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REPUBLIC OF INDONESIA

# THE STUDY
# ON
# THE AIRPORT DEVELOPMENT PROJECT
# IN
# CENTRAL JAVA AND YOGYAKARTA

## APPENDIX

NOVEMBER 1986

JAPAN INTERNATIONAL COOPERATION AGENCY

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## LIST OF APPENDICES

Appendix to Part I, Chapter 3 ( I-3 )

# Traffic Flow Survey for Yogyakarta, Surakarta and Semarang Airports

## 1 Survey Items

Survey items for passengers are as follows:

(1) Nationality
(2) Purpose of trip
(3) Orignal point of departure to the airport
(4) Access mode to the airport
(5) Fare and access time to the airport
(6) Route of the trip ( for foreigenrs only )
(7) Sex
(8) Age
(9) Occupation

## 2 Period of the Survey

The survey was executed for four days from Thursday, Aug. 29 to Sunday, Sep. 1, 1985.

Survey hours were from one hour before the first departing flight to the time of last departing flight at each airport.

## 3 Method of the Survey

The survey was made by directly interviewing the departing passengers. The interview survey form is shown in Fig. 1. The interview was carried out at the gate lounge or check-in lobby of each airport.

For the tourist group, only the group leader was interviewed as a representative of all members.

The number of departing passengers in the survey period is shown in Table 1, and the number of passengers interviewed is shown in Table 2. More than 80 % of all departing passengers were interviewed at each airport.

No.
Date / Tgl
Flight No. / Nomor Penerbangan
Number of Group Members / Banyaknya Anggota Rombongan

1. Nationality / Kewarga Negaraan
1. Indonesia / Indonesia
2. Japan / Jepang
3. Netherland / Belanda
4. United States / Amerika Serikat
5. France / Perancis
6. West Germany / Jerman Barat
7. Australia / Australia
8. Others / Lain-lain

2. Purpose of your stay here / Tujuan utama untuk datang ke Jogjakarta/Jawa Tengah
1. Sight-seeing / Pariwisata
2. Business / Dagang /Dinas
3. Others / Lain-lain

3. The original point of departure to this airport / Tempat asal keberangkatan sebelum ke Jogjakarta/Jawa Tengah
1. Kab.Cilacap, Kab.Banyumas, Kab.Purbalingga, Kab.Banjarnegara
2. Kab.Kebumen, Kab.Purworejo, Kab.Wonosobo, Kab.Magelang, Kab.Temanggung, Kot.Magelang
3. Kab.Klaten, Kab.Sukoharjo, Kab.Wonogiri, Kab.Karanganyar, Kab.Sragen, Kab.Surakarta, Kab.Boyolali
4. Kab.Grobogan, Kab.Semarang, Kot.Salatiga, Kab.Kendal, Kot.Semarang
5. Kab.Blora, Kab.Rembang, Kab.Pati, Kab.Kudus, Kab.Jepara
6. Kab.Batang, Kab.Pekalongan, Kab.Pemalang, Kab.Tegal, Kab.Brebes, Kot.Tegal, Kot.Pekalongan
7. Yogyakarta
8. Others/Lain-lain

4. Transportation facilities to this airport / Fasilitas angkutan ke pelabuhan udara
1. Taxi / Taksi
2. Private car / Kendaraan pribadi
3. Bus / Bus
4. Others / Lain-lain

5. Fare and access time to this airport / Ongkos kendaraan ke pelabuhan udara dan lamanya waktu sampai di pelabuhan udara.
Rp. ____ per person/tiap orang; per group/tiap rombongan
____ min./menit

6. Route of your trip / Sebutkan perjalanan anda.
City / Kota
Date / Tgl

A : Australia
F : France
J : Japan
N : Netherland
U : United States
W : West Germany

Ba : Bali
Bd : Bandung
Bj : Banjarmasin
Ci : Cilacap
De : Denpasar
Ja : Jakarta
Jj : Jogjakarta
Se : Semarang
Su : Surakarta
Ty : Yogyakarta

7. Sex / Jenis kelamin
1. Male / Laki
2. Female / Perempuan

8. Age / Umur
1. Under 19 / Dibawah 19
2. 20-29
3. 30-39
4. 40-49
5. 50-59
6. 60 and over / Diatas 60

9. Occupation / Pekerjaan
1. Administrative, executive staff / Karyawan perusahaan
2. Government official / Pegawai negeri
3. Professional / Wiraswasta
4. Self-employed / Pedagang
5. Agriculture/fishery worker / Pekerja pertanian/perikanan
6. Student / Pelajar/Mahasiswa
7. Housewife / Ibu rumahtangga
8. Others / Lain-lain

Fig. 1 Interview Survey Form

## Table 1 Number of Passengers of Departure Flight

1. YOGYAKARTA

| FLT NO. | DESTINATION | DEPARTURE TIME | TYPE OF AIRCRAFT | NUMBER OF PASSENGERS | | | | LOAD FACTOR |
|---|---|---|---|---|---|---|---|---|
| | | | | AUG. 29 | 30 | 31 | SEP. 1 | |
| MZ 546 | SURABAYA | 7 : 00 | F27 | 18 | 31 | 15 | 29 | 47.2 % |
| GA 431 | JAKARTA | 8 : 10 | D9S | 98 | 87 | 40 | 51 | |
| GA 630 | DENPASAR | 8 : 20 | D9S | 10 | 23 | 7 | 45 | |
| BO 236 | BANJARMASIN | 8 : 30 | HS7 | 40 | 27 | 20 | 38 | |
| GA 433 | JAKARTA | 10 : 10 | D9S | – | – | 40 | 23 | |
| GA 036 | JAKARTA | 11 : 40 | D9S | 94 | 102 | 21 | 50 | |
| GA 632 | DENPASAR | 12 : 00 | D9S | 28 | 46 | 13 | 61 | |
| GA 437 | JAKARTA | 13 : 40 | D9S | – | – | 53 | 69 | |
| BO 237 | BANDUNG | 14 : 15 | HS7 | – | 23 | 10 | 27 | |
| GA 439 | JAKARTA | 15 : 10 | D9S | 105 | 97 | 44 | 71 | |
| GA 634 | DENPASAR | 16 : 00 | D9S | 84 | 75 | 54 | 18 | |
| | | | T O T A L | 490 | 511 | 317 | 482 | |

2. SURAKARTA

| FLT NO. | DESTINATION | DEPARTURE TIME | TYPE OF AIRCRAFT | NUMBER OF PASSENGERS | | | | LOAD FACTOR |
|---|---|---|---|---|---|---|---|---|
| | | | | AUG. 29 | 30 | 31 | SEP. 1 | |
| GA 306 | SURABAYA | 8 : 40 | F28 | 12 | 13 | 7 | 17 | 51.5 % |
| GA 405 | JAKARTA | 8 : 50 | F28 | 60 | 30 | 14 | 61 | |
| GA 409 | JAKARTA | 14 : 50 | F28 | 66 | 39 | 27 | 46 | |
| | | | T O T A L | 138 | 82 | 48 | 134 | |

3. SEMARANG

| FLT NO. | DESTINATION | DEPARTURE TIME | TYPE OF AIRCRAFT | NUMBER OF PASSENGERS | | | | LOAD FACTOR |
|---|---|---|---|---|---|---|---|---|
| | | | | AUG. 29 | 30 | 31 | SEP. 1 | |
| QH 251 | JAKARTA | 7 : 00 | VCV | 53 | – | 39 | 35 | 47.7 % |
| DC 583 | PANGKALANBUN | 7 : 00 | CASA | 13 | – | – | 16 | |
| GA 020 | JAKARTA | 7 : 20 | F28 | 37 | 53 | 40 | 30 | |
| MZ 433 | PANGKALANBUN | 7 : 30 | CS2 | 13 | 20 | 10 | 19 | |
| GA 026 | SURABAYA | 7 : 55 | F28 | 38 | 26 | 39 | 23 | |
| GA 002 | JAKARTA | 8 : 20 | F28 | 36 | 15 | 17 | 22 | |
| MZ 554 | SURABAYA | 8 : 40 | F27 | – | 5 | 1 | 9 | |
| BO 239 | BANJARMASIN | 8 : 45 | HS7 | 5 | 11 | 21 | 14 | |
| GA 022 | JAKARTA | 10 : 20 | F28 | 43 | 56 | 33 | 37 | |
| GA 004 | JAKARTA | 12 : 20 | F28 | 18 | 35 | 46 | 43 | |
| QH 253 | JAKARTA | 13 : 15 | VCV | – | – | – | – | |
| GA 425 | JAKARTA | 13 : 20 | F28 | 37 | 30 | 30 | 39 | |
| BO 238 | JAKARTA | 14 : 00 | HS7 | 50 | 3 | 29 | 25 | |
| MZ 555 | BANDUNG | 15 : 10 | F27 | 24 | 11 | 17 | 17 | |
| GA 427 | JAKARTA | 15 : 20 | F28 | 50 | 53 | 66 | 67 | |
| GA 304 | SURABAYA | 15 : 30 | F28 | 36 | 33 | 53 | 29 | |
| GA 429 | JAKARTA | 16 : 20 | F28 | 63 | 32 | 40 | 24 | |
| | | | T O T A L | 486 | 383 | 481 | 449 | |

NOTE : AIRLINE CODES

GA : GARUDA  QH : MANDALA
MZ : MERPATI  DC : DERAYA
BO : BOURAQ

SEAT CAPACITY

DC9-32 (D9S) : 102  VCV : 65-68
F28 : 65  HS748: 44
F27 : 44-56  CASA : 18

Table 2 Number of Passengers Interviewed by Route

| Airport | Destination | Passengers Interviewed | | | | | Rate of Passengers Interviewed |
|---|---|---|---|---|---|---|---|
| | | 29 | 30 | 31 | 1 | Total | |
| 1. YOGYAKARTA | JAKARTA | 263 | 222 | 151 | 202 | 838 | 1,446 / 1,800 = 80.3% (Actual Total PAX 1,800) |
| | SURABAYA | 18 | 21 | 14 | 19 | 72 | |
| | BANJARMASIN | 32 | 11 | 20 | 22 | 85 | |
| | BANDUNG | 8 | 23 | 7 | 10 | 48 | |
| | DENPASAR | 103 | 144 | 60 | 96 | 403 | |
| | TOTAL | 424 | 421 | 252 | 349 | 1,446 | |
| 2. SURAKARTA | JAKARTA | 126 | 66 | 41 | 107 | 340 | 398 / 402 = 99.0% (Actual Total PAX 402) |
| | SURABAYA | 12 | 13 | 7 | 26 | 58 | |
| | TOTAL | 138 | 79 | 48 | 133 | 398 | |
| 3. SEMARANG | JAKARTA | 352 | 272 | 330 | 296 | 1,250 | 1,661 / 1,799 = 92.3% (Actual Total PAX 1,799) |
| | PANGKALANBUN | 26 | 19 | 10 | 34 | 89 | |
| | SURABAYA | 46 | 51 | 87 | 56 | 240 | |
| | BANJARMASIN | 5 | 11 | 15 | 14 | 45 | |
| | BANDUNG | 4 | 11 | 14 | 8 | 37 | |
| | TOTAL | 433 | 364 | 456 | 408 | 1,661 | |
| TOTAL | | 995 | 864 | 756 | 890 | 3,505 | 3,505 / 4,001 ≑ 87.6% |

## 4 Result of Survey

### (1) Nationality

The passengers of each airport are classified by nationality as shown in Table 3.

At Semarang and Surakarta airports, Indonesians made up 80 - 90 % of total passengers. However at Yogyakarta airport, Indonesians were less than 50 %, and foreigners mainly from Japan, Europe and United States were more than 50 % of all passengers.

There are five air routes from Yogyakarta, and the number of passengers travelling on each route is also shown in Table 3. For Indonesians, passengers bound for Jakarta or Denpasar were about 70 %, and others were bound for local cities. But for foreigners, passengers bound for Jakarta or Denpasar were more than 90 % of the total number of foreign passengers.

At Surakarta and Semarang airports, 70 - 90 % of the passengers were bound for Jakarta.

# Table 3 Nationality

( ) : %

1. YOGYAKARTA

| Route \ Nationality | Indonesia | Japan | Netherland | U.S. | France | West Germany | Australia | Others | Total |
|---|---|---|---|---|---|---|---|---|---|
| JAKARTA | 864 (60.5) | 171 (30.4) | 80 (37.6) | 64 (64.0) | 254 (94.4) | 120 (87.2) | 28 (58.3) | 336 (63.0) | 1,917 (58.1) |
| SURABAYA | 156 (40.9) | 0 (0) | 8 (3.8) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 3 (0.6) | 167 (5.1) |
| BANJARMASIN | 206 (44.4) | 0 (0) | 0 (0) | 6 (6.0) | 6 (2.2) | 1 (0.7) | 0 (0) | 6 (1.1) | 225 (6.8) |
| BANDUNG | 110 (7.7) | 0 (0) | 0 (0) | 12 (12.0) | 0 (0) | 0 (0) | 0 (0) | 4 (0.8) | 126 (3.8) |
| DENPASAR | 91 (6.4) | 391 (69.6) | 125 (58.7) | 18 (18.0) | 9 (3.3) | 25 (17.1) | 20 (41.7) | 184 (34.5) | 863 (26.2) |
| TOTAL | 1,427 (100.0) | 562 (100.0) | 213 (100.0) | 100 (100.0) | 269 (100.0) | 146 (100.0) | 48 (100.0) | 533 (100.0) | 3,298 (100.0) |
| | 1,427 (43.3) | 562 (17.0) | 213 (6.6) | 100 (3.0) | 269 (8.2) | 146 (4.4) | 48 (1.5) | 533 (16.2) | 3,298 (100.0) |

2. SURAKARTA

| Route \ Nationality | Indonesia | Japan | Netherland | U.S. | France | West Germany | Australia | Others | Total |
|---|---|---|---|---|---|---|---|---|---|
| JAKARTA | 558 (90.7) | 19 (79.2) | 8 (80.0) | 6 (54.5) | 0 (-) | 5 (20.0) | 0 (-) | 40 (85.1) | 636 (86.9) |
| SURABAYA | 57 (9.3) | 5 (20.8) | 2 (20.0) | 5 (45.5) | 0 (-) | 20 (80.0) | 0 (-) | 7 (14.9) | 96 (13.1) |
| TOTAL | 615 (100.0) | 24 (100.0) | 10 (100.0) | 11 (100.0) | 0 (-) | 25 (100.0) | 0 (-) | 47 (100.0) | 732 (100.0) |
| | 615 (84.0) | 24 (3.3) | 10 (1.4) | 11 (1.5) | 0 (0) | 25 (3.4) | 0 (0) | 47 (6.4) | 732 (100.0) |

3. SEMARANG

| Route \ Nationality | Indonesia | Japan | Netherland | U.S. | France | West Germany | Australia | Others | Total |
|---|---|---|---|---|---|---|---|---|---|
| JAKARTA | 1,996 (71.7) | 46 (74.2) | 2 (8.0) | 32 (80.0) | 0 (0) | 3 (100.0) | 4 (40.0) | 164 (91.1) | 2,247 (72.4) |
| PANGKALANBUN | 160 (5.7) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 160 (5.2) |
| SURABAYA | 437 (15.7) | 16 (25.8) | 23 (92.0) | 8 (20.0) | 0 (0) | 0 (0) | 0 (0) | 16 (8.9) | 500 (16.1) |
| BANJARMASIN | 75 (2.7) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 75 (2.4) |
| BANDUNG | 115 (4.1) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 6 (60.0) | 0 (0) | 121 (3.9) |
| TOTAL | 2,783 (100.0) | 62 (100.0) | 25 (100.0) | 40 (100.0) | 0 (100.0) | 3 (100.0) | 10 (100.0) | 180 (100.0) | 3,103 (100.0) |
| | 2,783 (89.7) | 62 (2.0) | 25 (0.8) | 40 (1.3) | 0 (0) | 3 (0.1) | 10 (0.3) | 180 (5.8) | 3,103 (100.0) |

(2) Purpose of Trip

The purpose of trip of the passengers is shown in Table 4.

At Yogyakarta airport, nearly 50% of passengers were on sightseeing excursions, and 20 % were on business trips.

But at Surakarta and Semarang, sightseeing passengers consisted of only 7 - 20 % of all passengers, but business passengers made up 30 -60 %.

Table 5 shows the purpose of trip for Indonesians and foreigners.

At Yogyakarta, 82 % of foreigners were tourists on sightseeing excursions. However, Indonesian tourists on sightseeing trips only amounted to 4 %, and business passengers totalled 34 %.

At Surakarta, Indonesian sightseeing tourists were also only 2 %, and business passengers were 34 %. Foreign sightseeing tourists were 38 % and business passengers were 33 %.

At Semarang, about 50 % of Indonesians and foreigners were on business trips, with the sightseeing passengers only amounting to 20 - 30 % for the Indonesians and foreign passengers.

## Table 4 Purpose of Trip by Routes

( ):%

1. YOGYAKARTA

| Route \ Purpose | Sightseeing | Business | Others | Total |
|---|---|---|---|---|
| JAKARTA | 938 (48.9) | 421 (21.9) | 561 (29.2) | 1,920 (100) |
| SURABAYA | 8 ( 4.8) | 74 (44.6) | 84 (50.6) | 166 (100) |
| BANJARMASIN | 17 ( 7.6) | 68 (30.2) | 140 (62.2) | 225 (100) |
| BANDUNG | 20 (15.7) | 47 (37.0) | 60 (47.2) | 127 (100) |
| DENPASAR | 624 (72.2) | 42 ( 4.9) | 198 (22.9) | 864 (100) |
| TOTAL | 1,607 (48.7) | 652 (19.7) | 1,043 (31.6) | 3,302 (100) |

2. SURAKARTA

| Route \ Purpose | Sightseeing | Business | Others | Total |
|---|---|---|---|---|
| JAKARTA | 42 ( 6.7) | 205 (32.5) | 384 (60.8) | 631 (100) |
| SURABAYA | 28 (28.9) | 32 (33.0) | 37 (38.1) | 97 (100) |
| TOTAL | 70 ( 9.6) | 237 (32.6) | 421 (57.8) | 728 (100) |

3. SEMARANG

| Route \ Porpose | Sightseeing | Business | Others | Total |
|---|---|---|---|---|
| JAKARTA | 377 (16.8) | 1,321 (58.8) | 549 (24.4) | 2,247 (100) |
| PANGKALANBUN | 41 (25.6) | 87 (54.4) | 32 (20.0) | 160 (100) |
| SURABAYA | 85 (17.0) | 255 (51.1) | 159 (31.9) | 499 (100) |
| BANJARMASIN | 28 (37.3) | 31 (41.3) | 16 (21.3) | 75 (100) |
| BANDUNG | 16 (13.2) | 67 (55.4) | 38 (31.4) | 121 (100) |
| TOTAL | 547 (17.6) | 1,761 (56.8) | 794 (25.6) | 3,102 (100) |

Table 5 Purpose of Trip by Nationality

1. YOGYAKARTA

( ) : %

| Purpose / Nationality | Sightseeing | Business | Others | Total |
|---|---|---|---|---|
| Indonesians | 49 ( 3.4) | 518 (36.3) | 859 (60.2) | 1,426 (100) |
| Foreigners | 1,557 (83.0) | 133 (7.1) | 186 ( 9.9) | 1,876 (100) |

2. SURAKARTA

| Purpose / Nationality | Sightseeing | Business | Others | Total |
|---|---|---|---|---|
| Indonesians | 18 ( 3.0) | 200 (32.8) | 392 (64.3) | 610 (100) |
| Foreigners | 52 (43.7) | 37 (31.1) | 30 (25.2) | 119 (100) |

3. SEMARANG

| Purpose / Nationality | Sightseeing | Business | Others | Total |
|---|---|---|---|---|
| Indonesians | 451 (16.2) | 1,585 (57.0) | 747 (26.8) | 2,783 (100) |
| Foreigners | 96 (30.2) | 175 (55.0) | 47 (14.8) | 318 (100) |

(3) Original Point of Departure to the Airport

The original point of departing passengers is summarized as shown in Table 6.

More than 80 % of passengers in each airport come from the zone including that airport.

Table 6 The Original Zone by Nationality

1. YOGYAKARTA — Unit : Person (%)

| Original Zone | Indonesian | Foreigner | Total |
|---|---|---|---|
| 1 | 10 ( 1.5) | 12 ( 1.5) | 22 ( 1.5) |
| 2 | 50 ( 7.7) | 3 ( 0.4) | 53 ( 3.7) |
| 3 | 61 ( 9.4) | 8 ( 1.0) | 69 ( 4.8) |
| 4 | 12 ( 1.9) | 3 ( 0.4) | 15 ( 1.0) |
| 5 | 0 ( 0 ) | 0 ( 0 ) | 0 ( 0 ) |
| 6 | 1 ( 0.2) | 0 ( 0 ) | 1 ( 0.1) |
| 7 | 508 (78.6) | 756 (94.4) | 1264 (87.4) |
| 8 | 4 ( 0.6) | 19 ( 2.4) | 23 ( 1.6) |
| Total | 646 (100 ) | 801 (100 ) | 1447 (100 ) |

2. SURAKARTA

| Original Zone | Indonesian | Foreigner | Total |
|---|---|---|---|
| 1 | 1 ( 0.3) | 0 ( 0 ) | 1 ( 0.3) |
| 2 | 0 ( 0 ) | 0 ( 0 ) | 0 ( 0 ) |
| 3 | 298 (87.9) | 44 (73.3) | 342 (85.7) |
| 4 | 7 ( 2.1) | 0 ( 0 ) | 7 ( 1.8) |
| 5 | 0 ( 0 ) | 0 ( 0 ) | 0 ( 0 ) |
| 6 | 0 ( 0 ) | 0 ( 0 ) | 0 ( 0 ) |
| 7 | 15 ( 4.4) | 16 (26.7) | 31 ( 7.8) |
| 8 | 18 ( 5.3) | 0 ( 0 ) | 18 ( 4.5) |
| Total | 339 (100 ) | 60 (100 ) | 399 (100 ) |

3. SEMARANG

| Original Zone | Indonesian | Foreigner | Total |
|---|---|---|---|
| 1 | 11 ( 0.7) | 8 ( 4.9) | 19 ( 1.1) |
| 2 | 22 ( 1.5) | 0 ( 0 ) | 22 ( 1.3) |
| 3 | 20 ( 1.3) | 0 ( 0 ) | 20 ( 1.2) |
| 4 | 1328 (88.6) | 139 (85.3) | 1467 (88.3) |
| 5 | 59 ( 3.9) | 4 ( 2.5) | 63 ( 3.8) |
| 6 | 27 ( 1.8) | 6 ( 3.7) | 33 ( 2.0) |
| 7 | 6 ( 0.4) | 1 ( 0.6) | 7 ( 0.4) |
| 8 | 26 ( 1.7) | 5 ( 3.1) | 31 ( 1.9) |
| Total | 1499 (100 ) | 163 (100 ) | 1662 (100 ) |

Note ; Zone codes are shown in Fig 2.

1
- Kab.Cilacap
- Kab.Banyumas
- Kab.Purbalingga
- Kab.Banjarnegara

2
- Kab.Kebumen
- Kab.Purworejo
- Kab.Wonosobo
- Kab.Magelang
- Kab.Temanggung
- Kot.Magelang

3
- Kab.Klaten
- Kab.Sukoharjo
- Kab.Wonogiri
- Kab.Karanganyar
- Kab.Sragen
- Kab.Surakarta
- Kab.Boyolali

4
- Kab.Grobogan
- Kab.Semarang
- Kot.Salatiga
- Kab.Kendal
- Kot.Semarang

5
- Kab.Blora
- Kab.Rembang
- Kab.Pati
- Kab.Kudus
- Kab.Jepara

6
- Kab.Batang
- Kab.Pekalongan
- Kab.Pemalang
- Kab.Tegal
- Kab.Brebes
- Kot.Tegal
- Kot.Pekalongan

7.Yogyakarta

8.Others/Lain-lain

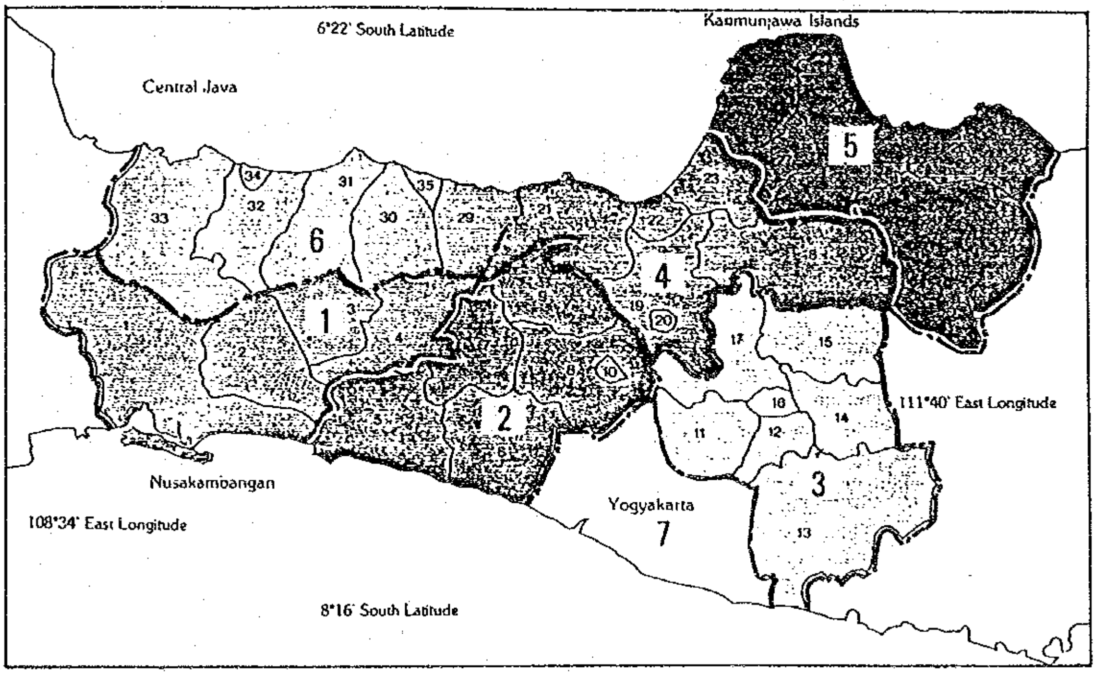



Fig. 2 Original Zone Codes

(4) Access mode to the Airport

The mode of access to the airport is shown in Table 7.

At Surakarta and Semarang airports, private cars were used for access by more than 60 % of the passengers. At Yogyakarta, private cars were used by 26 % of the passengers, because many tourist groups used buses for access to the airports.

Table 7 Access Mode by Nationality

( ) : %

1. YOGYAKARTA

| Mode \ Nationality | Indonesian | | Foreigner | | Total | |
|---|---|---|---|---|---|---|
| Taxi | 246 | (17.2) | 342 | (18.2) | 588 | (17.8) |
| Private Car | 724 | (50.7) | 90 | ( 4.8) | 814 | (24.7) |
| Bus | 133 | ( 9.3) | 1008 | (53.8) | 1141 | (34.6) |
| Others | 323 | ( 1.6) | 436 | (23.3) | 759 | (23.0) |
| Total | 1426 | (100.0) | 1876 | (100.0) | 3302 | (100.0) |

2. SURAKARTA

| Mode \ Nationality | Indonesian | | Foreigner | | Total | |
|---|---|---|---|---|---|---|
| Taxi | 102 | (16.6) | 8 | ( 6.9) | 110 | (15.0) |
| Private Car | 407 | (66.1) | 47 | (40.5) | 454 | (62.0) |
| Bus | 12 | ( 1.9) | 30 | (25.9) | 42 | ( 5.7) |
| Others | 95 | (15.4) | 31 | (26.7) | 126 | ( 9.4) |
| Total | 616 | (100.0) | 116 | (100.0) | 732 | (100.0) |

3. SEMARANG

| Mode \ Nationality | Indonesian | | Foreigner | | Total | |
|---|---|---|---|---|---|---|
| Taxi | 593 | (21.3) | 41 | (12.8) | 634 | (20.4) |
| Private Car | 1694 | (60.9) | 212 | (66.3) | 1906 | (61.4) |
| Bus | 70 | ( 2.5) | 47 | (14.7) | 117 | ( 3.8) |
| Others | 426 | (15.3) | 20 | ( 6.3) | 446 | (14.4) |
| Total | 2783 | (100.0) | 320 | (100.0) | 3103 | (100.0) |

4. TOTAL

| Mode \ Nationality | Indonesian | | Foreigner | | Total | |
|---|---|---|---|---|---|---|
| Taxi | 941 | (19.5) | 391 | (16.9) | 1332 | (18.7) |
| Private Car | 2825 | (58.5) | 349 | (15.1) | 3174 | (44.5) |
| Bus | 215 | ( 4.5) | 1085 | (46.9) | 1300 | (18.2) |
| Others | 844 | (17.5) | 487 | (21.1) | 1331 | (18.6) |
| Total | 4825 | (100.0) | 2312 | (100.0) | 7137 | (100.0) |

(5) Fare and Access Time to the Airport

Average value of the fare and the time for access are shownin Table 8.

Average access fare was Rp.1,000 - 1,600 per person for the three airports, and the access time was approximately 30 minutes to each airport.

Table 8 Average Access Fare & Access Time

| Item / Airport | Fare (Rp) | Time (min) |
|---|---|---|
| Yogyakarta | 1371.4 | 34.6 |
| Surakarta | 1642.2 | 27.7 |
| Semarang | 1022.6 | 34.1 |

(6) Route of Trip of Foreign Passengers

According to the results of the survey, there aré many kinds of travelling routes used by foreign passengers. More than 60 kinds of samples were collected for Yogyakarta airport, and about 15 kinds for Surakarta, and 20 kinds for Semarang.

However all the trip routes can be grouped into several typical patterns. For example, the following trip routes are represented by typical patterns, as shown below.

Jakarta - Ujung Pandang - Bali - Yogyakarta - Jakarta
Medan - Jakarta - Bali - Yogyakarta - Jakarta
Jakarta - Bali - Yogyakarta - Surabaya - Yogyakarta - Jakarta
Jakarta - Bali - Ujung Pandang - Surabaya - Yogyakarta - Jakarta e.t.c.

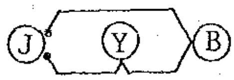
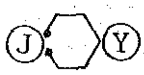
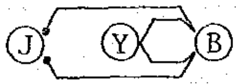
↓

Jakarta - Bali - Yogyakarta - Jakarta

a) Yogyakarta Arport

Trip routes are classified into seven patterns.

Table 9 Trip pattern in Yogyakarta Airport

| Pattern | All Passengers | Sightseeing Passengers |
|---|---|---|
| 1.  | 581 (36.5%) | 567 (41.3%) |
| 2.  | 351 (22.0%) | 351 (25.6%) |
| 3.  | 305 (19.2%) | 209 (15.2%) |
| 4.  | 187 (11.7%) | 170 (12.4%) |
| 5.  | 102 (6.4%) | 10 (0.7%) |
| 6.  | 35 (2.2%) | 35 (2.5%) |
| 7.  | 31 (1.9%) | 31 (2.3%) |
| Total | 1,592 (100.0%) | 1,373 (100.0%) |

Note: (J)= Jakarta, (Y)= Yogyakarta, (B)= Bali.

As shown in the above table, passengers visiting only Yogyakarta from Jakarta are 12 % (pattern 4). However, there are many passengers dropping in at Yogyakarta on their way to Bali from Jakarta, and also other passengers are making a return trip from Bali.

Those passengers visiting both Yogyakarta and Bali make up more than 85 % of all foreign passengers. About 60 % of all foreigners are passengers between Yogyakarta and Bali, and others are passengers between Yogyakarta and Jakarta.

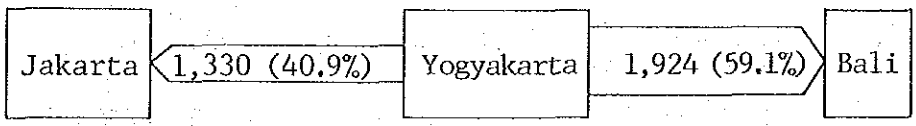



Fig. 3 Number of Passengers of Major Route

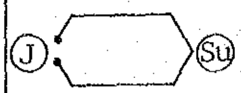
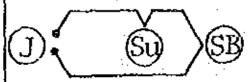
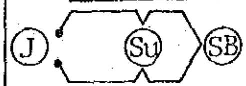
b) Surakarta Arport

There are two air routes from Surakarta airport, one is for Jakarta, and another for Surabaya. Though the number of collected samples is not so great in comparison with other two airports, the trip routes by passengers are classified into five patterns.

More than 50 % of foreign passengers come from Jakarta and return to Jakarta. And other passengers travel from Jakarta to Surabaya or Bali by way of Surakarta.

Nearly 80 % of all foreigners are passengers using the Jakarta - Surakarta route.

Table 10 Trip Pattern in Surakarta Airport

| Pattern | Foreign Passengers | Foreign Sightseeing Passengers |
|---|---|---|
|  | 41 (53.9%) | 2 (7.1%) |
|  | 20 (26.3%) | 20 (71.4%) |
|  | 5 (6.6%) | 5 (17.9%) |
|  | 5 (6.6%) | 1 (3.6%) |
|  | 5 (6.6%) | 0 (0.0%) |
| Total | 76 (100.0%) | 28 (100.0%) |

Note : Ⓙ = Jakarta (Su) = Surakarta (SB) = Surabaya
Ⓑ = Bali

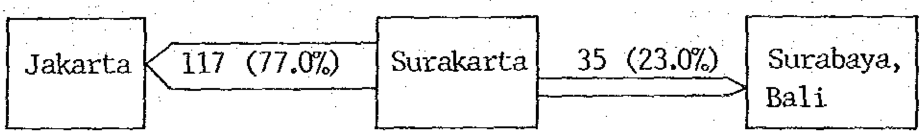


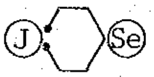
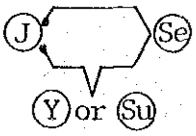
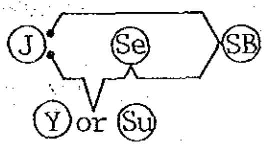

Fig. 4 Number of Passengers of Major Routes

c) Semarang airport

About 40 % of foreign passengers come from Jakarta and return to Jakarta. Other passengers travel through Semarang and other cities, such as Surabaya or Yogyakarta. Especially 36 % of sightseeing passengers are bound for Yogyakarta and Surakarta.

More than 80 % of all foreigners are passengers using the Jakarta - Semarang route.

Table 11 Trip pattern in Semarang Airport

| Pattern | Foreign Passengers | Foreign Sightseeing Passengers |
|---|---|---|
| 1.  | 71 (40.8%) | 25 (36.2%) |
| 2.  | 50 (28.7%) | 19 (27.5%) |
| 3.  | 42 (24.1%) | 25 (36.2%) |
| 4.  | 11 (6.3%) | 0 (0.0%) |
| Total | 174 (100.0%) | 69 (100.0%) |

Note : (J) = Jakarta, (Se) = Semarang, (SB) = Surabaya,
(Y) = Yogyakarta, Su = Surakarta

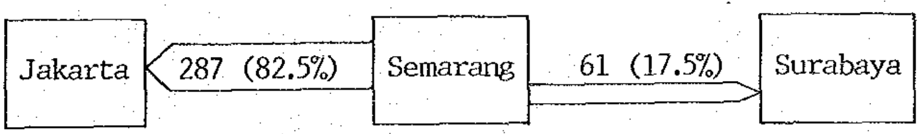



Fig. 5 Number of Passengers on the Major Routes

Appendix to Part I, Chapter 10 ( I-10 )

Aircraft Noise in Semarang Airport

Aircraft noise contour in Semarang airport in 2010 is shown in Fig. 1. The Aircraft noise is calculated in WECPNL based on the following conditions:

1) Runway Dimensions : 2,500m x 45m, RWY 13/31

2) Ratio of Landing/Take-off operations: LDG/TKOF = 1:1

3) Glide Slope Angle : $3^{\circ}$ (for RWY 13 Approach)

4) Runway Usability : RWY13 : RWY 31 = 90 % : 10 %

5) Daily Aircraft Movements: B-747 --- 16
MD-82 --- 10
F -28 --- 8

6) Proportion of Day and Night Flights:

- From/to JKT, SUB: Day - 80 %
Night- 20 %

- Others : Day -100 %

7) Flight Tracks : RWY 13 LDG --- Straight-in
RWY 31 LDG --- Circling
RWY 13 TKOF --- Left Turning
RWY 31 TKOF --- Straight

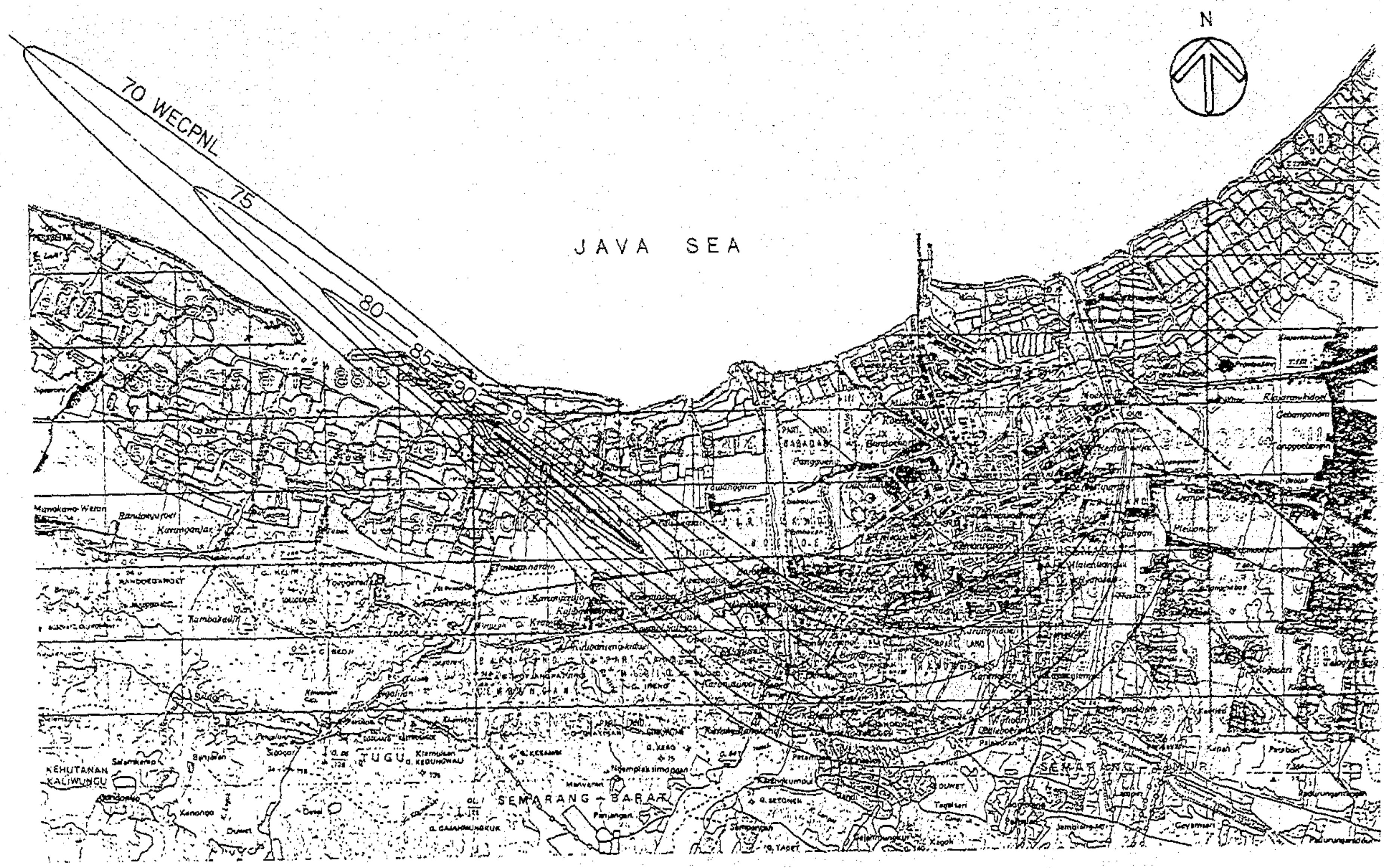



Fig. 1  Area Affected by Aircraft Noise

## Appendix to Part II, Vol.1, Chapter 3 ( II-1-3 )

## Results of Soil Investigation

### 1 Scope of Work

The soil investigation included both field tests and laboratory tests. The field tests consisted of the following.

a) Soil Borings
b) Test Pit Excavation
c) Standard Penetration Test
d) In-place Density
e) Field CBR Test
f) Sampling of Soils

The laboratory tests consisted of the following.

a) Physical Property Tests

- Specific Gravity
- Natural Water Content
- Particle Size Analysis
- Liquid Limit
- Plastic Limit
- Plasticity Index

b) Soil Engineering Tests

- Modified CBR Test

### 2 Location of the Soil Investigation

The site of the soil investigation is shown in Fig. 1 and the locations of soil borings and test pits are shown in Fig. 2. The investigation locations were divided into two areas for the proposed runway and terminal area.

The tests performed in the field and laboratory are shown in Table 1.

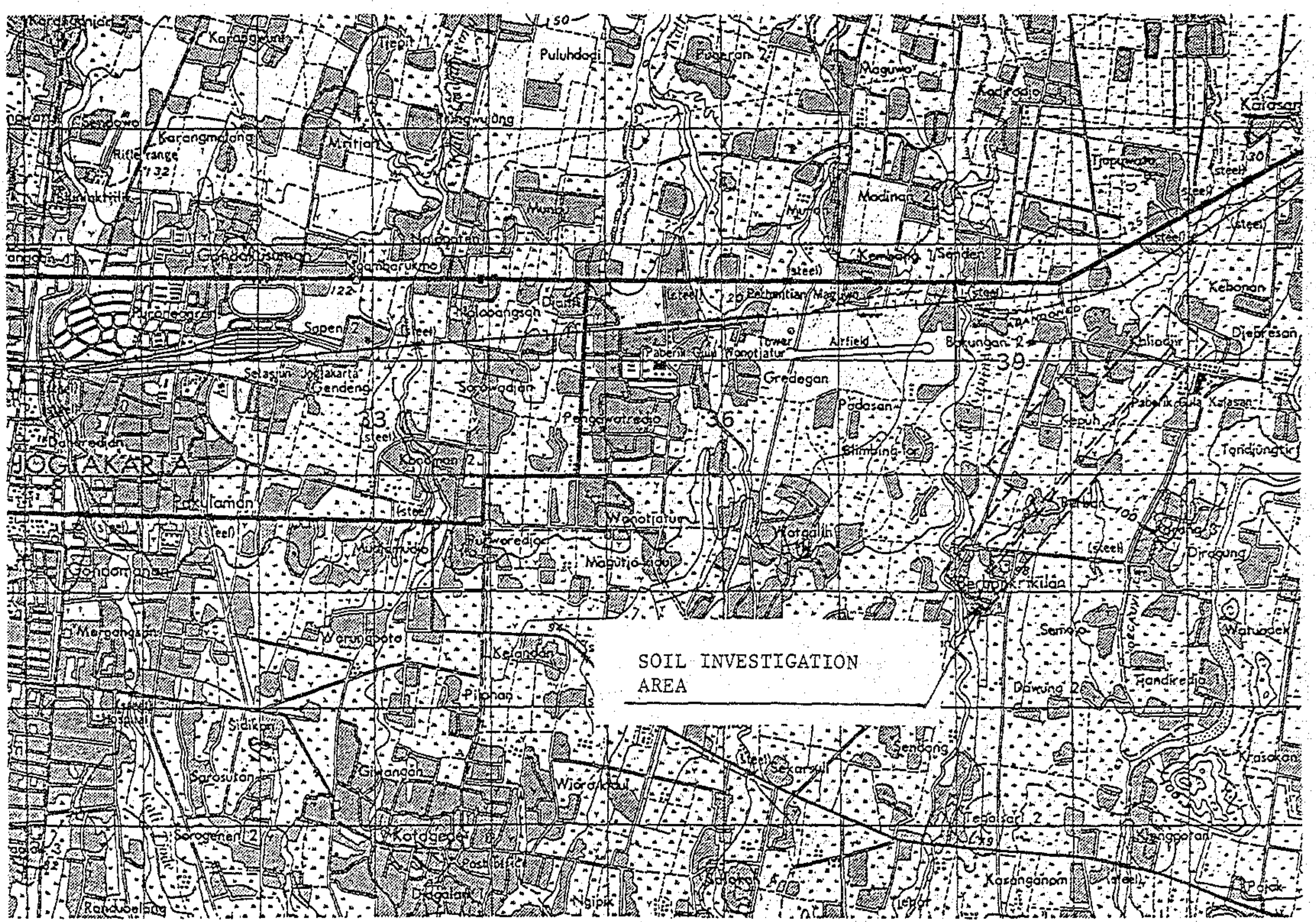



Fig. 1 Location of Soil Investigation (1)

COORDINATES & ELEVATION OF BOREHOLES AND TEST-PIT

| POINT | X | Y | Z |
|---|---|---|---|
| B-1 / T-1 | + 1195.407 | + 1000.000 | + 97.614 |
| TP-2 | + 2258.554 | + 967.339 | + 101.814 |
| B-2 / TP-3 | + 3330.000 | + 1000.000 | + 104.724 |
| B-3 / TP-4 | + 2150.000 | + 1350.000 | + 105.540 |

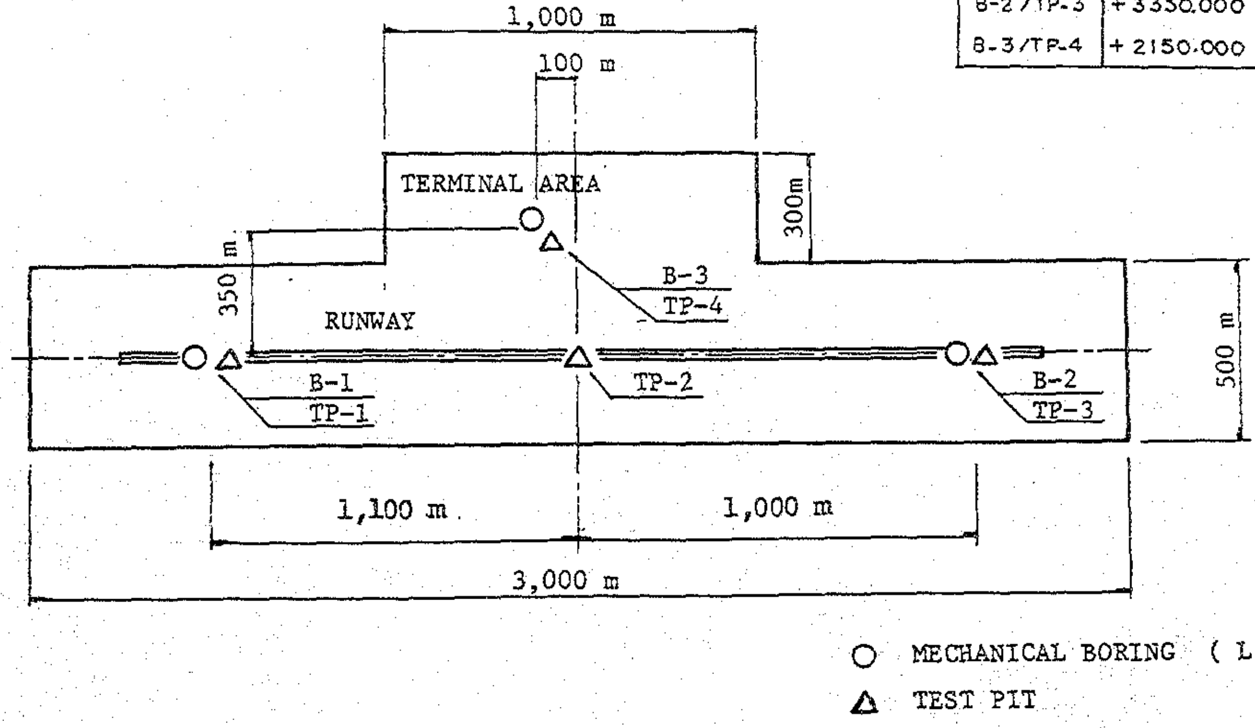



Fig. 2 Location of Soil Investigation (2)

Table 1 Items of Soil Investigation

| Items | Proposed Runway | Proposed Terminal Area |
|---|---|---|
| Soil Boring with SPT* | 2 holes D=10 m each | 1 hole D=10 m |
| Test Pit | 3 locations D=1.5 m each | 1 point D=1.5 m |
| In-place Density | 3 tests with Field CBR determinations | 1 test with Field CBR determinations |
| Natural Water Content | 3 tests | 1 test |
| 1. Physical Property Test<br>- Specific Gravity<br>- Natural Water Content<br>- Particle Size Analysis<br>- Liquid Limit<br>- Plastic Limit<br>- Plasticity Index | 13 determinations for 3 samples for each boring and Each test pit | |
| 2. Engineering Property Test<br>- Modified CBR Test | 4 tests from each Test Pit | |

* SPT : Standard Penetration Test

## 3 Surface and Subsurface Soil Conditions

The results of the field tests are summarized in Figs. 3 and 4 which show that the surface and subsurface soil layers consist mainly of clayey silt, silty sand, tuffaceous silt and sand. Top soil consisting of roots, decayed vegetation and organic material was found up to a depth of 0.5 m below the existing ground surface as determined from test pit and soil boring observations.

N values for the subsurface soil layers were determined to be within a range between 5 and 30 up to a depth of 5 m. Based on these N values, the subsurface soil layers are characterized as loose to medium dense types of soil.

The high ground water level as shown in Fig. 3 is an important factor related to geotechnical and design considerations.

In determination of the geotechnical requirements for the earthwork and strength requirements for the structures, a more in-depth study of the influence of the ground water level based on a more detailed soil investigation should be made.

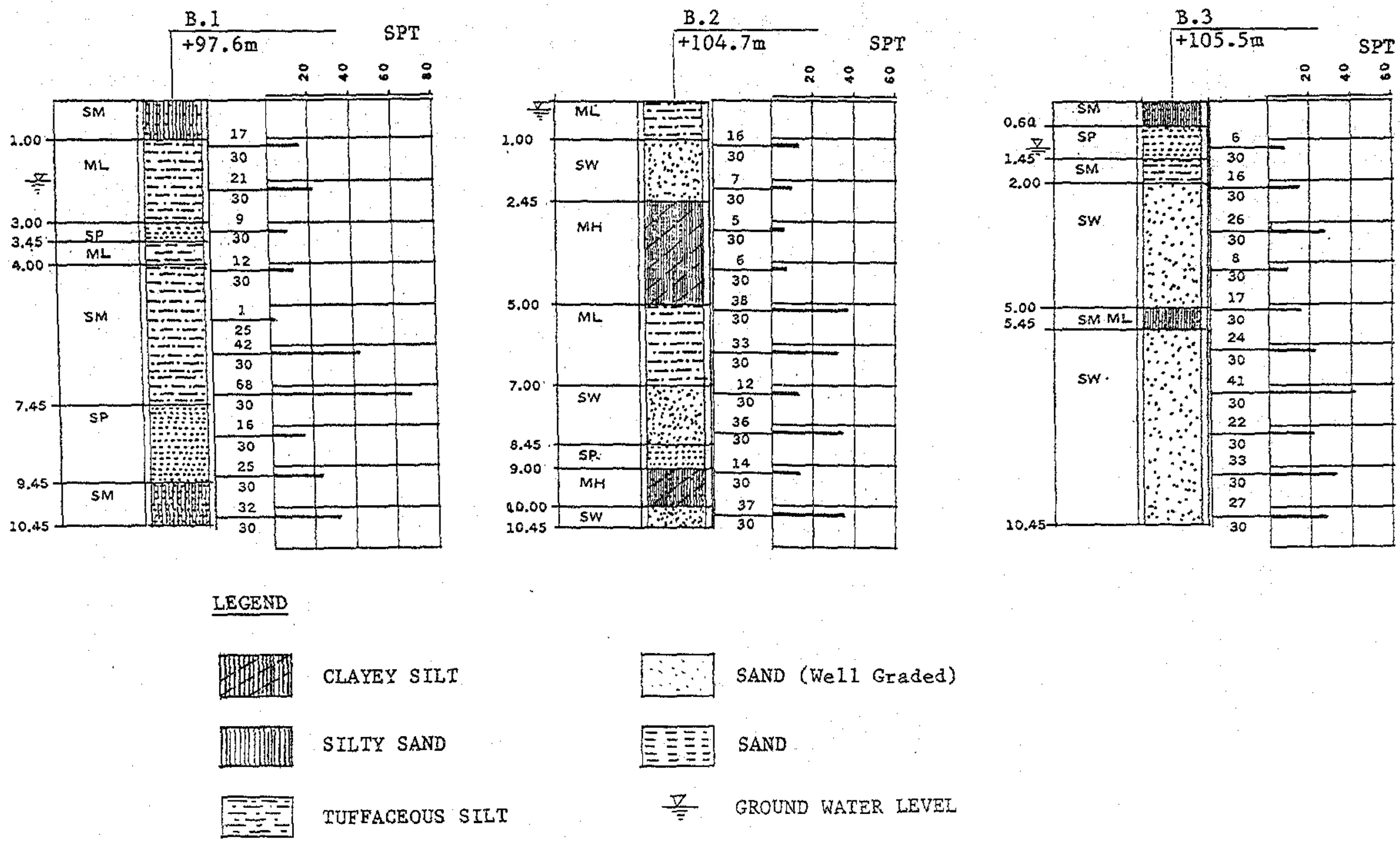



Fig. 3 Boring Log

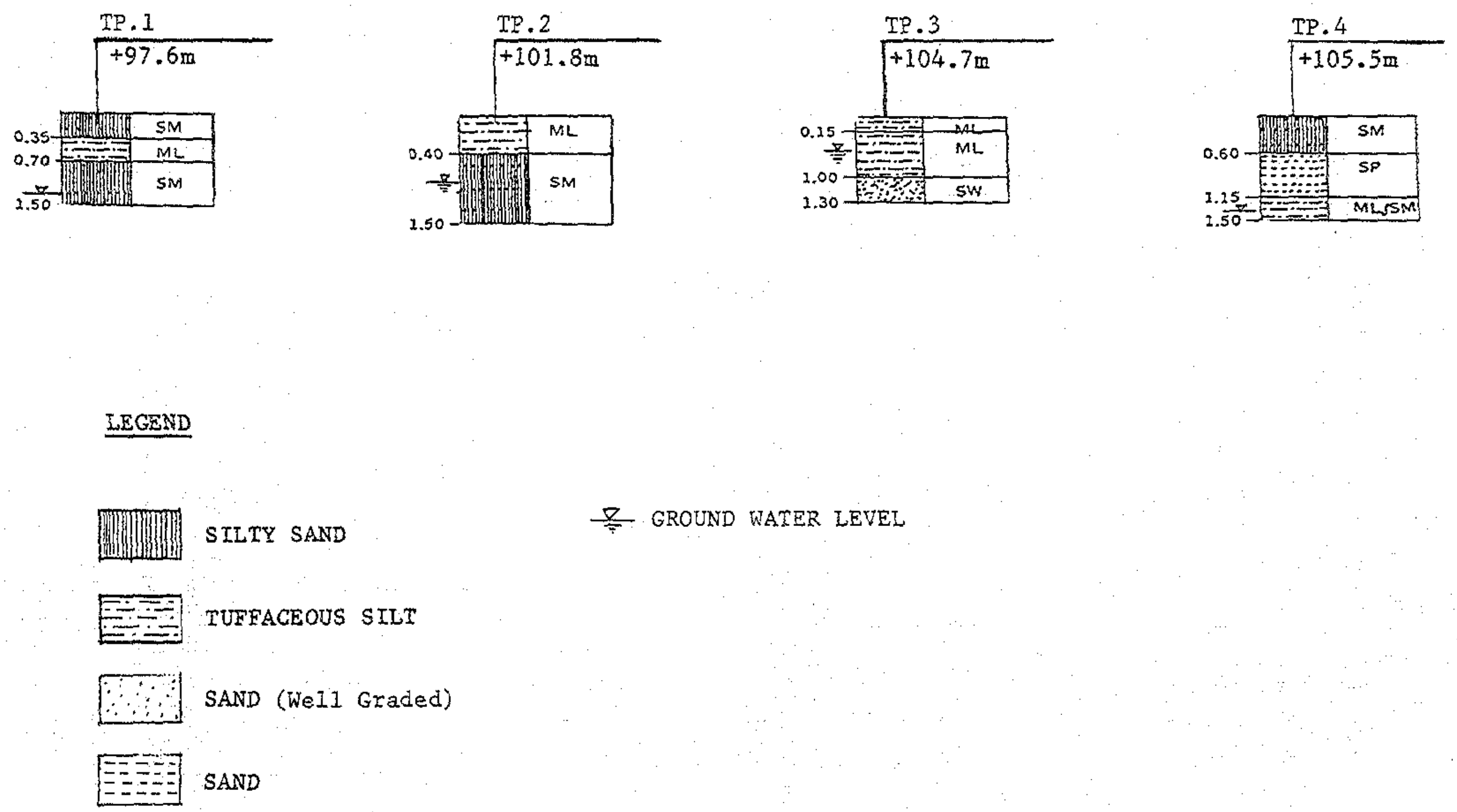



Fig. 4 Test Pit Log

## 4 Soil Mechanical Properties of the Soils

Physical properties and engineering properties which were determined by the field and laboratory tests are summarized in Table 2.

With regard to the physical properties of the soils, it is noted that the tuffaceous layer has a high natural water content with a low density.

The design CBR test carried out on the soaked specimens showed high values such as CBR 23, 24, 36 and 42. The high CBRs are related to the fact that the tests were performed on specimens compacted at about optimum water content and were estimated at a dry density of 95 % of the maximum.

In addition, samples of TP. 1, 2 ,3 and 4 consisted mainly of sandy types of soil.

The field CBR values, however, were much smaller than those determined in the laboratory. It is considered that this is dependent on the following reasons.

- The soils are influenced by the high ground water level.
- The field CBR tests were carried out at a level of only 0.5 m depth just below the top soil.

For design purposes, the CBR values of the fill portion were estimated to be at least 10 % for the compaction condition at around the natural water content, and for the natural subgrade in the outside area also. It is considered necessary that the ground water level should be lowered by drainage based on the pavement requirements, so that the higher CBR values can be expected on the natural subgrade after drainage and compaction treatments.

These results and descriptions only show the general aspects of the surface and subsurfaces soil conditions and the physical and engineering properties of just a few soil samples have been determined. More detailed soil investigations for studying design requirements of the earthwork, strength conditions of structural design, stability analysis, etc., should be carried out.

Table 2 Laboratory Test Results

| NO. | POINT NO. | DEPTH (meters) | $G_s$ | $W_n$ % | $\gamma_t$ $t/m^3$ | $\gamma_d$ $t/m^3$ | ATTERBERG LIMIT $W_L$ % | $W_p$ % | $I_p$ % | % finer by weight passing sleve no. 200 (USCS, symbol) | COMPACTION MODIFIED W opt. % | $\gamma_d$ max. $g/cm^3$ | Design Soaked C.B.R % | Field C.B.R % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | |
| 1. | B.1 | 0.50 | 2.77 | 26.8 | 1.92 | 1.51 | non-plastic | | | 43 (SM) | - | - | - | - |
| 2. | | 3.45 - 4.00 | 2.68 | | | | 42.1 | 27.1 | 15.0 | 79 (ML) | - | - | - | - |
| 3. | | 7.00 - 7.45 | 2.68 | | | | non-plastic | | | 40 (SP) | - | - | - | - |
| | | | | | | | | | | | | | | |
| 4. | B.2 | 0.50 | 2.72 | 66.4 | 1.55 | 0.93 | 32.2 | 22.0 | 10.2 | 69 (ML) | - | - | - | - |
| 5. | | 5.00 - 7.00 | 2.69 | | | | 33.4 | 25.2 | 8.2 | 76 (ML) | - | - | - | - |
| 6. | | 9.00 - 10.00 | 2.64 | | | | 52.2 | 31.2 | 21.0 | 94 (MH) | - | - | - | - |
| | | | | | | | | | | | | | | |
| 7. | B.3 | 0.50 | 2.76 | 28.5 | 1.90 | 1.48 | non-plastic | | | 48 (SM) | - | - | - | - |
| 8. | | 1.45 - 2.00 | 2.75 | | | | non-plastic | | | 45 (SP) | - | - | - | - |
| 9. | | 5.00 - 5.45 | 2.69 | | | | 40.0 | 29.1 | 10.9 | 51 (SM) | - | - | - | - |
| | | | | | | | | | | | | | | |
| 10. | TP.1 | 0.50 - 1.50 | 2.74 | 26.0 | 1.95 | 1.55 | 27.5 | 19.5 | 8.0 | 45 (SM) | 12.7 | 1.90 | 24 | 4.4 |
| 11. | TP.2 | 0.50 - 1.50 | 2.76 | 37.7 | 1.81 | 1.31 | non-plastic | | | 33 (SM) | 13.5 | 1.849 | 42 | 5.0 |
| 12. | TP.3 | 0.50 - 1.30 | 2.72 | 69.2 | 1.57 | 0.93 | 30.2 | 21.1 | 9.1 | 33 (ML) | 15.5 | 1,808 | 36 | 2.9 |
| 13. | TP.4 | 0.50 - 1.50 | 2.74 | 26.4 | 1.91 | 1.51 | non-plastic | | | 47 (SP) | 13.5 | 1.847 | 23.0 | 3.0 |

# Material Relating to Method of Establishing ATS Routes Defined by VOR

### 1.—Introduction

1.1 The guidance material in this Attachment is the result of a comprehensive data collection carried out under the auspices of ICAO in 1972 and the subsequent analysis and review of the data, which comprised radar extracted plots of some 13 000 tracks of aircraft flying on selected VOR-defined routes in Europe. No Doppler VORs were included in the route samples. Details of the data collection and analysis are contained in ICAO Circular 120-AN/89/2 — *Methodology for the Derivation of Separation Minima Applied to the Spacing Between Parallel Tracks in ATS Route Structures.*

1.2 In applying the guidance material in 3 and 4, it should be recognized that the data on which it is based, although considered to be representative of the type of air traffic environment in which it was collected, may not be a true reflection of the actual situation in all parts of the world. Any additional information available regarding the actual track-keeping performance of aircraft in a given portion of the airspace should therefore be taken into account.

1.3 Attention is also invited to the basic assumptions in 4.2 and to the fact that the values given in 4.1 represent a cautious approach. Before applying these values, account should therefore be taken of any practical experience gained in the airspace under consideration, as well as the possibility of achieving improvements in the over-all navigation performance of aircraft.

1.4 Further research and improvements in operational performance may result in changes in the values indicated in 3 and 4.

1.5 States are encouraged to keep ICAO fully informed of the results of the application of this guidance material.

### 2.—Determination of VOR system performance values

The large variability of the values which are likely to be associated with each of the factors that make up the total VOR system, and the limitation of presently available methods to measure all these effects individually with the required precision (for example, there is no agreed method of measuring flight technical error), has led to the conclusion that an assessment of the total system error provides a more realistic method for determining the VOR system performance.

*Note.—Guidance material on over-all VOR system accuracy is also contained in Annex 10, Volume I, Attachment C to Part I.*

### 3.—Determination of protected airspace along VOR-defined routes

3.1 For VOR-defined routes where radar is not used to assist aircraft in remaining within the protected airspace, the following guidance is provided.

3.2 As a minimum, 95 per cent of the traffic should be considered as requiring protection against activity in airspace adjacent to the routes.

3.3 The work described in ICAO Circular 120-AN/89/2 indicates that a VOR system performance based on the probability of containing 95 per cent of the traffic will require the following protected airspace along the centre line of the route to allow for possible deviations:

VOR routes with 50 NM or less between VORs: ± 4 NM.

VOR routes with up to 150 NM between VORs: ± 4 NM up to 25 NM from the VOR then expanding protected airspace up to ± 6 NM at 75 NM from the VOR.

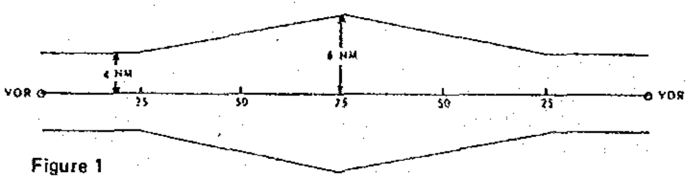



Figure 1

3.4 If the appropriate ATS authority considers that a better protection is required, e.g. because of the proximity of prohibited, restricted or danger areas, climb or descent paths of military aircraft, etc., it may decide that a higher percentage of the traffic should be contained within the protected airspace. For delineating the protected airspace the following values will then be used:

for segments with 50 NM or less between VORs, use the values in line A of the table below.

for segments with more than 50 NM and less than 150 NM between the VORs use the values given in line A of the table up to 25 NM, then expand linearly to the value given in line B at 75 NM from the VOR.

| | *Percentage of traffic contained in protected area* | | | | | |
|---|---|---|---|---|---|---|
| | *95* | *96* | *97* | *98* | *99* | *99.5* |
| | NM | NM | NM | NM | NM | NM |
| A | ±4 | ±4 | ±4.5 | ±5 | ±5.5 | ±6 |
| B | ±6 | ±6 | ±6.5 | ±6.5 | ±7 | ±8.5 |

For example, the protected area for a route of 120 NM between VORs and for which 99.5 per cent of the traffic should be contained in the protected area should have the following shape:

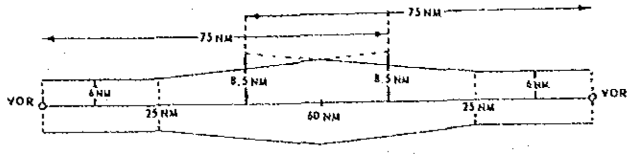



Figure 2

3.5 If two segments intersect at the VOR at an angle of more than 25 degrees, additional protected airspace should be provided in the vicinity of the VOR station.

3.6 Measured data for routes longer than 150 NM between VORs are not yet available. To determine protected airspace beyond 75 NM from the VOR, the use of an angular value of the order of 5° as representing the probable system performance would appear satisfactory. The following figure illustrates this application:

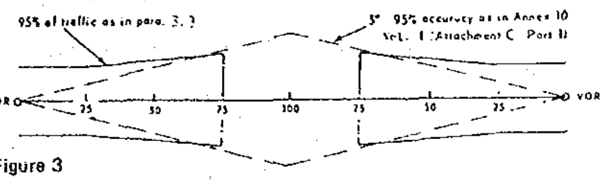



Figure 3

**4.—Spacing of parallel routes defined by VORs**

4.1 The data collection mentioned in 1.1 indicates that, in the type of environment investigated, the distance between route centre lines (S in Figure 4) for distances between VORs of 150 NM or less should normally be a minimum of:

a) 18 NM for parallel routes where the aircraft on the routes fly in opposite direction; and

b) 16.5 NM for parallel routes where the aircraft on the two routes fly in the same direction.

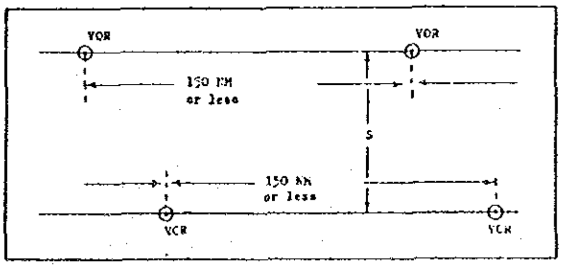



Figure 4

4.2 This spacing of parallel routes assumes:

a) aircraft may either during climb or descent or during level flight be at the same flight levels on the two routes;

b) traffic densities of 25 000 to 50 000 flights per busy two-month period;

c) VOR transmissions which are regularly flight checked in accordance with ICAO Doc 8071, *Manual on Testing of Radio Navigation Aids* and have been found to be satisfactory in accordance with the procedures in that document for navigational purposes on the defined routes; and

d) no monitoring or control of the lateral deviations is exercised.

4.3 Preliminary work indicates that, in the circumstances described in a) to d) below, it may be possible to reduce the minimum distance between routes. However, the figures given have not been precisely calculated and in each case a detailed study of the particular circumstances is essential:

a) if the aircraft on adjacent routes are not assigned the same flight levels, the distance between the routes may be reduced; the magnitude of the reduction will depend on the vertical separation between aircraft on the adjacent tracks and on the percentage of climbing and descending traffic, but is not likely to be more than 3 NM;

b) if the traffic density is much lower than indicated in 4.2 above, the distance between route centre lines may be slightly reduced; for example for traffic densities of about 10 000 flights per busy two-month period a reduction of 0.5 to 1 NM may be possible depending on the characteristics of the traffic flow (cf. ICAO Circular 120-AN/89/2);

c) the relative locations of the VORs defining the two tracks and the distance between the VORs will have an effect on the spacing, but this has not been quantified;

d) application of radar monitoring and control of the lateral deviations of the aircraft may have a large effect on the minimum allowable distance between routes.

**5.—Change-over points for VORs**

5.1 When considering the establishment of points for change-over from one VOR to another for primary navigational guidance on VOR-defined ATS routes, States should bear in mind that:

a) the establishment of change-over points should be made on the basis of performance of the VOR stations concerned, including an evaluation of the interference protection criteria. The process should be verified by flight checking (see Doc 8071, Volume I, Chapter 2);

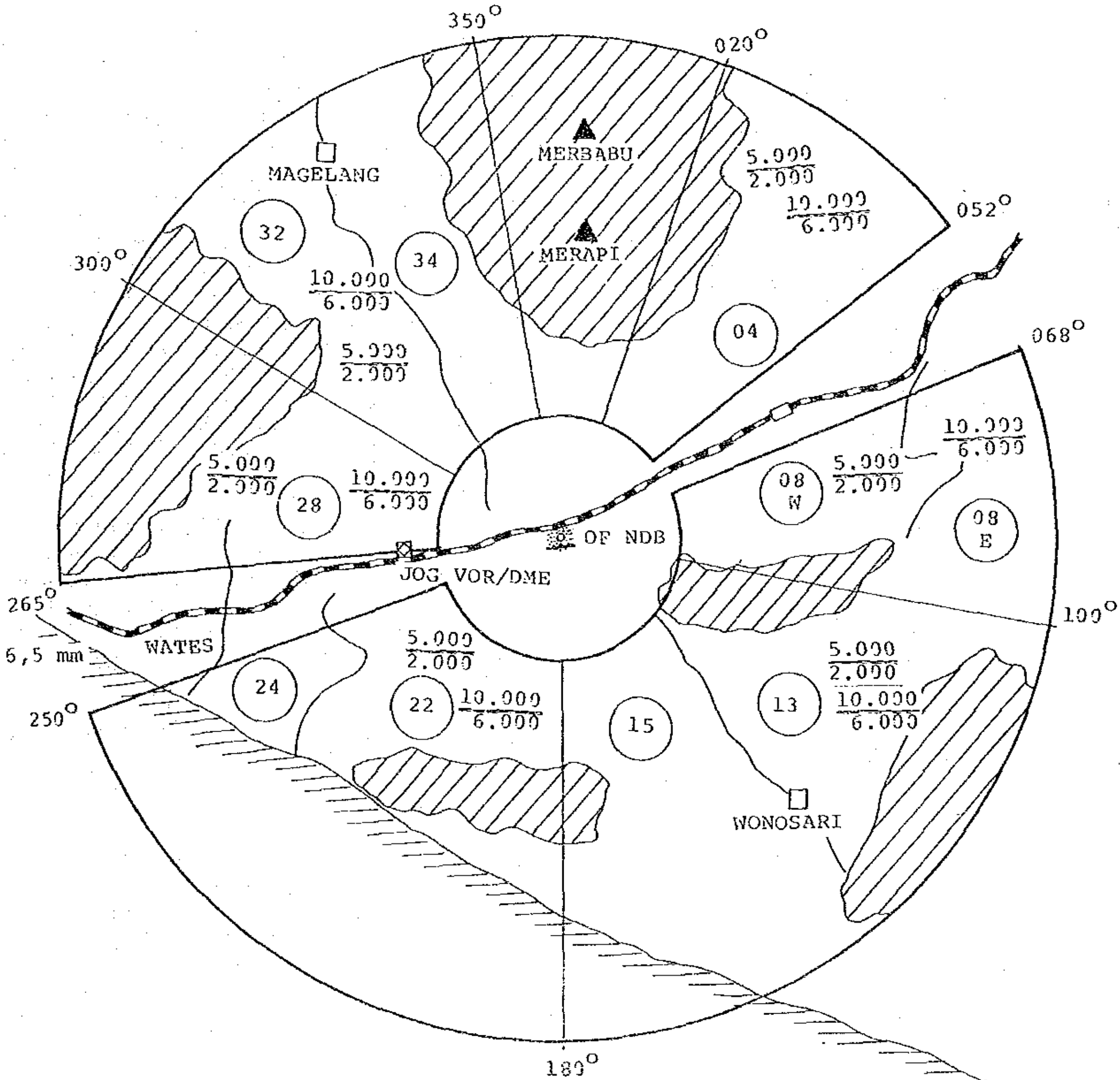
b) where frequency protection is critical, flight inspection should be undertaken at the highest altitudes to which the facility is protected.

5.2 Nothing in 5.1 should be interpreted as placing a restriction on the service ranges of VOR installations meeting the specifications in Annex 10, Volume I, Part I, 3.3.

Appendix to Part II, Vol.1, Chapter 4 (B) ( II-1-4 (B) )

Adi Sucipto Training Area, WIR-8, which is divided into ten portions

ADISUTJIPTO MILITARY CONTROLLED AIRSPACE



## Appendix to Part II, Vol.1, Chapter 4 (C) ( II-1-4 (C) )

## Guidance Material on the Characteristics of Wake Turbulence and Application of Increased Longitudinal Separation of Aircraft in such Condition

1. Introduction

1.1 The hazards associated with wake turbulence have long been demonstrated by a number of accidents and incidents. Many States have found it necessary to develop national regulations prescribing the application of increased separation minima in specified circumstances.

1.2 There is at the present time insufficient understanding of the correlation between turbulent wake theory and operational experience to state with an acceptable degree of certainty what weight classifications should be denoted and what separation should be applied between them. It is expected that the analysis of turbulent wake data collected by certain States will permit the development of more definitive criteria. Meanwhile this guidance material is provided to assist States to establish national procedures.

2. Wake Turbulence Characteristics

2.1 Wake turbulence vortices are present behind every aircraft, but are particularly severe when generated by large and wide-bodied jet aircraft. These vortices are two counter-rotating cylindrical air masses trailing aft from the aircraft (See Figure 7). The vortices are most dangerous to following aircraft during the take-off, initial climb, final approach and landing phases of flight. They tend to drift down, and when close to the ground move sideways from the track of the generating aircraft, occasionally rebounding upwards.

2.2 The characteristics of the wake vortex generated by an aircraft in flight are established initially by factors related to the aircraft gross weight, airspeed, configuration and wing span. Subsequently, the vortex characteristics are altered and eventually dominated by interactions between the vortices and the ambient atmosphere. The wind, wind shear, turbulence and atmospheric stability affect the motion and decay of a vortex system. Also in the terminal area, the proximity of the ground significantly affects vortex transport and decay.

2.3 Vortex wake generation begins on rotation when the nose wheel lifts off the runway and ends when the nose wheel touches down on landing. Vortex strength increases proportionally to weight, is greatest when the generating aircraft is heavy, is in a clean configuration, and is slow.

2.4 Helicopters produce vortices when in flight and there is some evidence that, per kilogramme of gross weight, their vortices are more intense than those of fixed wing aircraft. When hovering or while air taxiing they should be kept well clear of light aircraft.

2.5 Special attention needs to be given to situations of light wind, where vortices may stay in the approach and runway touchdown areas, drift to a parallel runway, or sink to the landing or take-off paths of succeeding aircraft.

2.6 Vortices generally dissipate or break up in one of three ways: first, over a long period of time, turbulent diffusion can enlarge each wake so that the wakes merge and dissipate; second, disturbances along the length of the vortices become unstable and sinuous oscillations develop which cause the vortices to touch and link together; and third, a sudden structural change known as vortex breakdown or bursting can abruptly widen the vortex core.

2.7 Ground effect becomes an important factor when considering the movement and decay of the vortices. The ground acts as a plane of reflection; as the trailing vortices descend toward the ground their vertical velocity decreases and (with no or little wind) they begin to travel horizontally over the ground away from each other at a height approximately half the wing span of the generating aircraft.

3. Effect of Wake Turbulence on Aircraft

3.1 The three basic effects of wake turbulence on a following aircraft are imposed roll, loss of height or rate of climb, and possible structural stress. The greatest danger is the imposed roll on the penetrating aircraft to a degree exceeding its counter control capability. Should the vortex encounter occur in the approach area, its impact is heightened because the following aircraft is in a critical state with regard to speed, thrust, altitude and reaction time.

4. Wake Turbulence Categorization of Aircraft

4.1 Wake turbulence separation minima should be based on a grouping of aircraft types into three categories according to the maximum certificated take-off weight.

4.2 The three categories recommended for use (Appendix 2, Item 9 of the flight plan) are:

(a) HEAVY (H) - all aircraft types of 136 000 kg (300 000 lb) or more;

(b) MEDIUM (M) - aircraft types less than 136 000 kg (300 000 lb) and more than 7 000 kg (15 500 lb); and

(c) LIGHT (L) - aircraft types of 7 000 kg (15 500 lb) or less.

5. Application of Wake Turbulence Minima

5.1 Wake turbulence minima are intended to minimize the potential hazards of wake turbulence. When the separation minima normally required for IFR purposes is greater than that for wake turbulence, such IFR minima will apply.

5.2 Wake turbulence minima may be applied for any situation not covered by specific minima whenever a controller believes there is a potential hazard due to wake turbulence. Since wake turbulence is invisible, its presence and exact location cannot be determined with precision. Consequently, controllers as well as pilots should thoroughly understand the likely situations where hazardous wake turbulence may be encountered.

6. Separation Minima related to Turbulent Wake Conditions

6.1 Based on the knowledge and experience accumulated to date, the following minima are offered as guidance to States.

6.2 Radar Separation Minima

| Leading Aircraft Category | Following Aircraft Category | Minima |
|---|---|---|
| HEAVY | HEAVY | 4 NM |
| | MEDIUM | 5 NM |
| | LIGHT | 6 NM |
| MEDIUM | HEAVY | 3 NM |
| | MEDIUM | 3 NM |
| | LIGHT | 4 NM |
| LIGHT | HEAVY | 3 NM |
| | MEDIUM | 3 NM |
| | LIGHT | 3 NM |

*Note.- See Figure 1.*

6.2.1 The minima set out in 6.2 should be applied when:

(a) an aircraft is operating directly behind another aircraft at the same altitude or less than 300 m (1 000 ft) below; or

(b) both aircraft are using the same runway, or parallel runways less than 760 m (2 500 ft) apart; or

(c) an aircraft is crossing behind another aircraft at the 6 o'clock position.

6.3 Non-radar Separation Minima

6.3.1 Arriving aircraft

6.3.1.1 For timed approaches, the following minima should be applied to aircraft landing behind a HEAVY aircraft as follows:

(a) MEDIUM aircraft - 2 minutes;

(b) LIGHT aircraft - 3 minutes.

6.3.2 Departing aircraft

6.3.2.1 Except as set out in 6.3.2.2, a minimum of 2 minutes should be applied between a LIGHT or MEDIUM aircraft taking off behind a HEAVY aircraft when the aircraft are using:

(a) the same runway;

(b) a parallel runway separated by less than 760 m (2 500 ft);

(c) crossing runways if projected flight paths will cross;

(d) a parallel runway separated by 760 m (2 500 ft) or more, if projected flight paths will cross.

*Note.- See Figure 2 and Figure 3.*

6.3.2.2 The separation minimum of 3 minutes should be applied between a LIGHT or MEDIUM aircraft when taking off behind a HEAVY aircraft from:

(a) an intermediate part of the same runway; or

(b) an intermediate part of a parallel runway less than 760 m (2 500 ft) apart.

*Note.- See Figure 4.*

6.4 Displaced landing threshold

6.4.1 A separation minimum of 2 minutes should be applied between a LIGHT or MEDIUM aircraft and a HEAVY aircraft when operating on a runway with a displaced landing threshold when:

(a) a departure follows a HEAVY aircraft arrival; or

(b) an arrival follows a HEAVY aircraft departure if the projected flight paths are expected to cross.

6.5 Opposite direction

6.5.1 A separation minimum of 2 minutes should be applied between a LIGHT or MEDIUM aircraft, and a HEAVY aircraft making a low or missed approach when:

(a) utilizing an opposite direction runway for take-off; or

(b) landing on the same runway in the opposite direction, or on a parallel opposite direction runway separated by less than 760 m (2 500 ft) apart.

*Note.- See Figure 5.*

7. Cautionary Wake Turbulence Messages (Cautionaries)

7.1 Figure 6 gives examples of when aerodrome controllers should advise aircraft of the potential existence of turbulent wake.

WAKE TURBULENCE SEPARATION MINIMA

FOR CROSSING AND FOLLOWING AIRCRAFT

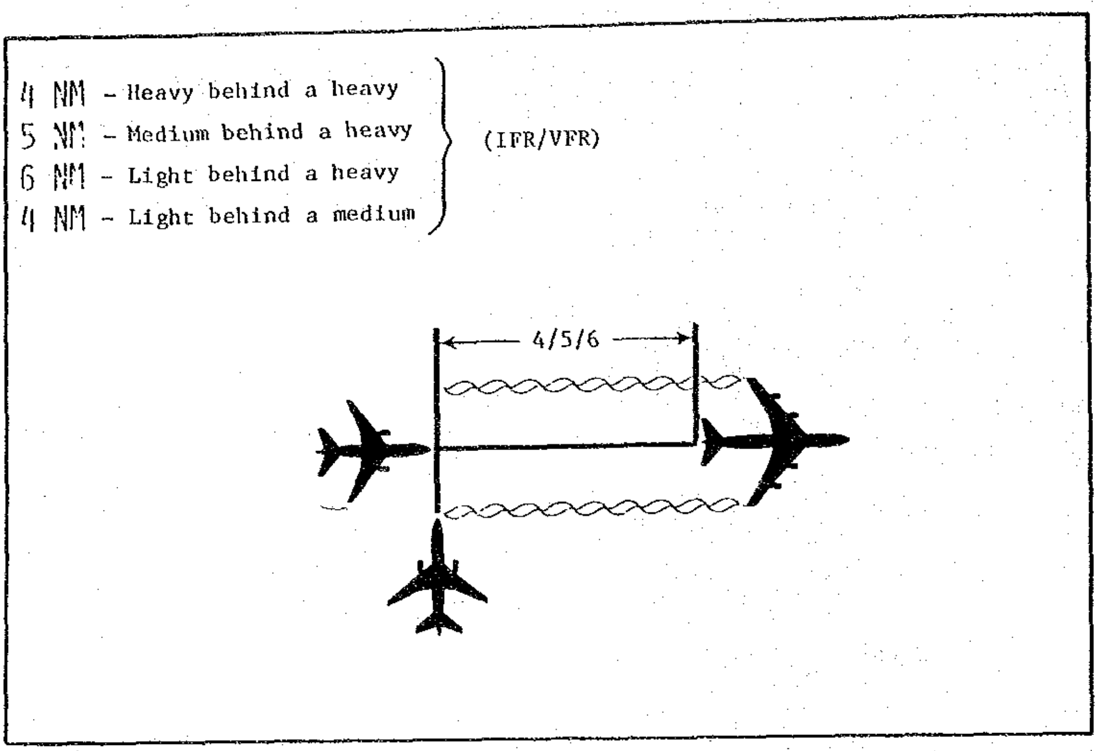



Figure 1 *(see 6.2.1)*

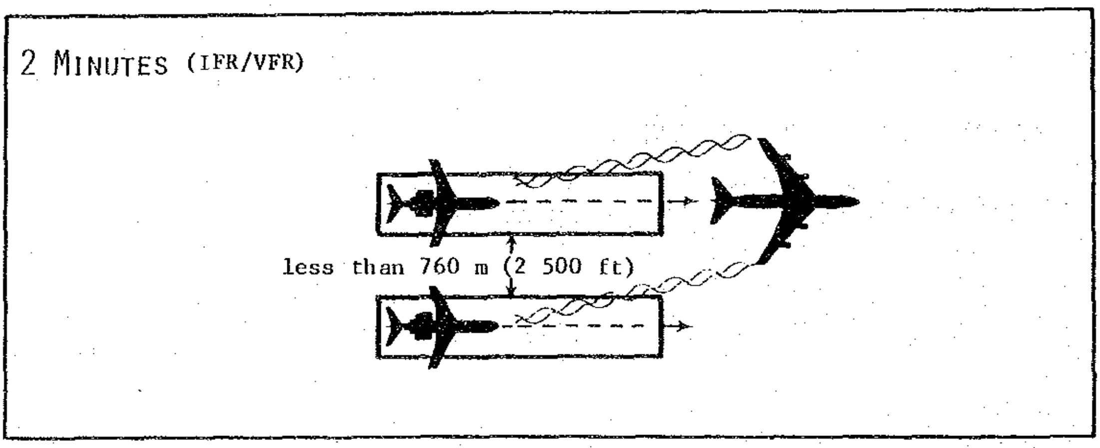



Figure 2 *(see 6.3.2.1)*

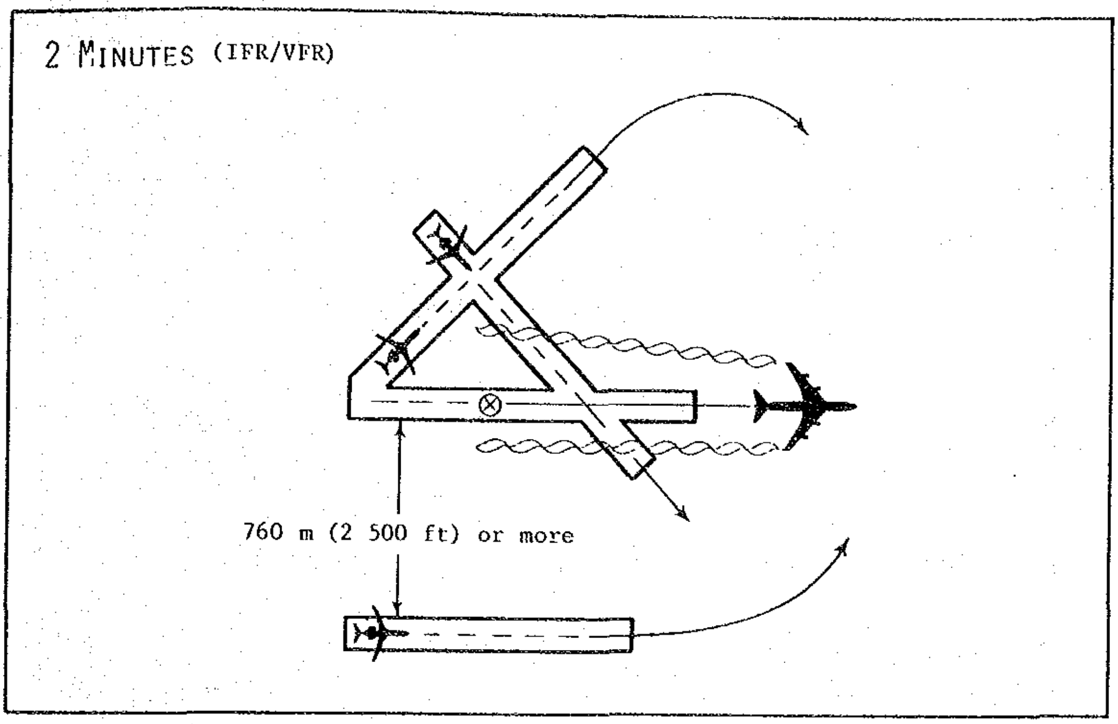



Figure 3 *(see 6.3.2.1)*

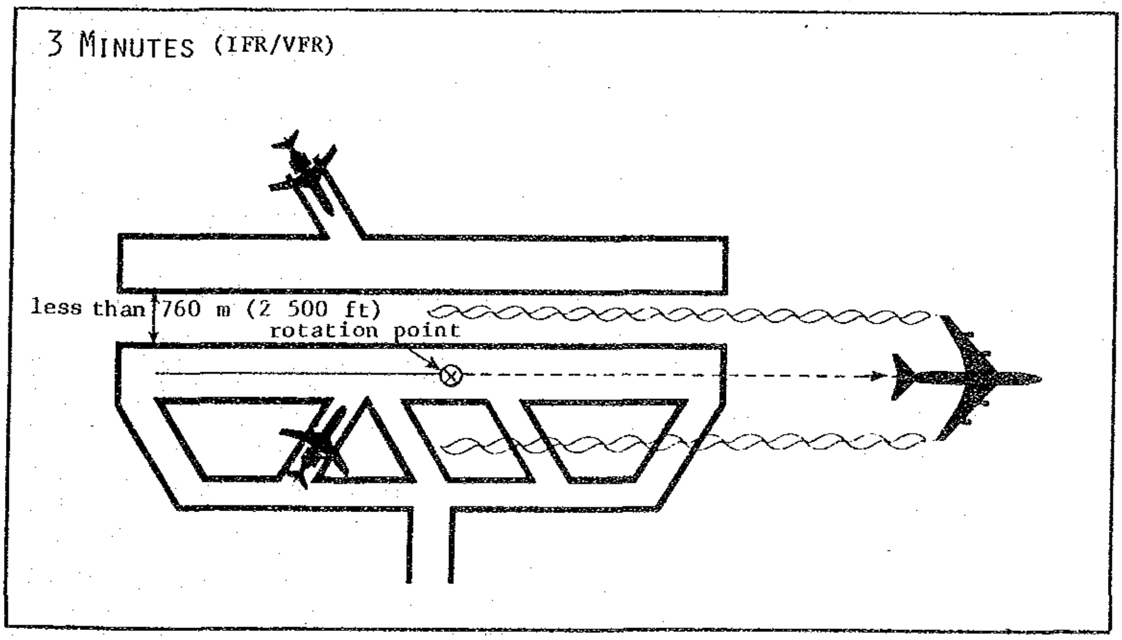



Figure 4 *(see 6.3.2.2)*

FOR OPPOSITE DIRECTION AIRCRAFT

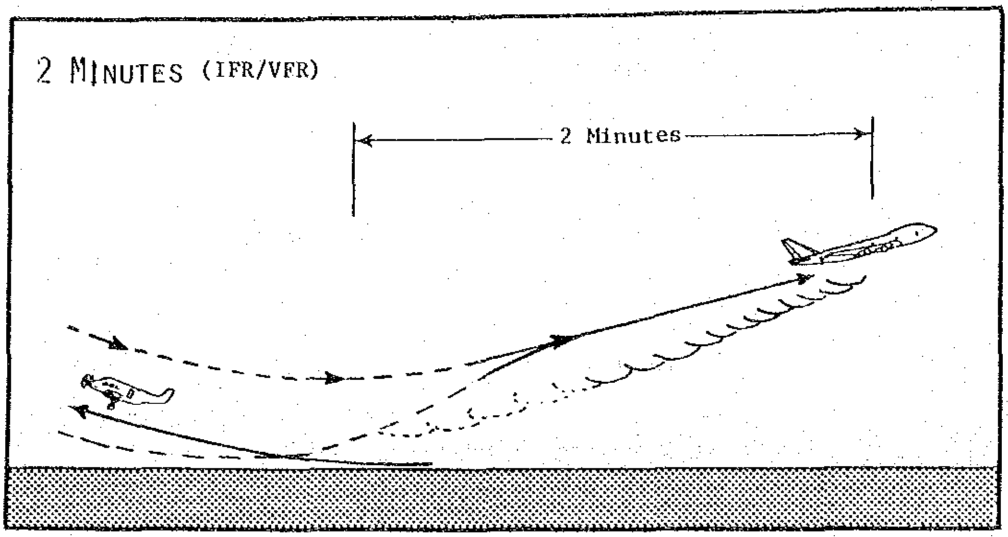
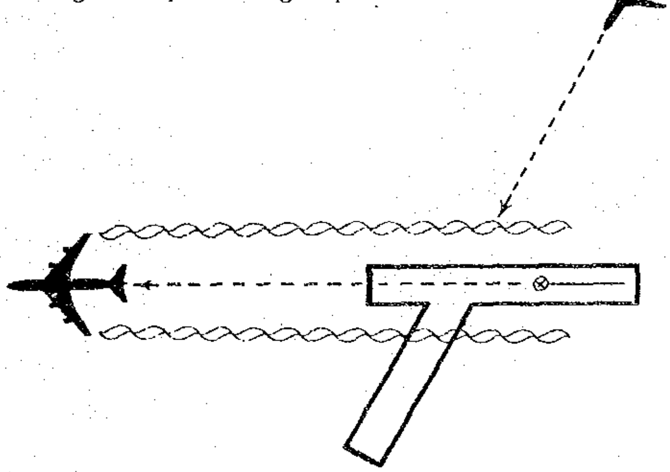



Figure 5 *(see 6.5.1 (a))*

## CAUTIONARIES

## VFR and VISUAL APPROACHES

Caution an aircraft approaching behind a departing heavy aircraft, or a light behind a medium aircraft, using a crossing runway if flight paths will cross.



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Caution an aircraft approaching behind an arriving heavy aircraft, or a light behind a medium aircraft, approaching

(a) the same runway

(b) a parallel runway less than 760 m (2 500 ft) away

(c) a crossing runway when flight paths will cross

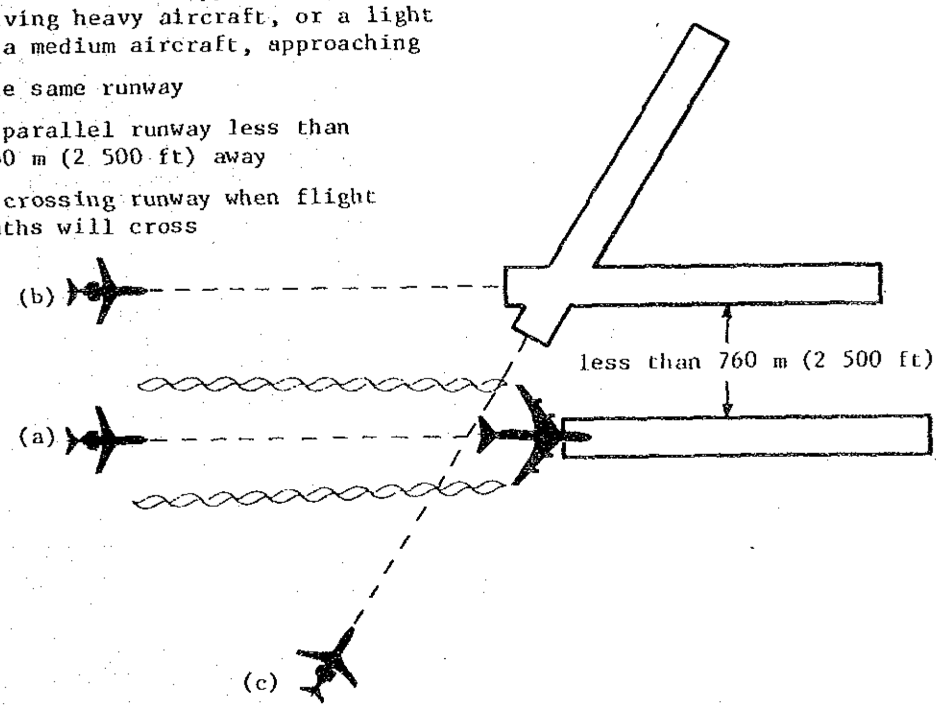
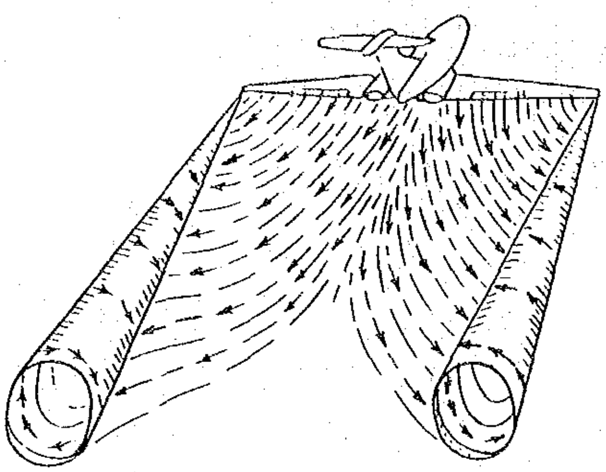



Figure 6 *(see 7.1)*

# VORTICES

## WAKE TURBULENCE

Wake turbulence could descend into the circuit of another airport



WATCH FOR

(a) calm or stable air,

(b) a light cross wind or tail wind which could keep a vortex on the runway,

(c) turbulence drifting to another runway.

Known VFR traffic should be advised of heavier group aircraft when they may be affected.

Caution aircraft about wake turbulence whenever the potential for it exists.

Caution taxiing aircraft and other vehicles manoeuvring behind a heavy jet.

Do not approve a rolling take-off by a heavy aircraft if its jet engine blast may be hazardous to a following aircraft or vehicle, or to taxiway lights.

Helicopters hovering or airborne while taxiing should be kept well clear of light aircraft.

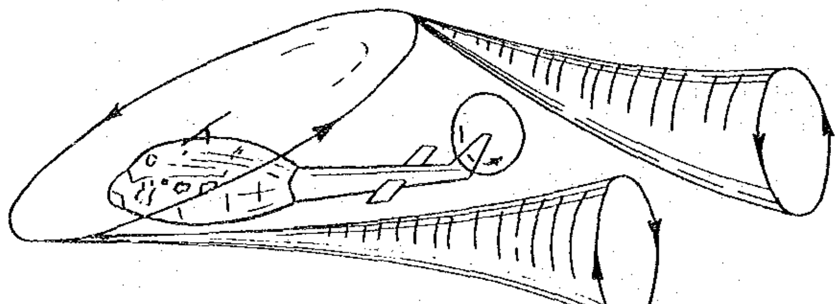


Figure 7 *(see 2.1)*

Appendix to Part II, Vol.1, Chapter 4 (D) ( II-1-4 (D) )

Estimated Altitude Coverage for Alternative Radar Sites

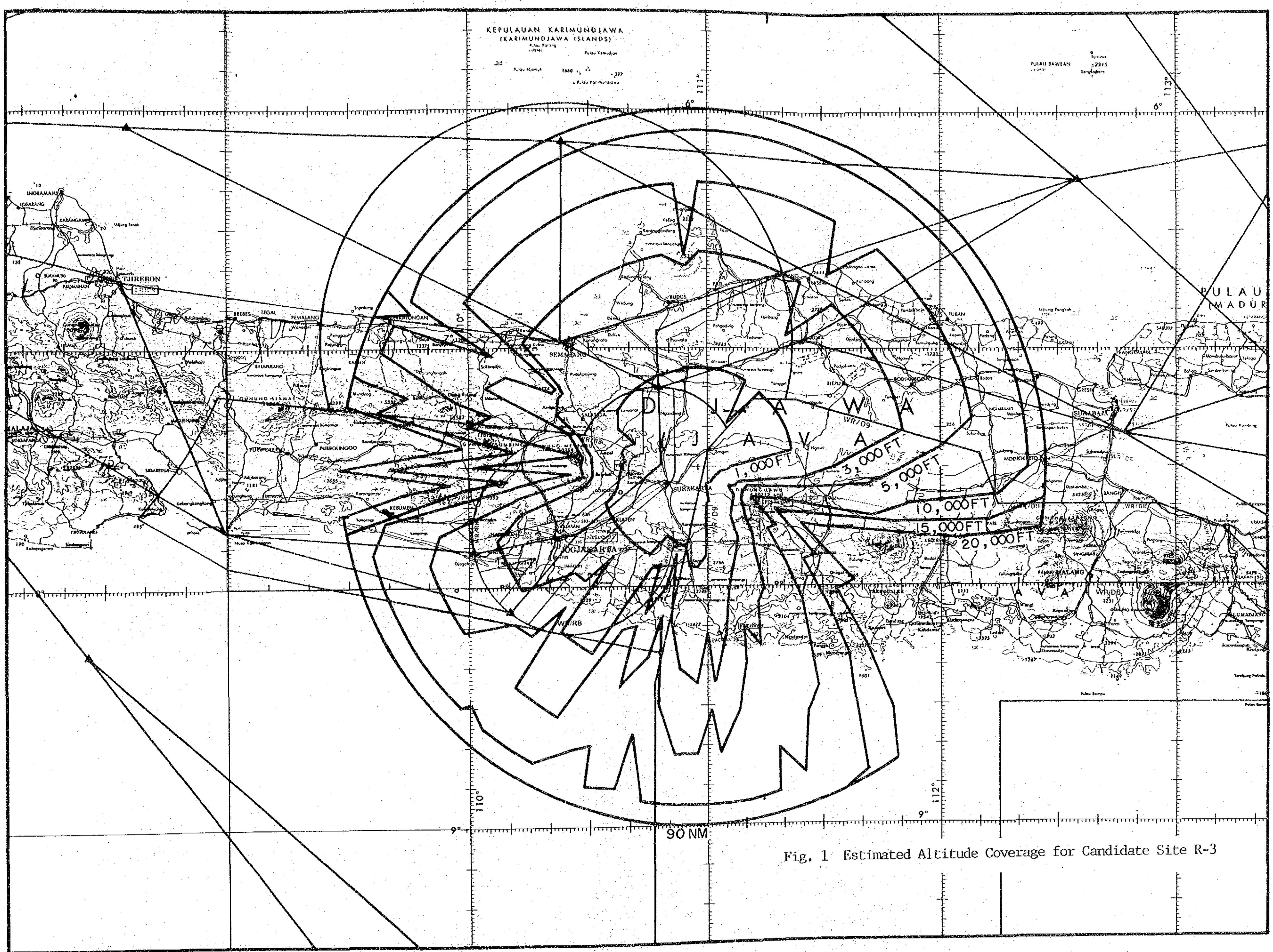



Fig. 1 Estimated Altitude Coverage for Candidate Site R-3

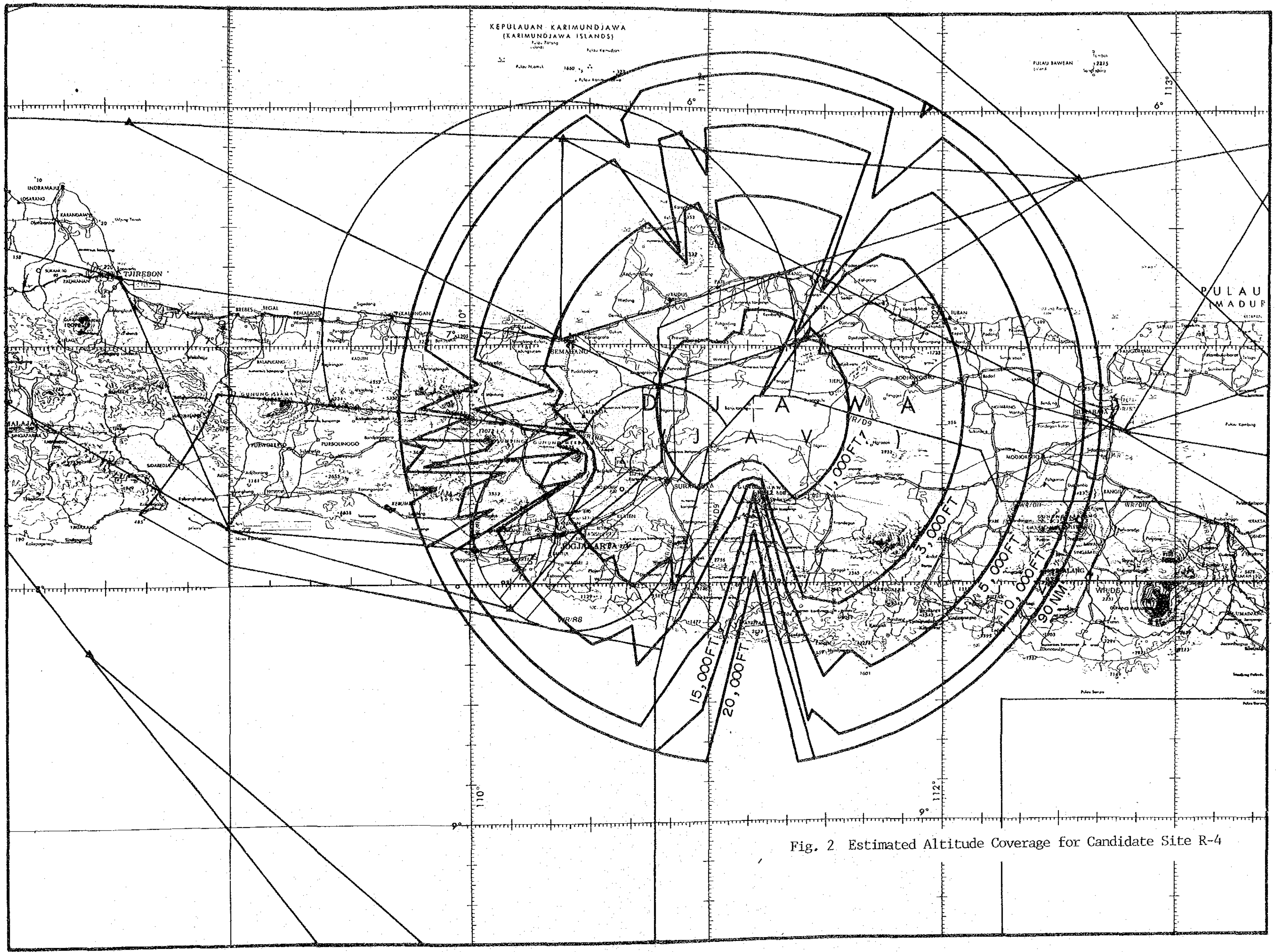



Fig. 2 Estimated Altitude Coverage for Candidate Site R-4

Appendix to Part II, Vol.1, Chapter 4 (E) ( II-1-4 (E) )

Dimensions of Realigned ATS Routes, Fixes and Intersections

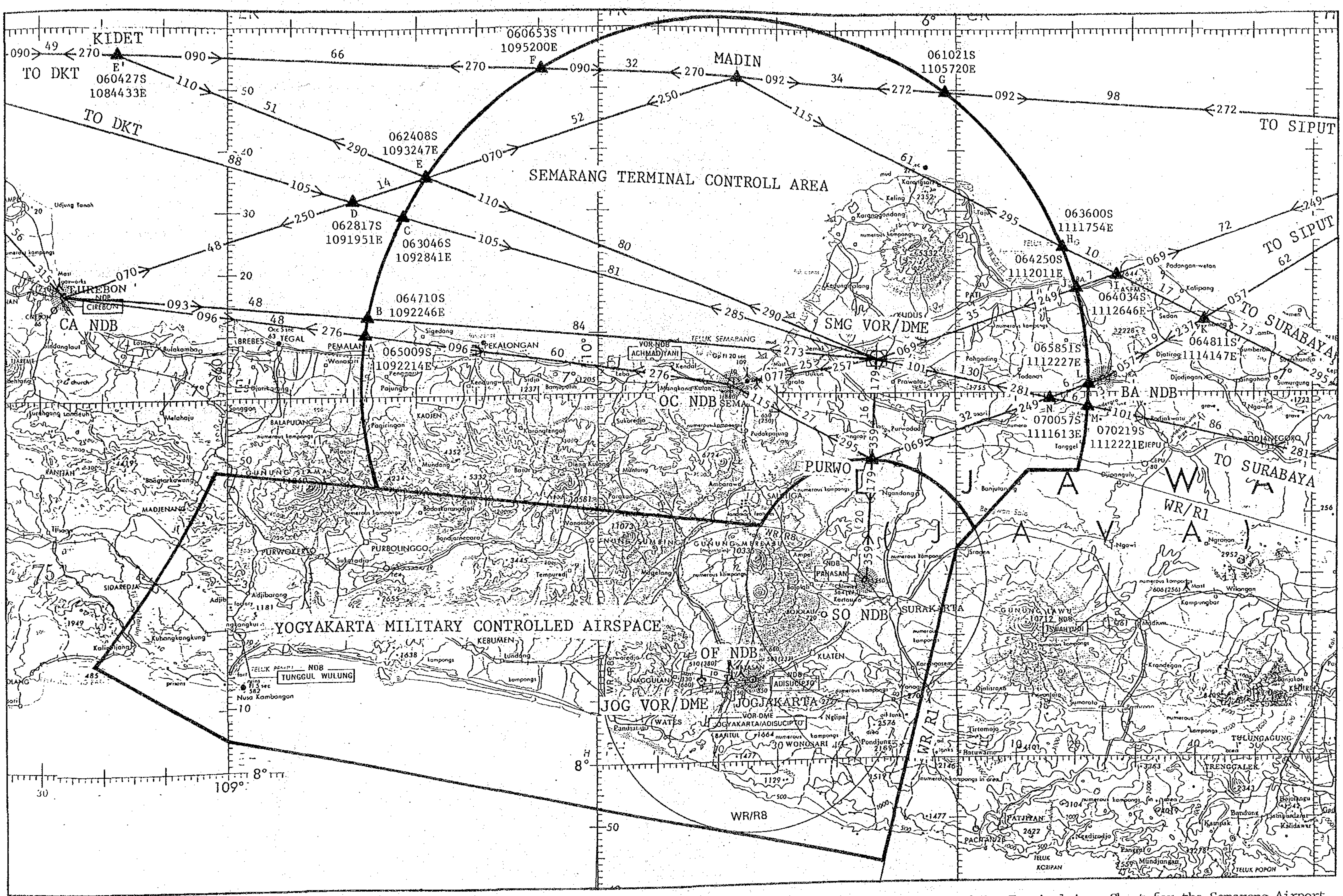


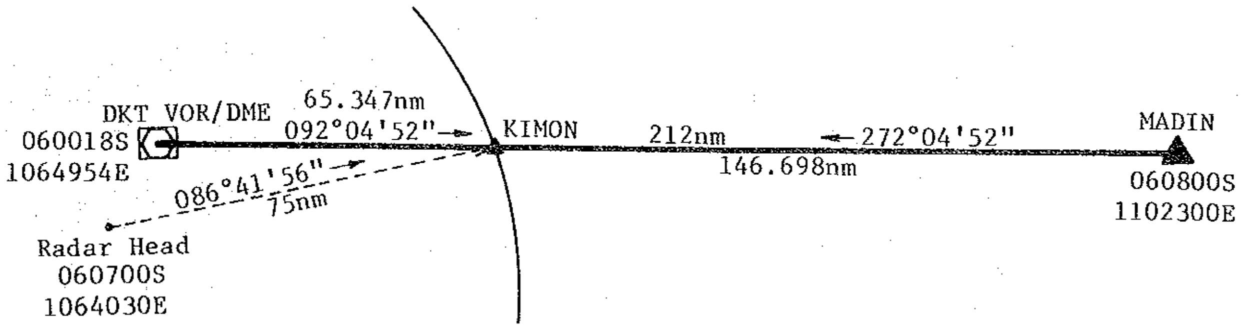

Fig.1 The Proposed New Terminal Area Chart for the Semarang Airport using SMG VOR/DME

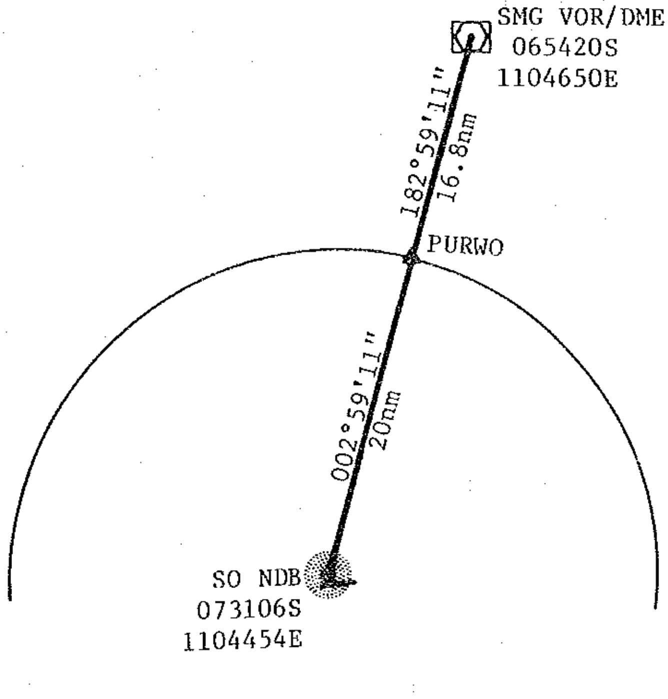
## Dimensions of Realigned ATS Routes, Fixes and Intersections in the Semarang TMA and its Vicinity Area

Dimensions of realigned ATS routes, Fixes and Intersections in the Semarang TMA and its vicinity area are listed in Tables 1 and 2.

a) Change of the Coordinates of "Kimon" and "Purwo"

The coordinates of "Kimon" and "Purwo" was calculated based on the following data.



b) Change of the Coordinates of Purwo

At present, installation work for a new VOR/DME is in progress at 3.5 Km east of Surakarta airport. In near future, when corridor between Surakarta airport and Purwo is revised using new VOR/DME, the coordinates of "Purwo", Points "N" and "L" and magnetic track of ATS routes between "Purwo" and SMG VOR/DME, OC and BA NDBs should be changed as shown in the chart below and Table 3.

The coordinates of Surakarta VOR/DME is presumed as 073025S / 1104732E in this calculation.

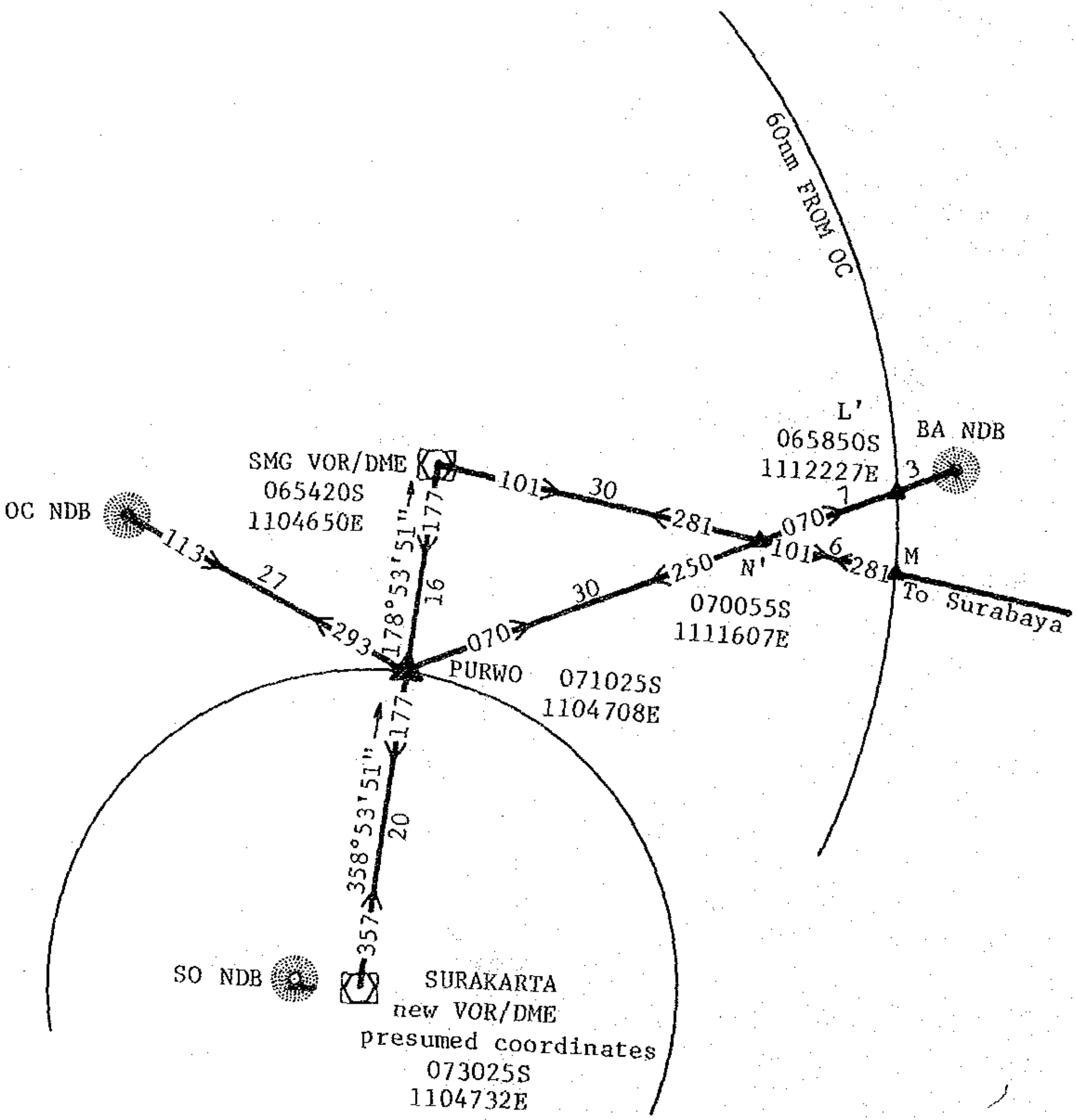


Table 1 The Dimensions of Realigned ATS Routes in the Semarang TMA and its Vicinity Area

( Magnetic variation is used 2 degrees east.)

| Coordinates and name of NAVAID and Fix | | Distance (NM) | True Course | Magnetic Course |
|---|---|---|---|---|
| OC NDB 065900S/1102200E | CA NDB 064300S/1083400E | 108.416 | 278°29'12"/098°29'12" | 276°/096° |
| OC NDB | PIALA 065009S/1092214E | 60.000 | 278°29'12"/098°29'12" | 276°/096° |
| CA NDB | PIALA | 48.416 | 098°29'12"/278°29'12" | 096°/276° |
| SMG VOR/DME 065420S/1104650E | CA NDB 064300S/1083400E | 132.382 | 274°54'40"/094°54'40" | 273°/093° |
| SMG VOR/DME | "B" 064710S/1092246E | 83.784 | 274°54'40"/094°54'40" | 273°/093° |
| SMG VOR/DME | KIMON 060240S/1075534E | 177.845 | 286°53'20"/106°53'20" | 285°/105° |
| SMG VOR/DME | "C" 063046S/1092841E | 81.111 | 286°53'20"/106°53'20" | 285°/105° |
| SMG VOR/DME | "D" 062817S/1091951E | 89.965 | 286°53'20"/106°53'20" | 285°/105° |
| SMG VOR/DME | "E" 062408S/1093247E | 79.510 | 292°19'23"/112°19'23" | 290°/110° |
| SMG VOR/DME | "E'" 060427S/1084433E | 131.343 | 292°19'23"S/112°19'23" | 290°/110° |
| DKT VOR/DME 060018S/1064954E | MADIN 060800S/1102300E | 212.045 | 092°04'52"/272°04'52" | 090°/270° |
| DKT VOR/DME | KIMON 060240S/1075534E | 65.347 | 092°04'52"/272°04'52" | 090°/270° |
| DKT VOR/DME | New KIDET (E') 060427S/1084433E | 114.089 | 092°04'52"/272°04'52" | 090°/270° |
| DKT VOR/DME 060018S/106495E | F 060653S/1095200E | 181.202 | 272°04'52"/092°04'52" | 270°090° |
| MADIN | SIPUT 061700S/1123500E | 131.534 | 093°55'25"/273°55'25" | 092°/272° |
| MADIN | G 061021S/1105720E | 34.309 | 093°55'25"/273°55'25" | 092°/272° |
| SBY VOR/DME 072118S/1124648E | MADIN | 160.518 | 297°10'15"/117°10'15" | 295°/115° |
| SBY VOR/DME | H 063600S/1111754E | 99.197 | 297°10'15"/117°10'15" | 295°/115° |
| H | I 064034S/1112646E | 9.969 | 117°10'15"/297°10'15" | 115°/295° |
| I | K 064811S/1114147E | 16.709 | 117°10'15"/297°10'15" | 115°295° |
| H | MADIN | 61.322 | 297°10'15"/117°10'15" | 295°/115° |
| SBY | I | 89.228 | 297°10'15"/117°10'15" | 295°115° |
| I | MADIN | 71.291 | 297°10'15"/117°10'15" | 295°/115° |
| SMG VOR/DME | SIPUT | 113.752 | 070°50'25"/250°50'25" | 069°/249° |

| Coordinates and name of NAVAID and Fix | | Distance (NM) | True Course | Magnetic Course |
|---|---|---|---|---|
| SMG VOR/DME | I | 41.975 | 70°50'25"/250°50'25" | 069°/249° |
| I | SIPUT | 71.777 | 70°50'25"/250°50'25" | 069°/249° |
| I | J | 6.905 | 70°50'25"/250°50'25" | 069°/249° |
| SMG VOR/DME | J | 35.070 | 070°50'26"/250°50'25" | 069°/249° |
| BA NDB 065800S/1112500E | SIPUT | 80.720 | 59°28'27"/239°28'27" | 057°/237° |
| BA NDB | K 064811S/1114147E | 19.324 | 59°28'27"/239°28'27" | 057°/237° |
| K | SIPUT | 61.396 | 59°28'27"/239°28'27" | 057°/237° |
| SBY VOR/DME | K | 72.519 | 297°10'15"/117°10'15" | 295°/115° |
| BA NDB | PURWO 071108S/1104557E | 40.918 | 251°16'42"/071°16'42" | 249°/069° |
| BA NDB | L 065851S/1112227E | 2.676 | 251°16'42"/071°16'42" | 249°/069° |
| L | PURWO | 38.255 | 251°16'42"/071°16'42" | 249°/069° |
| SMG VOR/DME | SBY VOR/DME | 122.055 | 102°45'51"/282°45'51" | 101°/281° |
| SBY VOR/DME | M 070219S/1112221E | 85.905 | 282°45'51"/102°45'51" | 281°/101° |
| SMG VOR/DME | M | 36.150 | 102°45'51"/282°45'51" | 101°/281° |
| SBY VOR/DME | N 070057S/1111613E | 92.107 | 282°45'51"/102°45'51" | 281°/101° |
| SMG VOR/DME | N | 29.948 | 102°45'51"/282°45'51" | 101°/281° |
| SMG VOR/DME | MADIN | 52.033 | 332°55'48"/152°55'48" | 331°/151° |
| SMG | OC | 25.089 | 259°16'49"/079°16'49" | 257°/077° |
| Purwo | OC | 27.431 | 294°35'42"/114°35'42" | 293°/113° |
| SMG VOR/DME | SO NDB | 36.817 | 182°59'11"/002°59'11" | 181°/001° |
| SMG VOR/DME | Purwo | 16.817 | 182°59'11"/002°59'11" | 181°/001° |

Table 2 The Dimensions of Realigned Fixes and Intersections in the Semarang TMA and its Vicinity Area

| Name of Point | Coordinates | Distance/Bearing from Navaids | | | |
|---|---|---|---|---|---|
| (PIALA) A | 06 50 09S/109 22 14E | from CA NDB<br>from OC NDB | 096°/48.416NM<br>276°/60NM | | |
| B | 06 47 10S/109 22 46E | from SMG VOR/DME<br>from CA NDB | 273°/83.784<br>093°/48.598 | | |
| C | 06 30 46S/109 28 41E | from SMG VOR/DME<br>from Kimon | 285°/81.111<br>105°/96.734 | | |
| D | 06 28 17S/109 19 51E | from SMG VOR/DME<br>from Kimon | 285°/89.965<br>105°/87.880 | | |
| New Cucut E | 06 24 08S/109 32 47E | from SMG VOR/DME<br>from CA NDB | 290°/79.510<br>070°/61.377 | from OC NDB | 304°/60NM |
| New Kidet E' | 06 04 27S/108 44 33E | New kidet from SMG<br>from DKT | 290°/131.343<br>090°/114.160 | | |
| F | 06 06 53S/109 52 00E | from SMG VOR/DME<br>from OC NDB | 309°/72.246<br>328°/60NM | from JKT | 090°/181.202 |
| G | 06 10 21S/110 57 20E | from SMG VOR/DME<br>from DKT VOR/DME | 011°/45.023 | | |
| H | 06 36 00S/111 17 54E | from SBY VOR/DME<br>from SMG VOR/DME | 295°/99.197<br>057°/35.887 | | |
| New Lasem I | 06 40 34S/111 26 46E | from SBY VOR/DME<br>from SMG VOR/DME | 295°/89.228<br>069°/41.983 | | |
| J | 06 42 50S/111 20 11E | from SMG VOR/DME | 069°/35.070 | | |
| K | 06 48 11S/111 41 47E | from SBY VOR/DME<br>from BA NDB | 295°/72.519<br>057°/19.324 | | |
| L | 06 58 51S/111 22 27E | from BA NDB<br>from Purwo | 249°/2.676<br>069°/38.242 | | |
| M | 07 02 19S/111 22 21E | from SBY VOR/DME<br>from SMG VOR/DME | 281°/85.905<br>101°/36.150 | | |
| N | 07 00 57S/111 16 13E | from SBY VOR/DME<br>from SMG VOR/DME | 281°/92.107<br>101°/29.948 | | |

Table 3 The Dimensions of Realigned ATS Routes, Fixes and Intersections when "Purwo" is shifted on the line joining Semarang and Surakarta VOR/DME

| Coordinates and name of NAVAID and Fix | | Distance (NM) | True Course | Magnetic Course |
|---|---|---|---|---|
| SMG VOR/DME<br>065420S/1104650E | SURAKARTA VOR/DME<br>073025S/1104732E | 36.090 | 178°53'51"/358°53'51" | 177°/357° |
| SMG VOR/DME | New Purwo<br>071025S/1104708E | 16.090 | 178°53'51"/358°53'51" | 177°/357° |
| New Purwo | SURAKARTA VOR/DME | 20.000 | 178°53'51"/358°53'51" | 177°/357° |
| New Purwo | CC NDB<br>065900S/1102500E | 27.431 | 294°35'42"/114°35'42" | 293°/113° |
| New Purwo | BA NDB | 39.577 | 071°42'56"/251°42'56" | 070°/250° |
| New Purwo | N'<br>070055S/1111607E | 30.287 | 071°42'56"/251°42'56" | 070°/250° |
| N' | BA NDB<br>065800S/1112500E | 9.290 | 071°42'56"/251°42'56" | 070°/250° |
| SMG VOR/DME | N' | 29.804 | 102°45'51"/282°45'51" | 101°/281° |
| New Purwo | L'<br>065850S/1112227E | 36.922 | 071°42'56"/251°42'56" | 070°/250° |
| N' | M | 6.346 | 102°45'51"/282°45'51" | 101°281° |
| L' | BA NDB | 2.655 | 071°42'56"/251°/42'56" | 070°/250° |
| | (Magnetic variation is used 2 degrees west) | | | |

Appendix to Part II, Vol.1, Chapter 6 (II-1-6)

## Construction Cost Estimates

Table 1 Estimated Construction Cost
( Foreign Portion in U.S.Dollars )

| | Phase of Construction / Work Item | Phase I | | Phase II | | Total | |
|---|---|---|---|---|---|---|---|
| | | Local Portion (million Rp.) | Foreign Portion (thousand US$) | Local Portion (million Rp.) | Foreign Portion (thousand US$) | Local Portion (million Rp.) | Foreign Portion (thousand US$) |
| Land Acquisition | Land Acquisition | 15,979 | 0 | 0 | 0 | 15,979 | 0 |
| | Compensation | 280 | 0 | 0 | 0 | 280 | 0 |
| | Land Acquisition * (Ultimate Expansion Area) | (3,835) | ( 0) | ( 0) | ( 0) | (3,835) | ( 0) |
| | Sub Total | 16,259 | 0 | 0 | 0 | 16,259 | 0 |
| Civil Works | Earth Work | 2,456 | 1,571 | 45 | 36 | 2,501 | 1,607 |
| | Drainage Works | 441 | 495 | 12 | 18 | 453 | 513 |
| | Pavement Works | 5,504 | 9,832 | 2,265 | 3,951 | 7,769 | 13,783 |
| | Access Road | 500 | 218 | 0 | 0 | 500 | 218 |
| | River Diversion | 222 | 375 | 0 | 0 | 222 | 375 |
| | Sub Total | 9,123 | 12,491 | 2,322 | 4,005 | 11,445 | 16,496 |
| Architectural Works | Passenger Terminal Building | 4,543 | 4,740 | 2,288 | 2,388 | 6,831 | 7,128 |
| | Cargo Terminal Building | 230 | 181 | 131 | 103 | 361 | 284 |
| | Administration Building | 473 | 515 | 139 | 151 | 612 | 666 |
| | Other Buildings | 322 | 253 | 0 | 0 | 322 | 253 |
| | Special Equipment | 0 | 3,966 | 0 | 1,332 | 0 | 5,298 |
| | Sub Total | 5,568 | 9,655 | 2,558 | 3,974 | 8,126 | 13,629 |
| Air Navigation Systems | Radio Navigation Aids | 501 | 4,345 | 81 | 1,655 | 582 | 6,000 |
| | Air Traffic Control and Aeronautical Telecommunications | 118 | 3,173 | 43 | 1,265 | 161 | 4,438 |
| | ATC Radar System | 254 | 7,936 | 99 | 3,173 | 353 | 11,109 |
| | Aeronautical Ground Lights | 1,262 | 3,124 | 248 | 621 | 1,510 | 3,745 |
| | Meteorological System | 62 | 1,738 | 19 | 517 | 81 | 2,255 |
| | Sub Total | 2,197 | 20,316 | 490 | 7,231 | 2,687 | 27,547 |
| Utilities Works | Power Supply System | 370 | 2,137 | 27 | 852 | 397 | 2,989 |
| | Water Supply System | 56 | 95 | 0 | 4 | 56 | 99 |
| | Sewarage System | 243 | 354 | 12 | 23 | 255 | 377 |
| | Solid Waste Disposal System | 30 | 116 | 0 | 0 | 30 | 116 |
| | Telecommunication System | 185 | 550 | 0 | 0 | 185 | 550 |
| | Sub Total | 884 | 3,252 | 39 | 879 | 923 | 4,131 |
| Other Equipment | Vehicles for Fire Fighting Services, etc. | 0 | 332 | 0 | 1,127 | 0 | 1,459 |
| | Sub Total | 0 | 332 | 0 | 1,127 | 0 | 1,459 |
| Total of Construction Works | | 34,031 | 46,046 | 5,409 | 17,216 | 39,440 | 63,262 |
| Engineering Services Cost | | 3,403 | 4,605 | 541 | 1,721 | 3,944 | 6,326 |
| Sub Total | | 37,434 | 50,651 | 5,950 | 18,937 | 43,384 | 69,588 |
| Contingency | | 3,743 | 5,065 | 595 | 1,894 | 4,338 | 6,959 |
| Grand Total | | 41,177 | 55,716 | 6,545 | 20,831 | 47,722 | 76,547 |

* Land Acquisition Cost for Ultimate Expansion Area is not included in Total Cost.

Exchange Rate: US$ 1.00 = Rp. 1,125

Appendix to Part II, Vol.1, Chapter 7 ( II-1-7 )

Economic Analysis

Table 1 Total Passenger Transportation Cost of Airline Companies

(Mill Rp./Year, 1985 price)

| Item / Year | "Without Project" or the Cost by Smaller Air Plane | | | | "With Project" or the Cost by Larger Air Plane | | | |
|---|---|---|---|---|---|---|---|---|
| | Jakar-ta | Den-pasar | Sura-baya | Ban-dung | Jarkar-ta | Den-pasar | Sura-baya | Ban-dung |
| 95 | 15,991 | 7,457 | 1,432 | 1,203 | 13,092 | 6,769 | 1,432 | 1,203 |
| 2000 | 20,862 | 8,826 | 1,841 | 1,547 | 17,080 | 8,826 | 1,841 | 1,547 |
| 5 | 27,746 | 12,937 | 2,454 | 2,063 | 22,699 | 11,169 | 1,764 | 2,063 |
| 10 | 36,924 | 17,254 | 3,315 | 2,749 | 30,208 | 14,904 | 2,383 | 2,749 |

Source : Estimated by JICA

Table 2 The Passenger which will Spill Over the Present Capacity of the Airport and which will Use Highway Bus ( or Sea Route ) Inevitably

(pass./year)

| Access Zone | Route | Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|---|---|
| Solo | Yogyakarta | Jakarta | 1,520 | 9,229 | 24,837 | 41,258 |
| Magelang | " | " | 1,171 | 7,107 | 19,127 | 31,774 |
| Yogyakarta | " | " | 11,869 | 72,064 | 193,936 | 322,167 |
| Solo | " | Denpasar | 608 | 3,692 | 9,935 | 16,504 |
| Magelang | " | " | 468 | 2,843 | 7,651 | 12,710 |
| Yogyakarta | " | " | 4,748 | 28,825 | 77,574 | 128,867 |
| Solo | " | Surabaya | 117 | 710 | 1,911 | 3,174 |
| Magelong | " | " | 90 | 547 | 1,471 | 2,444 |
| Yogyakarta | " | " | 913 | 5,543 | 14,918 | 24,782 |
| Solo | " | Bandung | 23 | 142 | 382 | 635 |
| Magelang | " | " | 18 | 109 | 294 | 439 |
| Yogyakarta | " | " | 183 | 1,109 | 2,984 | 4,956 |
| Solo | " | Banjarmasin | 70 | 426 | 1,146 | 1,904 |
| Magelang | " | " | 54 | 328 | 883 | 1,466 |
| Yogyakarta | " | " | 548 | 3,326 | 8,951 | 14,869 |

Source : Estimated by JICA

Table 3 User Benefit the Passenger which will Divert from Bus (or Sea Route ) to Air due to Larger Capacity of New Airport

(Rp/Pass. 1985 price)

| Access Zone \ Route \ Year | | | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|---|---|
| Solo | Yogyakarta | Jakarta | 2,031 | 13,227 | 25,785 | 38,300 |
| Magelang | " | " | 0 | 7,575 | 18,891 | 30,169 |
| Yogyakarta | " | " | 11,914 | 23,158 | 35,769 | 48,337 |
| Solo | " | Denpasar | 17,389 | 29,382 | 42,834 | 56,240 |
| Magelang | " | " | 38,256 | 52,550 | 68,583 | 84,562 |
| Yogyakarta | " | " | 40,331 | 54,123 | 69,593 | 85,010 |
| Solo | " | Surabaya | 0 | 0 | 0 | 0 |
| Magelang | " | " | 6,873 | 13,383 | 20,684 | 27,960 |
| Yogyakarta | " | " | 8,951 | 14,958 | 21,696 | 28,411 |
| Solo | " | Bandung | 0 | 6,211 | 15,075 | 23,910 |
| Magelang | " | " | 0 | 362 | 7,958 | 15,528 |
| Yogyakarta | " | " | 8,191 | 16,142 | 25,059 | 33,947 |
| Solo | " | Banjarmasin | 161,245 | 190,067 | 222,397 | 254,616 |
| Magelang | " | " | 182,110 | 213,233 | 248,143 | 282,935 |
| Yogyakarta | " | " | 184,187 | 214,808 | 249,155 | 283,386 |

Source : Estimated by JICA

Table 4 Trip Cost by Mode

(1985 price)

| Access Zone | Route | Item | By Bus or Sea Route (or "Without") Trip Time (hour) | By Bus or Sea Route (or "Without") Fare (Rp) | By Air (or "With") Trip Time (hour) | By Air (or "With") Fare (Rp) |
|---|---|---|---|---|---|---|
| Solo | Yogyakarta | Jakarta | 16.15 | 8,398 | 3.27 | 82,440 |
| Magelang | " | " | 14.48 | 7,527 | 2.87 | 78,590 |
| Yogyakarta | " | " | 15.53 | 8,073 | 2.25 | 72,553 |
| Solo | " | Denpasar | 17.16 | 9,202 | 3.27 | 73,300 |
| Magelang | " | " | 19.81 | 10,582 | 2.87 | 69,450 |
| Yogyakarta | " | " | 18.76 | 10,034 | 2.25 | 63,413 |
| Solo | " | Surabaya | 7.10 | 3,692 | 2.98 | 46,275 |
| Magelang | " | " | 9.75 | 5,070 | 2.58 | 42,425 |
| Yogyakarta | " | " | 8.70 | 4,524 | 1.96 | 36,388 |
| Solo | " | Bandung | 11.65 | 6,058 | 2.78 | 61,450 |
| Magelang | " | " | 9.95 | 5,174 | 2.38 | 57,600 |
| Yogyakarta | " | " | 11.03 | 5,733 | 1.76 | 51,563 |
| Solo | " | Banjarmasin | 38.75 | 63,683 | 3.66 | 98,275 |
| Magelang | " | " | 41.40 | 65,061 | 3.26 | 94,425 |
| Yogyakarta | " | " | 40.35 | 64,515 | 2.64 | 88,388 |

Source : Estimated by JICA

Table 5 Economic Cash Flow for Sensitive Analysis ( Cost 10 % up )

Unit:Million Rp.

| Year | Costs | | | Benefits | | | | Net Benefit |
|---|---|---|---|---|---|---|---|---|
| | Const. Cost | O & M Cost | Total Cost | Saving O & M Cost | Saving Transp. Cost | Over Flow Pax. | Total Benefit | |
| 1987 | 4068. | 0. | 4068. | 0. | 0. | 0. | 0. | -4068. |
| 1988 | 6402. | 0. | 6402. | 0. | 0. | 0. | 0. | -6402. |
| 1989 | 7604. | 0. | 7604. | 0. | 0. | 0. | 0. | -7604. |
| 1990 | 5333. | 0. | 5333. | 0. | 0. | 0. | 0. | -5333. |
| 1991 | 7017. | 0. | 7017. | 0. | 0. | 0. | 0. | -7017. |
| 1992 | 20901. | 0. | 20901. | 0. | 0. | 0. | 0. | -20901. |
| 1993 | 34734. | 0. | 34734. | 0. | 0. | 0. | 0. | -34734. |
| 1994 | 23641. | 0. | 23641. | 0. | 0. | 0. | 0. | -23641. |
| 1995 | 0. | 1629. | 1629. | 660. | 3587. | 1411. | 5658. | 4029. |
| 1996 | 956. | 1713. | 2669. | 660. | 3626. | 3335. | 7621. | 4952. |
| 1997 | 2240. | 1821. | 4060. | 660. | 3665. | 5259. | 9584. | 5524. |
| 1998 | 1795. | 1910. | 3705. | 660. | 3704. | 7184. | 11548. | 7843. |
| 1999 | 898. | 2003. | 2901. | 660. | 3743. | 9108. | 13511. | 10610. |
| 2000 | 12895. | 2102. | 14997. | 660. | 3782. | 11032. | 15474. | 477. |
| 2001 | 7624. | 2281. | 9906. | 660. | 4527. | 16251. | 21438. | 11533. |
| 2002 | 0. | 2441. | 2441. | 660. | 5271. | 21470. | 27401. | 24960. |
| 2003 | 4170. | 2562. | 6732. | 660. | 6020. | 26688. | 33368. | 26636. |
| 2004 | 4178. | 2735. | 6912. | 660. | 6760. | 31907. | 39327. | 32415. |
| 2005 | 0. | 2918. | 2918. | 660. | 7505. | 37126. | 45291. | 42373. |
| 2006 | 0. | 3062. | 3062. | 660. | 8004. | 44498. | 53162. | 50100. |
| 2007 | 0. | 3220. | 3220. | 660. | 8502. | 51870. | 61032. | 57812. |
| 2008 | 0. | 3386. | 3386. | 660. | 9001. | 59243. | 68904. | 65518. |
| 2009 | 1030. | 3556. | 4586. | 660. | 9499. | 66615. | 76774. | 72188. |
| 2010 | 0. | 3752. | 3752. | 660. | 9998. | 73987. | 84645. | 80893. |
| 2011 | 0. | 3752. | 3752. | 660. | 9998. | 73987. | 162913. | 159161. |

Discount Rate = 9. % B/C Ratio = 1.500 NPV = 47320.
Discount Rate = 12. % B/C Ratio = 1.099 NPV = 7818.
Discount Rate = 15. % B/C Ratio = 0.812 NPV = -12703.

EIRR = 12.923 %

Table 6 Economic Cash Flow for Sensitive Analysis ( Benefit 10 % down )

Unit:Million Rp.

| Year | Costs | | | Benefits | | | | Net Benefit |
|---|---|---|---|---|---|---|---|---|
| | Const. Cost | O & M Cost | Total Cost | Saving O & M Cost | Saving Transp. Cost | Over Flow Pax. | Total Benefit | |
| 1987 | 3698. | 0. | 3698. | 0. | 0. | 0. | 0. | -3698. |
| 1988 | 5820. | 0. | 5820. | 0. | 0. | 0. | 0. | -5820. |
| 1989 | 6913. | 0. | 6913. | 0. | 0. | 0. | 0. | -6913. |
| 1990 | 4848. | 0. | 4848. | 0. | 0. | 0. | 0. | -4848. |
| 1991 | 6379. | 0. | 6379. | 0. | 0. | 0. | 0. | -6379. |
| 1992 | 19001. | 0. | 19001. | 0. | 0. | 0. | 0. | -19001. |
| 1993 | 31576. | 0. | 31576. | 0. | 0. | 0. | 0. | -31576. |
| 1994 | 21492. | 0. | 21492. | 0. | 0. | 0. | 0. | -21492. |
| 1995 | 0. | 1481. | 1481. | 594. | 3228. | 1270. | 5092. | 3611. |
| 1996 | 869. | 1557. | 2426. | 594. | 3263. | 3002. | 6859. | 4433. |
| 1997 | 2036. | 1655. | 3691. | 594. | 3299. | 4733. | 8626. | 4935. |
| 1998 | 1632. | 1736. | 3368. | 594. | 3334. | 6466. | 10393. | 7025. |
| 1999 | 816. | 1821. | 2637. | 594. | 3369. | 8197. | 12160. | 9523. |
| 2000 | 11723. | 1911. | 13634. | 594. | 3404. | 9929. | 13927. | 293. |
| 2001 | 6931. | 2074. | 9005. | 594. | 4074. | 14626. | 19294. | 10289. |
| 2002 | 0. | 2219. | 2219. | 594. | 4744. | 19323. | 24661. | 22442. |
| 2003 | 3791. | 2329. | 6120. | 594. | 5418. | 24019. | 30031. | 23911. |
| 2004 | 3798. | 2486. | 6284. | 594. | 6084. | 28716. | 35394. | 29110. |
| 2005 | 0. | 2653. | 2653. | 594. | 6755. | 33413. | 40762. | 38109. |
| 2006 | 0. | 2784. | 2784. | 594. | 7204. | 40048. | 47846. | 45062. |
| 2007 | 0. | 2927. | 2927. | 594. | 7652. | 46683. | 54929. | 52002. |
| 2008 | 0. | 3078. | 3078. | 594. | 8101. | 53319. | 62014. | 58936. |
| 2009 | 936. | 3233. | 4169. | 594. | 8549. | 59954. | 69097. | 64928. |
| 2010 | 0. | 3411. | 3411. | 594. | 8998. | 66588. | 76181. | 72770. |
| 2011 | 0. | 3411. | 3411. | 594. | 8998. | 66588. | 154448. | 151037. |

Discount Rate = 9. % B/C Ratio = 1.496 NPV = 42717.
Discount Rate = 12. % B/C Ratio = 1.095 NPV = 6831.
Discount Rate = 15. % B/C Ratio = 0.809 NPV = -11774.

EIRR = 12.886 %

Table 7 Economic Cash Flow for Sensitive Analysis
( Cost 10 % up and Benefit 10 % down )

Unit:Million Rp.

| Year | Costs | | | Benefits | | | | Net Benefit |
|---|---|---|---|---|---|---|---|---|
| | Const. Cost | O & M Cost | Total Cost | Saving O & M Cost | Saving Transp. Cost | Over Flow Pax. | Total Benefit | |
| 1987 | 4068. | 0. | 4068. | 0. | 0. | 0. | 0. | -4068. |
| 1988 | 6402. | 0. | 6402. | 0. | 0. | 0. | 0. | -6402. |
| 1989 | 7604. | 0. | 7604. | 0. | 0. | 0. | 0. | -7604. |
| 1990 | 5333. | 0. | 5333. | 0. | 0. | 0. | 0. | -5333. |
| 1991 | 7017. | 0. | 7017. | 0. | 0. | 0. | 0. | -7017. |
| 1992 | 20901. | 0. | 20901. | 0. | 0. | 0. | 0. | -20901. |
| 1993 | 34734. | 0. | 34734. | 0. | 0. | 0. | 0. | -34734. |
| 1994 | 23641. | 0. | 23641. | 0. | 0. | 0. | 0. | -23641. |
| 1995 | 0. | 1629. | 1629. | 594. | 3228. | 1270. | 5092. | 3463. |
| 1996 | 956. | 1713. | 2669. | 594. | 3263. | 3002. | 6859. | 4190. |
| 1997 | 2240. | 1821. | 4060. | 594. | 3299. | 4733. | 8626. | 4566. |
| 1998 | 1795. | 1910. | 3705. | 594. | 3334. | 6466. | 10393. | 6688. |
| 1999 | 898. | 2003. | 2901. | 594. | 3369. | 8197. | 12160. | 9259. |
| 2000 | 12895. | 2102. | 14997. | 594. | 3404. | 9929. | 13927. | -1071. |
| 2001 | 7624. | 2281. | 9906. | 594. | 4074. | 14626. | 19294. | 9389. |
| 2002 | 0. | 2441. | 2441. | 594. | 4744. | 19323. | 24661. | 22220. |
| 2003 | 4170. | 2562. | 6732. | 594. | 5418. | 24019. | 30031. | 23299. |
| 2004 | 4178. | 2735. | 6912. | 594. | 6084. | 28716. | 35394. | 28482. |
| 2005 | 0. | 2918. | 2918. | 594. | 6755. | 33413. | 40762. | 37844. |
| 2006 | 0. | 3062. | 3062. | 594. | 7204. | 40048. | 47846. | 44783. |
| 2007 | 0. | 3220. | 3220. | 594. | 7652. | 46683. | 54929. | 51709. |
| 2008 | 0. | 3386. | 3386. | 594. | 8101. | 53319. | 62014. | 58628. |
| 2009 | 1030. | 3556. | 4586. | 594. | 8549. | 59954. | 69097. | 64511. |
| 2010 | 0. | 3752. | 3752. | 594. | 8998. | 66588. | 76181. | 72428. |
| 2011 | 0. | 3752. | 3752. | 594. | 8998. | 66588. | 154448. | 150696. |

Discount Rate = 9. % B/C Ratio = 1.360 NPV = 34105.
Discount Rate = 12. % B/C Ratio = 0.995 NPV = -377.
Discount Rate = 15. % B/C Ratio = 0.735 NPV = -17925.

EIRR = 11.954 %

Table 8 Economic Cash Flow
( Devaluation of Rupiah by 45 % )

Unit:Million Rp.

| Year | Costs | | | Benefits | | | | Net Benefit |
|---|---|---|---|---|---|---|---|---|
| | Const. Cost | O & M Cost | Total Cost | Saving O & M Cost | Saving Transp. Cost | Over Flow Pax. | Total Benefit | |
| 1987 | 4286. | 0. | 4286. | 0. | 0. | 0. | 0. | -4286. |
| 1988 | 6990. | 0. | 6990. | 0. | 0. | 0. | 0. | -6990. |
| 1989 | 7510. | 0. | 7510. | 0. | 0. | 0. | 0. | -7510. |
| 1990 | 4861. | 0. | 4861. | 0. | 0. | 0. | 0. | -4861. |
| 1991 | 7095. | 0. | 7095. | 0. | 0. | 0. | 0. | -7095. |
| 1992 | 25347. | 0. | 25347. | 0. | 0. | 0. | 0. | -25347. |
| 1993 | 42129. | 0. | 42129. | 0. | 0. | 0. | 0. | -42129. |
| 1994 | 28532. | 0. | 28532. | 0. | 0. | 0. | 0. | -28532. |
| 1995 | 0. | 1645. | 1645. | 660. | 3587. | 1411. | 5658. | 4013. |
| 1996 | 1229. | 1724. | 2953. | 660. | 3626. | 3335. | 7621. | 4668. |
| 1997 | 2879. | 1830. | 4709. | 660. | 3665. | 5259. | 9584. | 4875. |
| 1998 | 2213. | 1911. | 4124. | 660. | 3704. | 7184. | 11548. | 7424. |
| 1999 | 1106. | 1996. | 3102. | 660. | 3743. | 9108. | 13511. | 10409. |
| 2000 | 15240. | 2086. | 17326. | 660. | 3782. | 11032. | 15474. | -1852. |
| 2001 | 9422. | 2265. | 11687. | 660. | 4527. | 16251. | 21438. | 9751. |
| 2002 | 0. | 2428. | 2428. | 660. | 5271. | 21470. | 27401. | 24973. |
| 2003 | 5414. | 2538. | 7952. | 660. | 6020. | 26688. | 33368. | 25416. |
| 2004 | 5424. | 2710. | 8134. | 660. | 6760. | 31907. | 39327. | 31193. |
| 2005 | 0. | 2892. | 2892. | 660. | 7505. | 37126. | 45291. | 42399. |
| 2006 | 0. | 3023. | 3023. | 660. | 8004. | 44498. | 53162. | 50139. |
| 2007 | 0. | 3166. | 3166. | 660. | 8502. | 51870. | 61032. | 57866. |
| 2008 | 0. | 3317. | 3317. | 660. | 9001. | 59243. | 68904. | 65587. |
| 2009 | 1337. | 3472. | 4809. | 660. | 9499. | 66615. | 76774. | 71965. |
| 2010 | 0. | 3653. | 3653. | 660. | 9998. | 73987. | 84645. | 80992. |
| 2011 | 0. | 3655. | 3655. | 660. | 9998. | 73987. | 162913. | 159258. |

Discount Rate = 9. % B/C Ratio = 1.321 NPV = 34477.
Discount Rate = 12. % B/C Ratio = 0.969 NPV = -2793.
Discount Rate = 15. % B/C Ratio = 0.718 NPV = -21580.

EIRR = 11.690 %

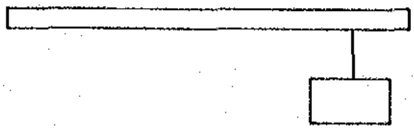
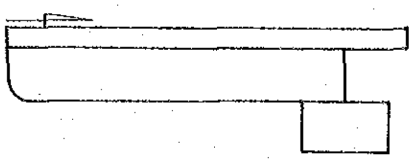
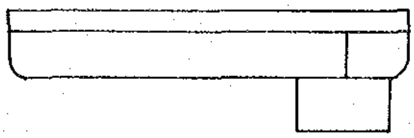
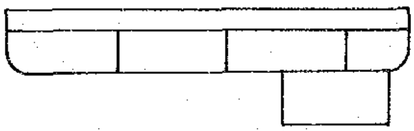
Appendix to Part II, Vol.2 Chapter 3 ( II-2-3 )

## Consideration of Parallel Taxiway

Based on the traffic demand forecast in the year 2010, air traffic is expected to be 6.2 movements in a peak hour (both takeoff and landing) and 6,400 movements annually. Therefore, parallel taxiway may not be justified as long as the civil aircraft movement up to the year 2010.

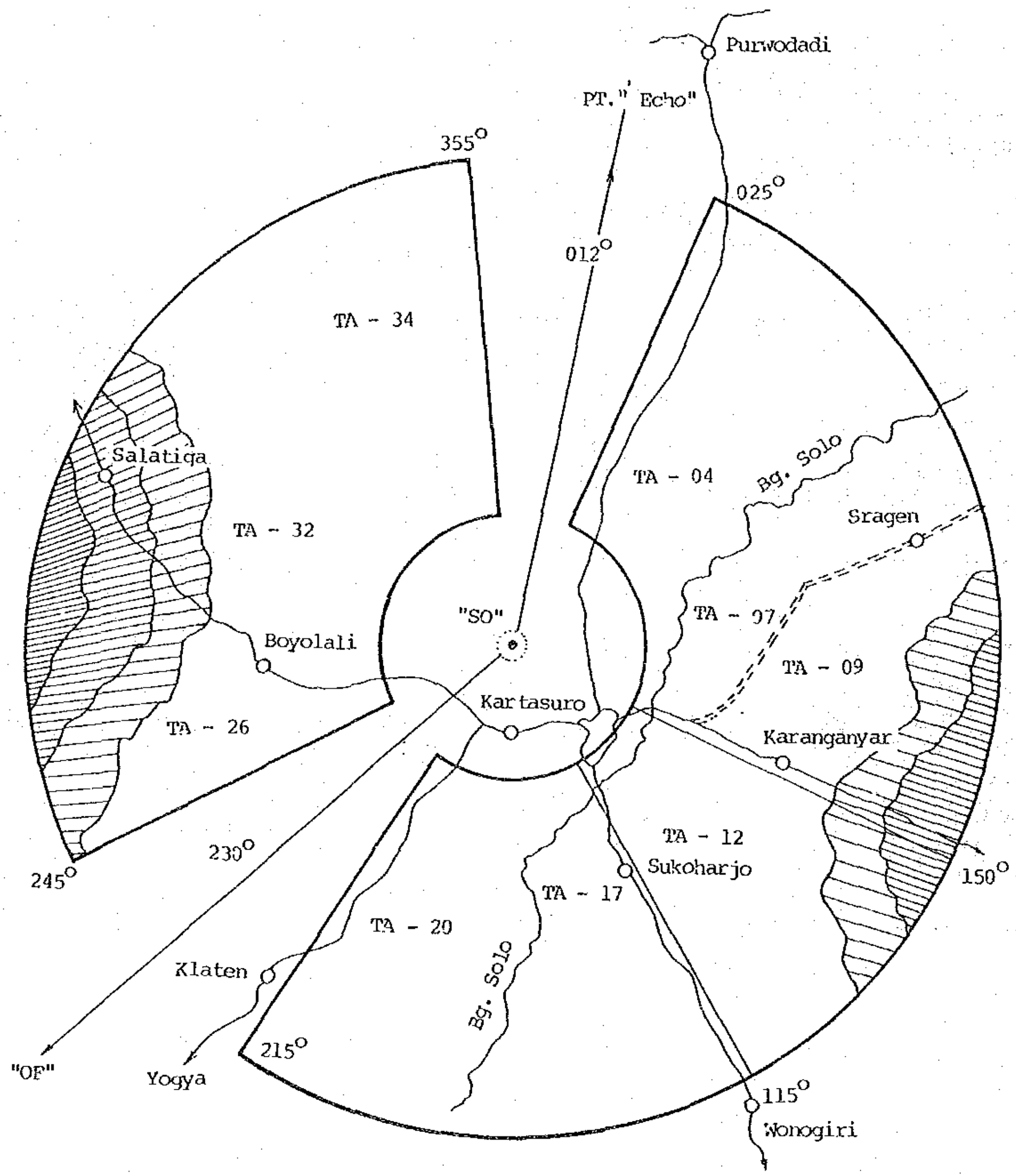
When a parallel taxiway will become necessary in a long future, it is desirable to construct the parallel taxiway in accordance with the implementation program with the capacity of runway operation shown in Table 1.

Table 1 Capacity of Runway Operations

| | Taxiway Layout | Annual Aircraft Movements (IFR) | Peak Hour Movements (IFR) |
|---|---|---|---|
| Phase I & II (up to 2010) |  | - 50,000 | 10 - 12 |
| Phase III |  | 50,000 - 80,000 | 18 - 20 |
| Phase IV |  | 80,000 - 140,000 | 30 - 35 |
| Phase V |  | | |
| Design Movements ( 2010 ) | | 6,400 | 6.2 |

Appendix to Part II, Vol.2, Chapter 4 ( II-2-4 )

AdiSumarmo Training Area, WRR-6, Which is divided into Nine Portions



Appendix to Part II, Vol.2, Chapter 6 (II-2-6)

## Construction Cost Estimates

### Table 1 Estimated Construction Cost
### ( Foreign Portion in U.S.Dollars )

| Phase of Construction / Work Item | | Phase I | | Phase II | | Total | |
|---|---|---|---|---|---|---|---|
| | | Local Portion (million Rp.) | Foreign Portion (thousand US$) | Local Portion (million Rp.) | Foreign Portion (thousand US$) | Local Portion (million Rp.) | Foreign Portion (thousand US$) |
| Land Acquisition | Land Acquisition | 1,560 | 0 | 0 | 0 | 1,560 | 0 |
| | Compensation | 35 | 0 | 0 | 0 | 35 | 0 |
| | Land Acquisition * (Ultimate Expansion Area) | (1,654) | ( 0) | ( 0) | ( 0) | (1,654) | ( 0) |
| | Sub Total | 1,595 | 0 | 0 | 0 | 1,595 | 0 |
| Civil Works | Earth Work | 966 | 446 | 10 | 35 | 976 | 481 |
| | Drainage Works | 529 | 649 | 0 | 0 | 529 | 649 |
| | Pavement Works | 2,777 | 4,961 | 955 | 1,574 | 3,732 | 6,535 |
| | Access Road | 235 | 108 | 470 | 222 | 705 | 330 |
| | River Diversion | 34 | 42 | 0 | 0 | 34 | 42 |
| | Sub Total | 4,541 | 6,206 | 1,435 | 1,831 | 5,976 | 8,037 |
| Architectural Works | Passenger Terminal Building | 2,106 | 2,198 | 1,366 | 1,426 | 3,472 | 3,624 |
| | Cargo Terminal Building | 262 | 207 | 230 | 181 | 492 | 388 |
| | Administration Building | 334 | 363 | 111 | 121 | 445 | 484 |
| | Other Buildings | 306 | 240 | 0 | 0 | 306 | 240 |
| | Special Equipment | 0 | 2,365 | 0 | 84 | 0 | 2,449 |
| | Sub Total | 3,008 | 5,373 | 1,707 | 1,812 | 4,715 | 7,185 |
| Air Navigation Systems | Radio Navigation Aids | 235 | 5,044 | 68 | 1,513 | 303 | 6,557 |
| | Air Traffic Control and Aeronautical Telecommunications | 87 | 2,271 | 37 | 908 | 124 | 3,179 |
| | ATC Radar System | 0 | 0 | 0 | 0 | 0 | 0 |
| | Aeronautical Ground Lights | 1,238 | 3,025 | 247 | 605 | 1,485 | 3,630 |
| | Meteorological System | 62 | 1,694 | 19 | 506 | 81 | 2,200 |
| | Sub Total | 1,622 | 12,034 | 371 | 3,532 | 1,993 | 15,566 |
| Utilities Works | Power Supply System | 479 | 2,238 | 23 | 842 | 502 | 3,080 |
| | Water Supply System | 44 | 80 | 0 | 4 | 44 | 84 |
| | Sewarage System | 257 | 353 | 12 | 3 | 269 | 356 |
| | Solid Waste Disposal System | 29 | 116 | 0 | 0 | 29 | 116 |
| | Telecommunication System | 260 | 550 | 0 | 0 | 260 | 550 |
| | Sub Total | 1,069 | 3,337 | 35 | 849 | 1,104 | 4,186 |
| Other Equipment | Vehicles for Fire Fighting Services | 0 | 965 | 0 | 0 | 0 | 965 |
| | Sub Total | 0 | 965 | 0 | 0 | 0 | 965 |
| Total of Construction Works | | 11,835 | 27,915 | 3,548 | 8,024 | 15,383 | 35,939 |
| Engineering Services Cost | | 1,184 | 2,792 | 355 | 802 | 1,539 | 3,594 |
| Sub Total | | 13,019 | 30,707 | 3,903 | 8,826 | 16,922 | 39,533 |
| Contingency | | 1,302 | 3,071 | 390 | 883 | 1,692 | 3,953 |
| Grand Total | | 14,321 | 33,778 | 4,293 | 9,709 | 18,614 | 43,486 |

* Land Acquisition Cost for Ultimate Expansion Area is not included in Total Cost.

Exchange Rate: US$ 1.00 = Rp. 1,125

Appendix to Part II, Vol.2, Chapter 7 ( II-2-7 )

Economic Analysis

Table 1 Total Passenger Transportation Cost of Airline Companies

(Mill Rp./Year, 1985 price)

| Item / Year | "Without Project" or the Cost by Smaller Air Plane | | "With Project" or the Cost by Larger Air Plane | |
|---|---|---|---|---|
| | Jakarta | Surabaya | Jakarta | Surabaya |
| 1995 | 8,754 | 1,499 | 7,961 | 1,499 |
| 2000 | 11,967 | 2,029 | 10,882 | 2,029 |
| 5 | 16,485 | 2,793 | 14,239 | 2,793 |
| 10 | 22,733 | 3,883 | 19,636 | 3,883 |

Source : Estimated by JICA

Table 2 The Passenger which will Spill Over the Present Capacity of the Airport and which will Use Highway Bus Inevitably

(pass./year)

| Access Zone | Route | Year | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|---|---|
| Solo | Surakarta | Jakarta | 0 | 45,865 | 179,186 | 314,061 |
| " | " | Surabaya | 0 | 9,394 | 36,701 | 64,326 |
| Yogyakarta | " | Jakarta | 0 | 3,105 | 12,129 | 21,259 |
| " | " | Surabaya | 0 | 636 | 2,484 | 4,354 |

Source : Estimated by JICA

Table 3 User Benefit the Passenger which will Divert from Bus to Air due to Larger Capacity of the Airport

(Rp/Pass. 1985 price)

| Access Zone | Route | | 1992 | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|---|---|---|
| Solo | Surakarta | Jakarta | 4,599 | 13,433 | 25,108 | 38,203 | 51,253 |
| " | " | Surabaya | 0 | 398 | 5,348 | 10,900 | 16,433 |
| Yogyakarta | " | Jakarta | 0 | 0 | 8,489 | 20,498 | 32,467 |
| " | " | Surabaya | 0 | 0 | 3,539 | 9,970 | 16,379 |

Source : Estimated by JICA

Table 4 Trip Cost by Mode

(1985 price)

| Access Zone | Route | | By Bus (or "Without") Trip Time (hour) | By Bus (or "Without") Fare (Rp) | By Air (or "With") Trip Time (hour) | By Air (or "With") Fare (Rp) |
|---|---|---|---|---|---|---|
| Solo | Surakarta | Jakarta | 16.15 | 8,398 | 2.36 | 74,290 |
| " | " | Surabaya | 7.10 | 3,692 | 1.57 | 36,925 |
| Yogyakarta | " | Jakarta | 15.53 | 8,073 | 3.27 | 83,040 |
| " | " | Surabaya | 8.70 | 4,524 | 2.48 | 45,675 |

Source : Estimated by JICA

Table 5 Economic Cash Flow for Sensitive Analysis ( Cost 10 % up )

Unit:Million Rp.

| Year | Costs | | | Benefits | | | | Net Benefit |
|---|---|---|---|---|---|---|---|---|
| | Const. Cost | O & M Cost | Total Cost | Saving O & M Cost | Saving Transp. Cost | Over Flow Pax. | Total Benefit | |
| 1987 | 1353. | 0. | 1353. | 0. | 0. | 0. | 0. | -1353. |
| 1988 | 2536. | 0. | 2536. | 0. | 0. | 0. | 0. | -2536. |
| 1989 | 1694. | 0. | 1694. | 0. | 0. | 0. | 0. | -1694. |
| 1990 | 13085. | 0. | 13085. | 0. | 0. | 0. | 0. | -13085. |
| 1991 | 14970. | 0. | 14970. | 0. | 0. | 0. | 0. | -14970. |
| 1992 | 11595. | 726. | 12321. | 100. | 198. | 524. | 822. | -11499. |
| 1993 | 8792. | 777. | 9569. | 100. | 397. | 1048. | 1545. | -8024. |
| 1994 | 0. | 1087. | 1087. | 100. | 595. | 1571. | 2266. | 1179. |
| 1995 | 0. | 1111. | 1111. | 100. | 793. | 2095. | 2988. | 1877. |
| 1996 | 961. | 1169. | 2131. | 100. | 851. | 2619. | 3570. | 1439. |
| 1997 | 3144. | 1231. | 4375. | 100. | 910. | 3144. | 4154. | -221. |
| 1998 | 459. | 1330. | 1789. | 100. | 968. | 3668. | 4736. | 2947. |
| 1999 | 7677. | 1401. | 9078. | 100. | 1027. | 4190. | 5317. | -3761. |
| 2000 | 2835. | 1513. | 4347. | 100. | 1085. | 4715. | 5900. | 1553. |
| 2001 | 0. | 1564. | 1564. | 100. | 1317. | 8423. | 9840. | 8276. |
| 2002 | 1868. | 1693. | 3561. | 100. | 1549. | 12131. | 13780. | 10219. |
| 2003 | 1868. | 1781. | 3649. | 100. | 1782. | 15838. | 17720. | 14071. |
| 2004 | 0. | 1884. | 1884. | 100. | 2014. | 19546. | 21660. | 19776. |
| 2005 | 0. | 1987. | 1987. | 100. | 2246. | 23254. | 25600. | 23613. |
| 2006 | 0. | 2101. | 2101. | 100. | 2416. | 28442. | 30958. | 28857. |
| 2007 | 0. | 2215. | 2215. | 100. | 2586. | 33631. | 36317. | 34102. |
| 2008 | 1015. | 2345. | 3361. | 100. | 2757. | 38820. | 41677. | 38317. |
| 2009 | 0. | 2518. | 2518. | 100. | 2927. | 44008. | 47035. | 44517. |
| 2010 | 0. | 2666. | 2666. | 100. | 3097. | 49197. | 52394. | 49728. |
| 2011 | 0. | 2666. | 2666. | 100. | 3097. | 49197. | 130662. | 127996. |

Discount Rate = 9. % B/C Ratio = 1.559 NPV = 30484.
Discount Rate = 12. % B/C Ratio = 1.122 NPV = 5613.
Discount Rate = 15. % B/C Ratio = 0.817 NPV = -7245.

EIRR = 13.074 %

Table 6 Economic Cash Flow for Sensitive Analysis ( Benefit 10 % down )

Unit:Million Rp.

| Year | Costs | | | Benefits | | | | Net Benefit |
|---|---|---|---|---|---|---|---|---|
| | Const. Cost | O & M Cost | Total Cost | Saving O & M Cost | Saving Transp. Cost | Over Flow Pax. | Total Benefit | |
| 1987 | 1230. | 0. | 1230. | 0. | 0. | 0. | 0. | -1230. |
| 1988 | 2305. | 0. | 2305. | 0. | 0. | 0. | 0. | -2305. |
| 1989 | 1540. | 0. | 1540. | 0. | 0. | 0. | 0. | -1540. |
| 1990 | 11895. | 0. | 11895. | 0. | 0. | 0. | 0. | -11895. |
| 1991 | 13609. | 0. | 13609. | 0. | 0. | 0. | 0. | -13609. |
| 1992 | 10541. | 660. | 11201. | 90. | 178. | 472. | 740. | -10461. |
| 1993 | 7993. | 706. | 8699. | 90. | 357. | 943. | 1391. | -7309. |
| 1994 | 0. | 988. | 988. | 90. | 536. | 1414. | 2039. | 1051. |
| 1995 | 0. | 1010. | 1010. | 90. | 714. | 1886. | 2689. | 1679. |
| 1996 | 874. | 1063. | 1937. | 90. | 766. | 2357. | 3213. | 1276. |
| 1997 | 2858. | 1119. | 3977. | 90. | 819. | 2830. | 3739. | -238. |
| 1998 | 417. | 1209. | 1626. | 90. | 871. | 3301. | 4262. | 2636. |
| 1999 | 6979. | 1274. | 8253. | 90. | 924. | 3771. | 4785. | -3468. |
| 2000 | 2577. | 1375. | 3952. | 90. | 977. | 4244. | 5310. | 1358. |
| 2001 | 0. | 1422. | 1422. | 90. | 1185. | 7581. | 8856. | 7434. |
| 2002 | 1698. | 1539. | 3237. | 90. | 1394. | 10918. | 12402. | 9165. |
| 2003 | 1698. | 1619. | 3317. | 90. | 1604. | 14254. | 15948. | 12631. |
| 2004 | 0. | 1713. | 1713. | 90. | 1813. | 17591. | 19494. | 17781. |
| 2005 | 0. | 1806. | 1806. | 90. | 2021. | 20929. | 23040. | 21234. |
| 2006 | 0. | 1910. | 1910. | 90. | 2174. | 25598. | 27862. | 25952. |
| 2007 | 0. | 2014. | 2014. | 90. | 2327. | 30268. | 32685. | 30671. |
| 2008 | 923. | 2132. | 3055. | 90. | 2481. | 34938. | 37509. | 34454. |
| 2009 | 0. | 2289. | 2289. | 90. | 2634. | 39607. | 42332. | 40043. |
| 2010 | 0. | 2424. | 2424. | 90. | 2787. | 44277. | 47155. | 44731. |
| 2011 | 0. | 2424. | 2424. | 90. | 2787. | 44277. | 125423. | 122999. |

Discount Rate = 9. % B/C Ratio = 1.564 NPV = 27929.
Discount Rate = 12. % B/C Ratio = 1.123 NPV = 5149.
Discount Rate = 15. % B/C Ratio = 0.817 NPV = -6607.

EIRR = 13.077 %

Table 7 Economic Cash Flow for Sensitive Analysis
( Cost 10 % up and Benefit 10 % down )

Unit:Million Rp.

| Year | Costs | | | Benefits | | | | Net Benefit |
|---|---|---|---|---|---|---|---|---|
| | Const. Cost | O & M Cost | Total Cost | Saving O & M Cost | Saving Transp. Cost | Over Flow Pax. | Total Benefit | |
| 1987 | 1353. | 0. | 1353. | 0. | 0. | 0. | 0. | -1353. |
| 1988 | 2536. | 0. | 2536. | 0. | 0. | 0. | 0. | -2536. |
| 1989 | 1694. | 0. | 1694. | 0. | 0. | 0. | 0. | -1694. |
| 1990 | 13085. | 0. | 13085. | 0. | 0. | 0. | 0. | -13085. |
| 1991 | 14970. | 0. | 14970. | 0. | 0. | 0. | 0. | -14970. |
| 1992 | 11595. | 726. | 12321. | 90. | 178. | 472. | 740. | -11581. |
| 1993 | 8792. | 777. | 9569. | 90. | 357. | 943. | 1391. | -8178. |
| 1994 | 0. | 1087. | 1087. | 90. | 536. | 1414. | 2039. | 953. |
| 1995 | 0. | 1111. | 1111. | 90. | 714. | 1886. | 2689. | 1578. |
| 1996 | 961. | 1169. | 2131. | 90. | 766. | 2357. | 3213. | 1082. |
| 1997 | 3144. | 1231. | 4375. | 90. | 819. | 2830. | 3739. | -636. |
| 1998 | 459. | 1330. | 1789. | 90. | 871. | 3301. | 4262. | 2474. |
| 1999 | 7677. | 1401. | 9078. | 90. | 924. | 3771. | 4785. | -4293. |
| 2000 | 2835. | 1513. | 4347. | 90. | 977. | 4244. | 5310. | 963. |
| 2001 | 0. | 1564. | 1564. | 90. | 1185. | 7581. | 8856. | 7292. |
| 2002 | 1868. | 1693. | 3561. | 90. | 1394. | 10918. | 12402. | 8841. |
| 2003 | 1868. | 1781. | 3649. | 90. | 1604. | 14254. | 15948. | 12299. |
| 2004 | 0. | 1884. | 1884. | 90. | 1813. | 17591. | 19494. | 17610. |
| 2005 | 0. | 1987. | 1987. | 90. | 2021. | 20929. | 23040. | 21053. |
| 2006 | 0. | 2101. | 2101. | 90. | 2174. | 25598. | 27862. | 25761. |
| 2007 | 0. | 2215. | 2215. | 90. | 2327. | 30268. | 32685. | 30470. |
| 2008 | 1015. | 2345. | 3361. | 90. | 2481. | 34938. | 37509. | 34149. |
| 2009 | 0. | 2518. | 2518. | 90. | 2634. | 39607. | 42332. | 39814. |
| 2010 | 0. | 2666. | 2666. | 90. | 2787. | 44277. | 47155. | 44488. |
| 2011 | 0. | 2666. | 2666. | 90. | 2787. | 44277. | 125423. | 122756. |

Discount Rate = 9. % B/C Ratio = 1.422 NPV = 22975.
Discount Rate = 12. % B/C Ratio = 1.021 NPV = 962.
Discount Rate = 15. % B/C Ratio = 0.743 NPV = -10214.

EIRR = 12.191 %

Table 8 Economic Cash Flow
( Devaluation of Rupiah by 45 % )

Cost 0.% up Benefits 0.% down Unit:Million Rp.

| Year | Costs | | | Benefits | | | | Net Benefit |
|---|---|---|---|---|---|---|---|---|
| | Const. Cost | O & M Cost | Total Cost | Saving O & M Cost | Saving Transp. Cost | Over Flow Pax. | Total Benefit | |
| 1987 | 1583. | 0. | 1583. | 0. | 0. | 0. | 0. | -1583. |
| 1988 | 3011. | 0. | 3011. | 0. | 0. | 0. | 0. | -3011. |
| 1989 | 1895. | 0. | 1895. | 0. | 0. | 0. | 0. | -1895. |
| 1990 | 15413. | 0. | 15413. | 0. | 0. | 0. | 0. | -15413. |
| 1991 | 18298. | 0. | 18298. | 0. | 0. | 0. | 0. | -18298. |
| 1992 | 14110. | 673. | 14783. | 100. | 198. | 524. | 822. | -13961. |
| 1993 | 10737. | 719. | 11456. | 100. | 397. | 1048. | 1545. | -9911. |
| 1994 | 0. | 1060. | 1060. | 100. | 595. | 1571. | 2266. | 1206. |
| 1995 | 0. | 1111. | 1111. | 100. | 793. | 2095. | 2988. | 1877. |
| 1996 | 1226. | 1164. | 2390. | 100. | 851. | 2619. | 3570. | 1180. |
| 1997 | 3946. | 1220. | 5166. | 100. | 910. | 3144. | 4154. | -1012. |
| 1998 | 553. | 1323. | 1876. | 100. | 968. | 3668. | 4736. | 2860. |
| 1999 | 8823. | 1388. | 10211. | 100. | 1027. | 4190. | 5317. | -4894. |
| 2000 | 3456. | 1502. | 4958. | 100. | 1085. | 4715. | 5900. | 942. |
| 2001 | 0. | 1553. | 1553. | 100. | 1317. | 8423. | 9840. | 8287. |
| 2002 | 2400. | 1670. | 4070. | 100. | 1549. | 12131. | 13780. | 9710. |
| 2003 | 2400. | 1750. | 4150. | 100. | 1782. | 15838. | 17720. | 13570. |
| 2004 | 0. | 1844. | 1844. | 100. | 2014. | 19546. | 21660. | 19816. |
| 2005 | 0. | 1937. | 1937. | 100. | 2246. | 23254. | 25600. | 23663. |
| 2006 | 0. | 2041. | 2041. | 100. | 2416. | 28442. | 30958. | 28917. |
| 2007 | 0. | 2145. | 2145. | 100. | 2586. | 33631. | 36317. | 34172. |
| 2008 | 1303. | 2263. | 3566. | 100. | 2757. | 38820. | 41677. | 38111. |
| 2009 | 0. | 2438. | 2438. | 100. | 2927. | 44008. | 47035. | 44597. |
| 2010 | 0. | 2573. | 2573. | 100. | 3097. | 49197. | 52394. | 49821. |
| 2011 | 0. | 2573. | 2573. | 100. | 3097. | 49197. | 130662. | 128089. |

Discount Rate = 9. % B/C Ratio = 1.338 NPV = 21477.
Discount Rate = 12. % B/C Ratio = 0.958 NPV = -2265.
Discount Rate = 15. % B/C Ratio = 0.695 NPV = -14201.

EIRR = 11.609 %

JICA