,90	0,350	64	155,84	343,2599	114,42	110,87
9,54	0,375	67	160,74	354,0529	118,0176	114,4676
10,16	0,400	70	164,45	362,2247	120,7416	117,1916
10,80	0,425	72	168,16	370,3965	123,4655	119,9155
11,43	0,450	74	170,63	375,837	125,279	121,729
12,07	0,475	76	173,1	381,2775	127,0925	123,5425
12,70	0,500	78	174,34	384,0088	128,0029	124,4529

Keterangan: P_1 (kg) didapat dari "Tabel Konvesi Pembacaan Arloji" pada pengujian penetrasi.

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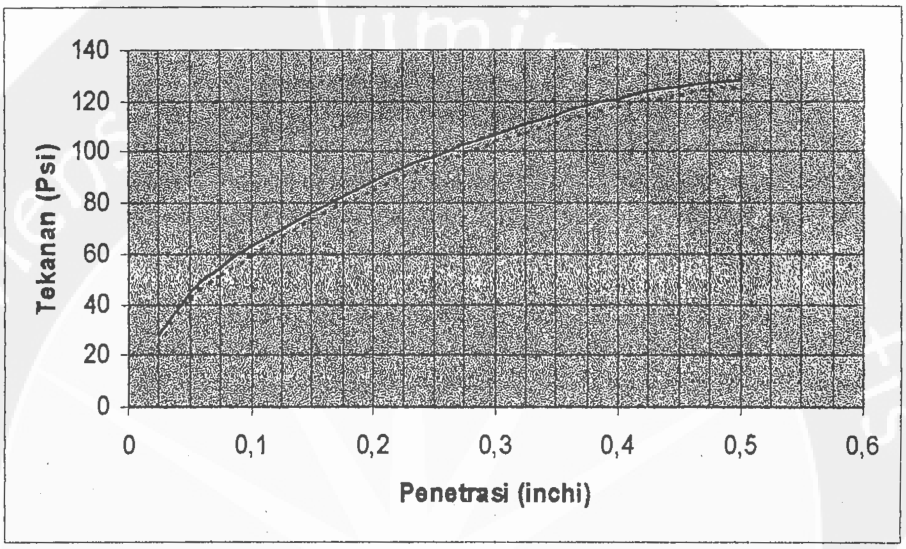
DIKERJAKAN : RINANDA PUTRI (9752)

Kurva CBR Titik Dua



Kurva awal = ————————

Kurva koreksi = - - - - - - - - - - - - -

Penetrasi 0,1 = $\dfrac{59,9963}{1000} x100 = 6\,\%$

Mengetahui,

(Sumiyati Gunawan, ST, MT.)
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LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Pemeriksaan CBR Titik Tiga

Penetrasi		Beban			Tekanan	Tekanan terkoreksi
mm	inchi	Pembacaan arloji	P_1 (kg)	$P_2 = 0{,}454.P_1$ (lbs)	$P = \frac{P_2}{3}$	Dari grafik (psi)
0,64	0,025	22	38,33	84,42731	28,14244	22,84244
1,27	0,050	30	61,82	136,1674	45,38913	40,08913
1,91	0,075	35	77,89	171,5639	57,18796	51,88796
2,54	0,100	40	90,26	198,8106	66,27019	60,97019
3,18	0,125	45	101,38	223,304	74,43465	69,13465
3,81	0,150	50	111,23	245	81,66667	76,36667
4,45	0,175	55	121,17	266,8943	88,96476	83,66476
5,08	**0,200**	59	132,29	291,3877	97,12922	**91,82922**
5,72	0,225	63	138,4	304,8458	101,6153	96,31527
6,36	0,250	67	144,66	318,6344	106,2115	100,9115
7,00	0,275	71	150,84	332,2467	110,7489	105,4489
7,62	0,300	75	155,79	343,1498	114,3833	109,0833
8,26	0,325	79	160,74	354,0529	118,0176	112,7176
8,90	0,350	82	165,68	364,9339	121,6446	116,3446
9,54	0,375	86	169,39	373,1057	124,3686	119,0686
10,16	0,400	90	173,1	381,2775	127,0925	121,7925
10,80	0,425	93	175,58	386,7401	128,9134	123,6134
11,43	0,450	97	178,05	392,1806	130,7269	125,4269
12,07	0,475	100	179,29	394,9119	131,6373	126,3373
12,70	0,500	103	180,52	397,6211	132,5404	127,2404

Keterangan: P_1 (kg) didapat dari "Tabel Konvesi Pembacaan Arloji" pada pengujian penetrasi.

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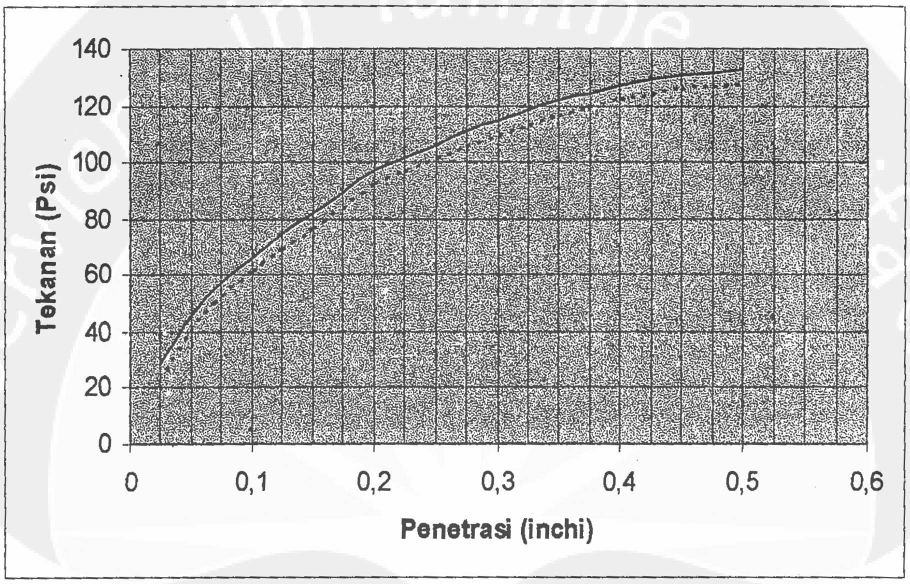
LABORATORIUM MEKANIKA TANAH

DIKERJAKAN : RINANDA PUTRI (9752)

Kurva CBR Titik Tiga



Kurva awal = ————————

Kurva koreksi = - - - - - - - - - - - -

Penetrasi 0,2 = $\frac{91,8299}{1500} x100 = 6,13\%$

Mengetahui,

(Sumiyati Gunawan, ST, MT.)
Kepala Lab. Mekanika Tanah

BALAI METEOROLOGI DAN GEOFISIKA WILAYAH V
STASIUN METEOROLOGI TANAH MERAH
Telp./Fax : 0971-31155 Bandar Udara Tanah Merah (99663)

UNSUR DATA KLIMATOLOGI

Periode / Tahun : 2000
Pada : Stasiun Meteorologi Tanah Merah
Posisi : 06°05' LS / 140° 19' BT
Ketinggian : ± 17 meter dpl.

UNSUR IKLIM \ BULAN		JAN	PEB	MAR	APR	MEI	JUN	JUL	AGS	SEP	OKT	NOV	DES
CURAH HUJAN (MM)		309.8	110.2	146.9	321.2	247.7	42.0	12	3.8	2.4	165.9	98.2	244
KELEMBABAN (%)		84	86	87	86	86	82	81	80	76	80	80	83
SUHU UDARA (°C)	RATA	27.0	27.2	27.0	27.2	26.5	25.3	24.5	25.0	26.2	28.4	28.0	27.6
	MAKS	30.9	30.6	31.1	31.2	30.4	28.2	28.3	29.2	31.5	31.7	32.4	32.2
	MIN	24.1	24.5	24.6	24.4	23.8	23.3	21.5	21.5	21.7	23.7	24.2	24.3
LAMA PENYINARAN MATAHARI (JAM)		133.9	885.5	148.4	133.0	155.0	111.7	136.8	160.0	217.5	160.0	195.0	133.0
KEC. ANGIN (knots)		9	10	10	9	11	13	13	20	20	18	9	10
ARAH ANGIN		W	NW	NW	N	SE	SE	SE	SE	SE	SE	NW	N
TEKANAN UDARA		06.4	06.8	07.3	07.1	08.6	09.7	10.8	10.0	10.3	08.7	06.0	05.7

Kepala Stasiun Meteorologi Tanah Merah,

DJ. AWI MARARO
NIP. : 120 118 811

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BALAI METEOROLOGI DAN GEOFISIKA WILAYAH V
STASIUN METEOROLOGI TANAH MERAH
Telp./Fax : 0971-31155 Bandar Udara Tanah Merah (99663)

UNSUR DATA KLIMATOLOGI

Periode / Tahun : 2001
Pada : Stasiun Meteorologi Tanah Merah
Posisi : 06°05' LS / 140° 19' BT
Ketinggian : ± 17 meter dpl.

BULAN / UNSUR IKLIM		JAN	PEB	MAR	APR	MEI	JUN	JUL	AGS	SEP	OKT	NOV	DES
CURAH HUJAN (MM)		340.1	163.4	364.6	342.8	85.5	14.7	1	4.9	14.9	41.4	387.5	193.4
KELEMBABAN (%)		82	84	84	86	79	80	77	76	74	75	83	81
SUHU UDARA (°C)	RATA	27.3	27.0	27.4	27.1	26.3	26.0	25.1	25.9	26.6	27.4	27.5	27.6
	MAKS	30.8	31.1	31.1	31.0	30.3	29.7	29.9	29.7	31.6	32.5	31.7	31.3
	MIN	21.1	24.1	24.3	24.4	23.0	23.0	21.6	21.1	21.7	23.4	23.4	23.4
LAMA PENYINARAN MATAHARI (JAM)		137.2	84.9	170.0	110.5	200.0	129.0	163.0	204.5	210.4	248.0		97.0
KEC. ANGIN (knots)		8	15	8	15	7	5	12	13	16	17	6	12
ARAH ANGIN		N	NW	N	E	E	SE	SE	SE	SE	E	SE	NW
TEKANAN UDARA		06.7	04.5	07.5	07.6	10.0	09.1	11.1	10.9	09.9	08.6	07.1	07.7

Kepala Stasiun Meteorologi Tanah Merah,

DJ. AWI MARARO
NIP. : 120 118 811

BALAI METEOROLOGI DAN GEOFISIKA WILAYAH V
STASIUN METEOROLOGI TANAH MERAH
Telp./Fax : 0971-31155 Bandar Udara Tanah Merah (99663)

UNSUR DATA KLIMATOLOGI

Periode / Tahun : 2002
Pada : Stasiun Meteorologi Tanah Merah
Posisi : 06°05' LS / 140° 19' BT
Ketinggian : ± 17 meter dpl.

UNSUR IKLIM \ BULAN		JAN	PEB	MAR	APR	MEI	JUN	JUL	AGS	SEP	OKT	NOV	DES
CURAH HUJAN (MM)		205.2	323.9	241.5	246.6	19.9	48.8	10.2	5.1	77.1	1.8	41.1	117.9
KELEMBABAN (%)		82	83	82	84	80	80	78	75	75	73	73	77
SUHU UDARA (°C)	RATA	27.8	27.3	27.3	27.1	26.6	26.2	25.0	25.0	25.7	26.7	28.1	28.4
	MAKS	31.7	31.2	30.9	31.1	30.8	30.0	29.5	29.7	31.1	31.7	33.0	32.7
	MIN	21.6	24.2	24.2	24.0	23.1	23.1	21.4	21.3	21.3	22.0	23.9	24.
LAMA PENYINARAN MATAHARI (JAM)		188.9	91.4	172.0	164.2	192.0	126.0	167.6	218.8	231.0	274.0	249.0	202.5
KEC. ANGIN (knots)		11	12	8	9	10	12	13	15	15	15	17	10
ARAH ANGIN		NW	N	W	SE	SE	SE	SE	SE	SE	SE	SE	S
TEKANAN UDARA		07.1	07.9	07.8	08.1	09.9	09.9	12.4	11.5	11.5	08.5	08.5	08.5

Kepala Stasiun Meteorologi Tanah Merah,

BADAN METEOROLOGI DAN GEOFISIKA ★ BALAI WILAYAH V ★ STASIUN METEOROLOGI TANAH MERAH

DJ. AWI MARARO
NIP. : 120 118 811

BALAI METEOROLOGI DAN GEOFISIKA WILAYAH V
STASIUN METEOROLOGI TANAH MERAH
Telp./Fax : 0971-31155 Bandar Udara Tanah Merah (99663)

UNSUR DATA KLIMATOLOGI

Periode / Tahun : 2003
Pada : Stasiun Meteorologi Tanah Merah
Posisi : 06°05' LS / 140° 19' BT
Ketinggian : ± 17 meter dpl.

UNSUR IKLIM \ BULAN		JAN	PEB	MAR	APR	MEI	JUN	JUL	AGS	SEP	OKT	NOV	DES
CURAH HUJAN (MM)		167	466.5	443.7	81.8	67.5	16.7	35.3	11.5	9.7	47.2	33.3	209.7
KELEMBABAN (%)		81	82	82	81	79	80	80	76	75	75	75	79
SUHU UDARA (°C)	RATA	27.4	27.6	27.4	27.3	27.0	2.61	25.4	25.3	26.1	27.0	27.4	28.1
	MAKS	32.0	30.9	31.0	31.4	31.2	30.2	29.2	29.8	31.0	32.0	32.5	32.5
	MIN	24.3	24.6	24.6	24.3	24.0	22.9	22.4	21.6	22.0	22.1	23.6	24.9
LAMA PENYINARAN MATAHARI (JAM)		137.6	95.6	131.8	189.1	193.0	205.4	129.1	161.0	198.8	126.0	238.0	13.8
KEC. ANGIN (knots)		9	10	10	9	11	12	14	8	17	10	6	11
ARAH ANGIN		NW	SW	W	S	SE	SE	SE	SE	SE	SE	SE	C
TEKANAN UDARA		07.9	07.4	08.2	08.6	09.2	10.6	09.9	11.3	10.7	08.1	09.1	06.8

Kepala Stasiun Meteorologi Tanah Merah,

BALAI METEOROLOGI DAN GEOFISIKA ★ STASIUN METEOROLOGI TANAH MERAH ★ BALAI WILAYAH V

DJ. AWI MARARO
NIP. : 120 118 811

BALAI METEOROLOGI DAN GEOFISIKA WILAYAH V
STASIUN METEOROLOGI TANAH MERAH
Telp./Fax : 0971-31155 Bandar Udara Tanah Merah (99663)

UNSUR DATA KLIMATOLOGI

Periode / Tahun : 2004
Pada : Stasiun Meteorologi Tanah Merah
Posisi : 06°05' LS / 140° 19' BT
Ketinggian : ± 17 meter dpl.

UNSUR IKLIM \ BULAN		JAN	PEB	MAR	APR	MEI	JUN	JUL	AGS	SEP	OKT	NOV	DES
CURAH HUJAN (MM)		294.6	245.9	304.5	86.12	271.9	13.1	22.8	44	180	131	98.4	104.0
KELEMBABAN (%)		82	84	84	80	82	78	76	73	75	75	79	80
SUHU UDARA (°C)	RATA	27.2	26.9	27.4	27.5	27.2	25.3	24.7	24.4	26.7	26.9	27.5	27.6
	MAKS	31.7	30.7	31.1	30.8	31.0	29.3	28.9	29.6	30.2	29.8	29.8	32.5
	MIN	24.6	23.7	24.5	23.5	24.6	22.1	21.1	19.6	24.3	21.6	22.1	24.0
LAMA PENYINARAN MATAHARI (JAM)		163.6	104.5	123.1	207.0	127.7	130.7	207.8	228.9	138.2	125.0	211.6	108.8
KEC. ANGIN (knots)		9	12	12	8	5	5	7	6	4	6	7	10
ARAH ANGIN		NW	NW	W	E	SE	SE	SE	S	SE	SE	SE	S
TEKANAN UDARA		07.5	07.1	06.8	08.6	08.5	11.7	11.3	11.3	08.7	08.8	06.0	06.8

Kepala Stasiun Meteorologi Tanah Merah,

BADAN METEOROLOGI DAN GEOFISIKA STASIUN METEOROLOGI TANAH MERAH BALAI WILAYAH V

DJ. AWI MARARO
NIP. : 120 118 811

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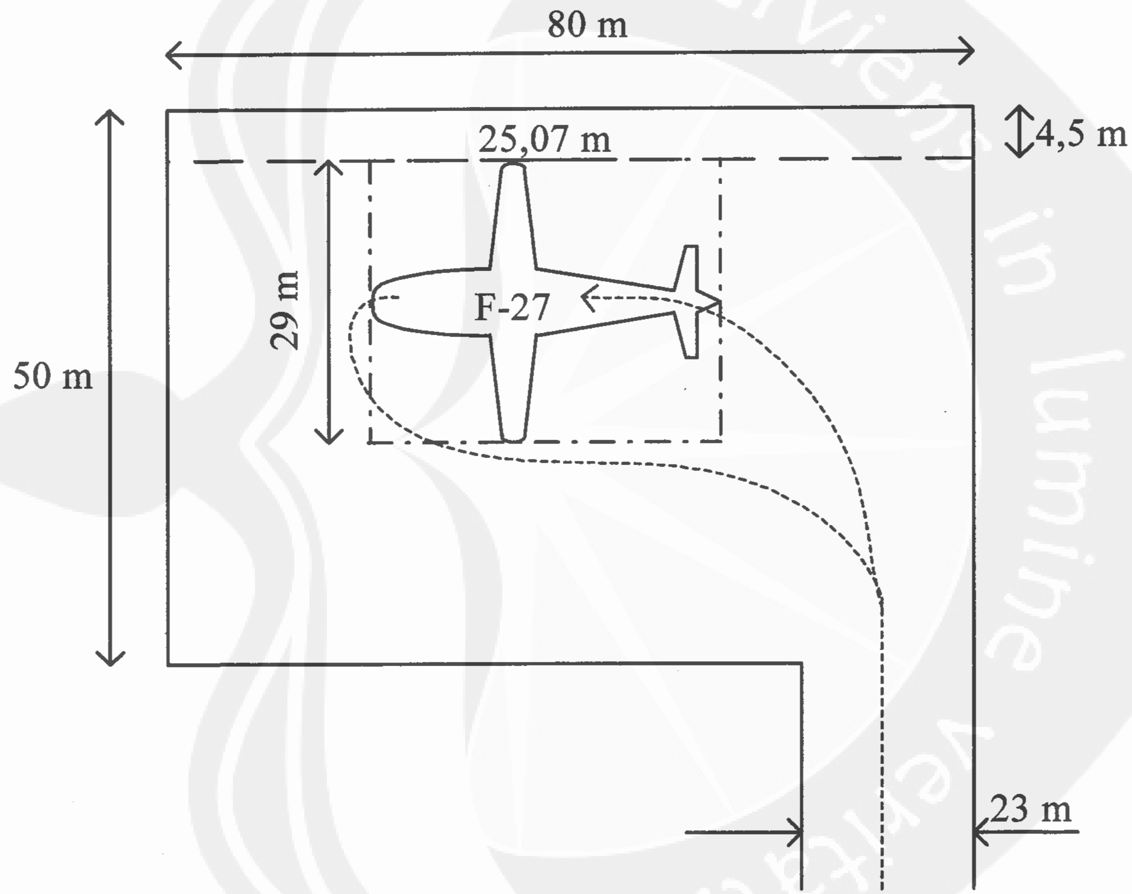
DATA TEKNIS PESAWAT TERBANG CASSA 212

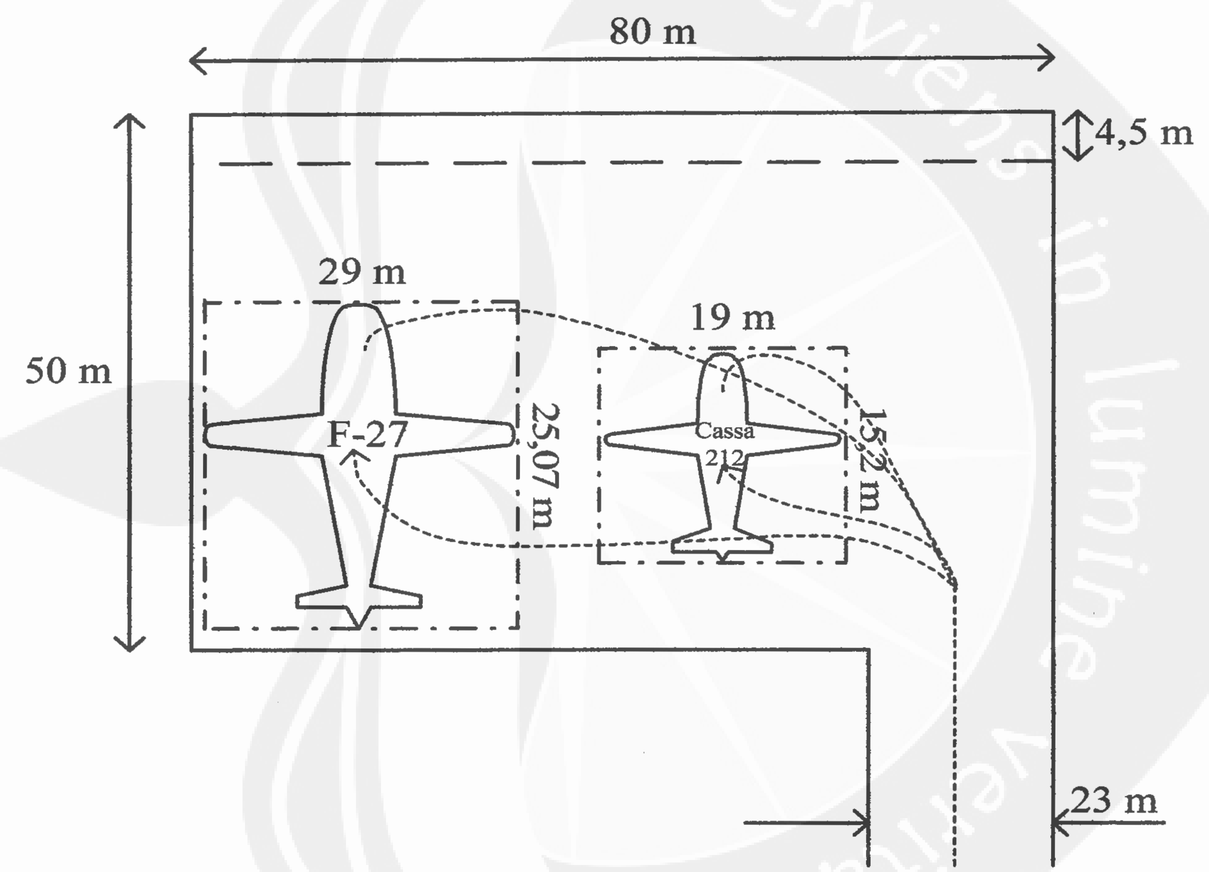
1 Operating Weight Empty	5500 kg	
2 Pay Load	1400 kg	
3 Maximum Structural Take Off Weight	7450 kg	Ops Tow = 7166
4 Maximum Structural Landing Weight	7350 kg	Ops Low = 7100
5 Kapasitas Angkut Penumpang Maksimum	18 seats	
6 Jumlah Crew Pesawat	2 orang	
7 Kapasitas Angkut Bagasi Kabin	180 kg	
8 Kapasitas Angkut Bagasi/Cargo	200 kg	
9 Jarak Jelajah Maximum	600 NM/4 jam	
10 Ketinggian Terbang Pesawat	Below 10.000 ft	
11 Kecepatan Pesawat	160 kts	
12 Kebutuhan BBM per mil	700 lbs/HRS	
13 Kapasitas Tangki BBM	3400 lbs	
14 Panjang Badan Pesawat	596.61"	
15 Lebar Rentang Sayap Pesawat	748.03"	
16 Wheel Tread (jarak antara main gear)	122.05"	
17 Wheel Base (jarak antara nose gear dengan main gear)	214.76"	
18 Maksimum Height (tinggi maksimum badan pesawat)	248.42"	

Kupang, 12 September 2002
Yang Memberikan Informasi

SOVRY AMALO



Konfigurasi Parkir di Apron Khusus Pesawat Fokker-27



Konfigurasi Parkir di Apron Untuk Pesawat Fokker-27 dan Cassa 212