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**AERODROME STANDARDS**

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## AERODROME STANDARDS

### 1. INTRODUCTION

The Government of the Republic of Namibia (GRN), through its Ministry of Works, Transport and Communication (MWTC) has commissioned the Swedish Consultants KM International AB in association with VKE (Namibia) Inc., Nordic Consulting Group (NCG) and Swedish National Road Consulting AB (SweRoad) to undertake a National Transportation Master Plan Study (NTMPS). In order to cover all aspects of the Study, the Consultant has also sub-contracted the firms Opus International Consultants (NZ), Africon and SwedeRail.

This document presents the recommendations as prepared by Africon Namibia for Task 14 of the Namibian National Transportation Master Plan Study (NTMPS).

Task 14 entails the identifying of aerodromes that will be the responsibility of the Ministry of Works, Transport & Communications including standards and procedures for their operations.

This document is structured as follows:

- Part 2 presents the ICAO Classification
- Part 3 identifies the infrastructure standards for each aerodrome class
- Part 4 identifies and quantifies maintenance requirements for the infrastructure of each aerodrome class

### 2. ICAO CLASSIFICATION

Three aerodrome classes were identified for the Namibian Aerodrome Network, namely:

- **Class A** : Aerodrome capable of handling large jet aircraft and a high volume of traffic, and facilities to handle international flights and passengers
- **Class B** : Infrastructure capable of handling smaller aircraft (commuter type) and volumes, not necessarily a point of entry (See Annexure C for examples).

- **Class C** : Minimum facility for access by air, implying a non-licensed facility with rudimentary infrastructure to handle only small aircraft on an occasional basis (See Annexure C for examples).

The mentioned classes were defined from a network point of view and as standards and maintenance requirements are to be based on ICAO standards, the different Network Classes had to be translated to ICAO codes.

Aerodrome classification according to ICAO standards depends on two factors :

- The approach procedure that would be used by handling aircraft
- The size of aircraft that has to be accommodated

As aerodromes categorized as Class A would all be the responsibility of the NACo it was decided not to classify these airports according to ICAO and as a result no standards were set.

Class B and C airports are airports that will accommodate low traffic volumes and visual approach procedures for these airports will suffice. Both classes are therefore classified as non-instrument runways.

The Class B airports serve the larger towns and although they are not necessarily a point of entry they could become a destination served by scheduled flights. (i.e. commuter flights). The aircraft currently used by the national carrier on the lower volumes routes are Beechcraft 1900's which are ICAO Code 2B aircraft. Code 2B is the code following 1A and although it has higher standards it does not mean a leap in standards. The higher standards are a reference field length of between 800m and 1200m and a runway width of 23m. Aircraft with a wingspan of less than 24m can be accommodated which include aircraft such as Beechcraft King Air 350, Beechcraft King Air 200 and Beechcraft 1900, it also allows for smaller jet aircraft such as the Citation V.

The Class C airports as defined by the NTMPS are minimum facilities for access by air and as the lowest ICAO Code is 1A, class C airports were categorized as ICAO Code 1A airports. This implies a runway reference field length of less than 800m and a width of 18m, accommodating aircraft with a wing span of less than 15m. Aircraft belonging to this Code are Cessna 172, Beechcraft Baron E55, Cessna Skywagon 207, Cessna 402, Piper Cherokee SX260, etc.

The ICAO classification for Class B and C airports will therefore be:

- **Class B** : ICAO Code 2B non-instrument runway
- **Class C** : ICAO Code 1A non-instrument runway

### **3. AERODROME STANDARDS**

#### **3.1 BACKGROUND**

The aerodrome standards that are applicable to a specific aerodrome code are determined by the following:

- Legislation applicable to licensed and unlicensed aerodromes in Namibia.
- ICAO standards as Namibia is a contracting state.

The requirements of the mentioned determinators are as follows:

- Current Namibian legislation requires the following from an aerodrome license holder:
  - aerodrome must be maintained in a serviceable condition
  - aerodrome must be kept free from unauthorized access
  - all obstructions must be marked
  - an apparatus must be installed and maintained that indicates surface wind direction
  - required marking must be maintained in a conspicuous condition.

For a non-licensed aerodrome the pilot is responsible for ensuring that the landing area conforms to the minimum basic length required for a specific aircraft and that the approach areas are safe.

- ICAO standards for aerodromes are contained in Annex 14 to the Convention on International Civil Aviation.

Therefore to set standards for infrastructure that need to be provided at Class B and C (Code 2B and 1A) aerodromes the requirements of the two determinators need to be taken into account.

## **3.2 INFRASTRUCTURE REQUIREMENTS**

To standardise the infrastructure requirements for Class B and C (Code 2B and 1A) aerodromes the following approach was used:

- Broad infrastructure elements constituting an aerodrome were identified and defined
- Standards for the different elements were set for Class B and C aerodromes.

In certain cases the requirements of the different determinators overlap for certain aerodrome elements and although it would be ideal to satisfy ICAO requirements in all cases it became evident that this would prove to be a very expensive exercise. In certain cases it was therefore decided to satisfy only the requirements as contained in legislation applicable to aerodromes. The monetary impact of satisfying the required criteria has not been quantified as a status quo review of all aerodrome characteristics needs to be undertaken first.

### **3.2.1 Aerodrome elements**

The elements that constitute an aerodrome are:

- obstacle limitation surfaces
- runways, taxiways and aprons
- fencing
- motor vehicle movement areas
- surface wind indicator
- marking and markers
- stormwater drainage system
- aerodrome services infrastructure.

The elements are defined in the following paragraphs.



#### **3.2.1.1 Obstacle limitation surfaces**

Obstacle limitation surfaces are the surfaces that determine the airspace around aerodromes that need to be maintained free of obstacles so as to permit the intended aeroplane operations at the aerodrome to be conducted safely and to prevent the aerodrome from becoming unusable by the growth of obstacles around the aerodrome.

#### **3.2.1.2 Runways, taxiways and aprons**

The part of the aerodrome to be used for the take-off, landing, taxiing and parking of aircraft, consisting of the runway, taxiway and apron.

#### **3.2.1.3 Fencing**

Perimeter fencing to restrict unauthorized access.

#### **3.2.1.4 Motor vehicle movement areas**

Access road from closest public road, and parking area for vehicles.

#### **3.2.1.5 Surface wind indicator**

Windcone

#### **3.2.1.6 Marking and markers**

Marking: Symbols on the aircraft movement area to convey aeronautical information.

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

### **3.2.1.7 Stormwater drainage system**

System consisting of open channels, inlets, culverts and sloping surfaces with the purpose of draining water away from the aircraft movement area.

### **3.2.1.8 Aerodrome services infrastructure**

Aerodrome services that can possibly be provided at class B and C aerodromes are:

- Aerodrome Management
- Air Traffic Service
- Refuelling Services
- Security Services
- Rescue and Fire Fighting Services
- Passenger Handling Facilities
- General Services Infrastructure

Immigration, customs, police and quarantine facilities need not be provided at Class B and C aerodromes as they are not normally points of entry, however if facilities need to be provided the extent thereof needs to be negotiated with the user department.

## **3.2.2 AERODROME ELEMENT STANDARDS**

The standards applicable to the different aerodrome elements are discussed for Class B and C aerodromes. Table 1 summarises the aerodrome standards for the different classes followed by discussions of each element. Drawings are included in Annexure A to elucidate certain elements.

**TABLE 1 : SUMMARY OF AERODROME ELEMENT STANDARDS**

| Item           | Element                                       | Class B                          |    | Class C             |
|----------------|---|----------------------------------|----|---------------------|
|                |   | ICAO code<br>runway              | 2b | ICAO code 1A runway |
| <b>3.2.2.2</b> |   |                                  |    |                     |
| (a)            | <b><u>Runway</u></b>                          |                                  |    |                     |
| (i)            | Aeroplane reference field length              | 1200m                            |    | 800m                |
| (ii)           | Runway width                                  | 23m                              |    | 18m                 |
| (iii)          | Runway surface                                | Asphalt or gravel                |    | Gravel              |
| (iv)           | Runway shoulder                               | none                             |    | none                |
| (v)            | Runway strip width                            | 80m                              |    | 60m                 |
| (vi)           | Runway strip length beyond runway end         | 60m                              |    | 30m                 |
| (vii)          | Runway end safety area                        | none                             |    | none                |
| (viii)         | Runway longitudinal slope; average<br>maximum | 2%                               |    | 2%                  |
|                |   | 2%                               |    | 2%                  |
| (ix)           | Turning area radius                           | 17m                              |    | none                |
| (x)            | Runway PCN                                    | 21                               |    | 10                  |
| (b)            | <b><u>Taxiway</u></b>                         |                                  |    |                     |
| (i)            | Taxiway length between runway and apron       | 62m                              |    | 41m                 |
| (ii)           | Taxiway width                                 | 10.5m                            |    | 7.5m                |
| (iii)          | Taxiway shoulders                             | none                             |    | none                |
| (iv)           | Taxiway graded strip width                    | 43m                              |    | 32.5m               |
| (v)            | Taxiway strip width                           | 25m                              |    | 22m                 |
| (vi)           | Taxiway maximum longitudinal slope            | 3%                               |    | 3%                  |
| (vii)          | Taxiway surface                               | asphalt or gravel                |    | gravel              |
| (viii)         | Taxiway PCN                                   | 20                               |    | 10                  |
| (c)            | <b><u>Apron</u></b>                           |                                  |    |                     |
| (i)            | Apron dimensions                              | 140m x 35m                       |    | 20m x 40m           |
| (ii)           | Apron taxiway dimensions                      | 140m x 27m                       |    | -                   |
|                |   | concrete/paving<br>blocks/gravel |    | gravel              |
| (iii)          | Apron taxiway surfacing                       | asphalt/gravel                   |    | -                   |
|                |   | 73.5m                            |    | 50m                 |
| (iv)           | Apron PCN                                     | 20                               |    | 10                  |
| <b>3.2.2.3</b> | <b><u>Fencing</u></b>                         |                                  |    |                     |
|                | 2.1m high preferably razor type               | yes                              |    | not necessary       |
| <b>3.2.2.4</b> | <b><u>Vehicle movement area</u></b>           |                                  |    |                     |
| (a)            | <b><u>Access road</u></b>                     |                                  |    |                     |
| (i)            | Access road surface                           | gravel                           |    | gravel              |
| (ii)           | Access road width                             | 7.5m                             |    | 7.5m                |
| Item           | Element                                       | Class B                          |    | Class C             |
|                |   | ICAO code<br>runway              | 2b | ICAO code 1A runway |

NTMPS  
Aerodrome Standards

|                |                                      | runway        |         |
|----------------|--------------------------------------|---------------|---------|
| (b)            | <b>Parking area</b>                  |               |         |
| (i)            | Parking area surface                 | gravel        | gravel  |
| (ii)           | Parking area dimensions              | 17.5m x 12.5m | 5m x 5m |
| <b>3.2.2.5</b> | <b><u>Surface wind indicator</u></b> |               |         |
|                | Windsock 3.6m long, 0.9m diameter    | yes           | yes     |

### 3.2.2.1 Obstacle limitation surfaces

Obstacle limitation surfaces applicable to Class B and C aerodromes are discussed under the following headings:

- General requirements applicable to Class B and C aerodromes
- Specific requirements applicable to Class B and C aerodromes.

#### (a) General requirements

- runways are constructed such that operations can be conducted to or from both directions
- the runways will be used for the operation of aircraft using visual approach procedures (non-instrument runway).

The requirements relating to obstacle limitation surfaces are summarized in the following table 2:

**TABLE 2 : SPECIFIC REQUIREMENTS RELATING TO OBSTACLE LIMITATION SURFACES**

| <b>APPROACH RUNWAY</b>  |                                       |          |
|-------------------------|---------------------------------------|----------|
| <b>Surface</b>          | <b>Non-instrument<br/>Code number</b> |          |
|                         | <b>1</b>                              | <b>2</b> |
| <b>CONICAL</b>          |                                       |          |
| Slope                   | 5%                                    | 5%       |
| Height                  | 35 m                                  | 55 m     |
| <b>INNER HORIZONTAL</b> |                                       |          |
| Height                  | 45 m                                  | 45 m     |

Code Number 1 = Class C  
Code Number 2 = Class B

| <b>APPROACH RUNWAY</b>   |                                       |          |
|--------------------------|---------------------------------------|----------|
| <b>Surface</b>           | <b>Non-instrument<br/>Code number</b> |          |
|                          | <b>1</b>                              | <b>2</b> |
| Radius                   | 2 000 m                               | 2 500 m  |
| <b>APPROACH</b>          |                                       |          |
| Length of inner edge     | 60 m                                  | 80 m     |
| Distance from threshold  | 30 m                                  | 60 m     |
| Divergence (each side)   | 10%                                   | 10%      |
| Length                   | 1 600 m                               | 2 500 m  |
| Slope                    | 5%                                    | 4%       |
| <b>TRANSITIONAL</b>      |                                       |          |
| Slope                    | 20%                                   | 20%      |
| <b>TAKE-OFF RUNWAY</b>   |                                       |          |
| <b>Surface</b>           | <b>Code Number</b>                    |          |
|                          | <b>1</b>                              | <b>2</b> |
| Length of inner edge     | 60 m                                  | 80 m     |
| Distance from runway end | 30 m                                  | 60 m     |
| Divergence (each side)   | 10%                                   | 10%      |
| Final width              | 380 m                                 | 580 m    |
| Length                   | 1 600 m                               | 2 500 m  |
| Slope                    | 5%                                    | 4%       |

The purpose of the table is for clarification purposes only and does not replace the tables and requirements as contained in ICAO Annex 14.

In conclusion the applicable standards relating to obstacle limitation surfaces can be summarized as follows:

**Class C** : As for a Code 1 Non-instrument runway

**Class B** : As for a Code 2 Non-instrument runway.

### 3.2.2.2 Runways, taxiways and aprons

Aircraft movement areas are discussed for each class of aerodrome under the following headings:

- Runways
- Taxiways
- Aprons.

The standards quoted here are based on ICAO Annex 14 standards with:

- Class B aerodromes complying to Standards for Code 2B aircraft
- Class C aerodromes complying to Standards for Code 1A aircraft.

A standard layout for each aerodrome type is presented in Drawings 1 and 2 for Class C and B aerodromes respectively.

(a) Runways

Runway characteristics for each aircraft class are discussed under the following headings:

- Actual runway length
- Runway width
- Runway surface
- Runway shoulders
- Runway strip width
- Runway strip length
- Runway end safety area
- Runway longitudinal slopes
- Runway turning areas
- Runway PCN.

(i) Aeroplane reference field length

The aeroplane reference field length for Class B aerodromes is 1 200m which implies actual runway lengths as contained in Table 3.

**TABLE 3 : ACTUAL RUNWAY LENGTHS FOR CLASS B AERODROMES BASED ON AN AEROPLANE REFERENCE FIELD LENGTH OF 1 200 m**

| AERODROME      | CLASS | AEROPLANE<br>REFERENCE FIELD<br>LENGTH | ACTUAL RUNWAY *<br>LENGTH REQUIRED |
|----------------|-------|--|------------------------------------|
| 1. Tsumeb      | B     | 1 200 m                                | 2 025 m                            |
| 2. Otjiwarongo | B     | 1 200 m                                | 2 052 m                            |

The aeroplane reference field length for class C aerodromes is 800m which implies actual runway lengths as contained in Table 4.

\* Note: Actual runway length required is the aeroplane reference field length corrected for elevation, temperature and slope.

**TABLE 4 : ACTUAL RUNWAY LENGTHS FOR CLASS C AERODROMES BASED ON AN AEROPLANE REFERENCE FIELD LENGTH OF 800 m**

| AERODROME     | CLASS | AEROPLANE<br>REFERENCE FIELD<br>LENGTH | ACTUAL RUNWAY *<br>LENGTH REQUIRED |
|---------------|-------|--|------------------------------------|
| 1. Aminuis    | C     | 800 m                                  | 1 282 m                            |
| 2. Aroab      | C     | 800 m                                  | 1 241 m                            |
| 3. Bagani     | C     | 800 m                                  | 1 231 m                            |
| 4. Bethanie   | C     | 800 m                                  | 1 226 m                            |
| 5. Eenhana    | C     | 800 m                                  | 1 267 m                            |
| 6. Gobabis    | C     | 800 m                                  | 1 331 m                            |
| 7. Kamanjab   | C     | 800 m                                  | 1 303 m                            |
| 8. Karasburg  | C     | 800 m                                  | 1 241 m                            |
| 9. Karibib    | C     | 800 m                                  | 1 277 m                            |
| 10. Khorixas  | C     | 800 m                                  | 1 188 m                            |
| 11. Maltahohe | C     | 800 m                                  | 1 327 m                            |
| 12. Mariental | C     | 800 m                                  | 1 263 m                            |
| 13. Nepara    | C     | 800 m                                  | 1 273 m                            |
| 14. Okakarara | C     | 800 m                                  | 1 251 m                            |
| 15. Okaukuejo | C     | 800 m                                  | 1 263 m                            |
| 16. Okongwati | C     | 800 m                                  | 1 264 m                            |

| <b>AERODROME</b> | <b>CLASS</b> | <b>AEROPLANE<br/>REFERENCE FIELD<br/>LENGTH</b> | <b>ACTUAL RUNWAY *<br/>LENGTH REQUIRED</b> |
|------------------|--------------|---|--|
| 17. Opuwo        | C            | 800 m   | 1 252 m                                    |
| 18. Oranjemund   | C            | 800 m   | 854 m                                      |
| 19. Oshakati     | C            | 800 m   | 1 254 m                                    |
| 20. Otjinene     | C            | 800 m   | 1 337 m                                    |
| 21. Otjitutuo    | C            | 800 m   | 1 253 m                                    |
| 22. Rietfontein  | C            | 800 m   | 1 259 m                                    |
| 23 Rosh Pinah    | C            | 800 m   | 1 027 m                                    |
| 24. Sesfontein   | C            | 800 m   | 987 m                                      |
| 25. Sesriem      | C            | 800 m   | 1 185 m                                    |
| 26. Swakopmund   | C            | 800 m   | 860 m                                      |
| 27. Terrace Bay  | C            | 800 m   | 860 m                                      |
| 28. Tsumkwe      | C            | 800 m   | 1 245 m                                    |
| 29. Tweerivieren | C            | 800 m   | 1 206 m                                    |
| 30. Uutapi       | C            | 800 m   | 1 040 m                                    |
| 31. Zais         | C            | 800 m   | 1 082 m                                    |

\* Note: Actual runway length required is the aeroplane reference field length corrected for elevation, temperature and slope.

(ii) Runway width

Class C : The required runway width is 18 m based on ICAO requirements for Code 1A aircraft

Class B : The required runway width is 23 m based on ICAO requirements for Code 2B aircraft.

(iii) Runway surface

Class C : Gravel surface will suffice (in the cases of aerodromes with surfaced runways, allocation of maintenance funding will be as for unsurfaced runways)

Class B : Gravel surface will suffice, but preferably asphalt surfacing to be provided.

(iv) Runway shoulder

Class C : No runway shoulders need to be provided

Class B : No runway shoulders need to be provided.

(v) Runway strip width

Class C : The required strip and graded strip width is 60 m

Class B : The required strip and graded strip width is 80 m.



(vi) Runway strip length

Class C : Strip length needs to extend 30 m beyond threshold

Class B : Strip length needs to extend 60 m beyond threshold.

(vii) Runway end safety area

Class C : No runway end safety area required

Class B : No runway end safety area required.

(viii) Longitudinal slopes

Class C : Maximum longitudinal slope is 2% and the maximum average longitudinal slope is 2%

Class B : Maximum longitudinal slope is 2% and the maximum average longitudinal slope is 1%.

(ix) Turning areas

Class C : Turning areas not required

Class B : Turning areas with a radius of 17 m need to be provided at thresholds.

(x) Runway PCN

Class C : PCN of 10

Class B : PCN of 20

The mentioned PCN's are based on the aircraft types that can use the different runways. Therefore a PCN of 10 at Class C aerodromes is based on the fact that Class C aerodromes will accommodate smaller aircraft than Class B aerodromes which require a PCN of 20.

(b) Taxiways

Taxiway characteristics for each aircraft class are discussed under the following headings:

- Taxiway length
- Taxiway width
- Taxiway shoulders
- Taxiway strip width
- Taxiway graded strip width
- Maximum longitudinal slope
- Taxiway surfacing
- Taxiway PCN.

(i) Taxiway length

Class C : A 41 m long taxiway needs to be provided between the runway edge and the apron

Class B : A 62 m long taxiway needs to be provided between the runway edge and the apron.

(ii) Taxiway width

Class C : Taxiway width of 7,5 m needs to be provided

Class B : Taxiway width of 10,5 m needs to be provided.

(iii) Taxiway shoulders

Class C : No taxiway shoulders need to be provided

Class B : No taxiway shoulders need to be provided.

(iv) Taxiway strip width

Class C : Taxiway strip width of 32,5 m needs to be provided

Class B : Taxiway strip width of 43 m needs to be provided.

- (v) Taxiway graded strip width  
Class C : Graded strip width of 22 m needs to be provided  
Class B : Graded strip width of 25 m needs to be provided.
- (vi) Maximum longitudinal slope  
Class C : Longitudinal slope not to exceed 3%  
Class B : Longitudinal slope not to exceed 3%.
- (vii) Taxiway surfacing  
Class C : Gravel surface  
Class B : Gravel surface will suffice, but preferably asphalt surfacing.
- (viii) Taxiway PCN  
Class C : PCN value of 10  
Class B : PCN value of 20.
- (c) Aprons

Apron characteristics are discussed under the following headings:

- Apron dimensions
  - Apron surfacing
  - Runway/apron separation
  - Apron PCN.
- (i) Apron dimensions  
Class C : An apron of 20 m x 40 m needs to be provided which can accommodate two type 1A aircraft  
Class B : An apron of 140 m x 62 m needs to be provided which can accommodate two type 2B aircraft.

(ii) Apron surfacing

Class C : Gravel surface

Class B : An apron consisting of a concrete apron of 140 m x 35 m and an asphalt surfaced apron taxiway of 27 m x 140 m should preferably be provided but gravel areas will suffice. If cost effective, areas can also be surfaced with paving blocks.

(iii) Runway/apron separation

Class C : Separation between runway centreline and apron edge closest to runway, should be 50 m

Class B : Separation between runway centreline and apron edge closest to runway, should be 73,5 m.

(iv) Apron PCN

Class C: PCN value of 10

Class B: PCN value of 20.

### **3.2.2.3 Fencing**

Fencing needs to be provided such that it does not protrude into the obstacle limitation surfaces for the different aerodrome classes. The fences should furthermore be placed outside the runway strips as indicated in Drawings 1 and 2.

For Class C aerodromes it is anticipated that in certain cases no fencing will be provided due to local conditions, whilst Class B aerodromes will be provided with fences except in the coastal regions due to, amongst other, the adverse climate.

The fence should consist preferably of razor mesh with posts as specified in Drawing 3 : Fencing Details.

### **3.2.2.4 Vehicle movement areas**

The vehicle movement areas required for Class B and C aerodromes are discussed under the following headings:

- An access road from the nearest public road
- Parking area for vehicles.

(a) Access road

Class B + C : A gravel surfaced access road of 7,5 m width needs to be provided from the nearest public road to the aerodrome.

(b) Parking area

Class C : A gravel surfaced parking area for two vehicles needs to be provided.  
Dimensions of parking area to be 5 m x 5 m

Class B : A gravel surfaced parking area needs to be provided for 10 vehicles.  
Dimensions of parking area to be 17 m x 12,5 m (area = 219 m<sup>2</sup>).

### **3.2.2.5 Surface wind indicator**

Windcones need to be provided at both Class B and C aerodromes with position as indicated on Drawings 1 and 2.

The specification of the windcone should be as per chapter 5 of Annex 14, i.e. 3,6 m in length and diameter of 0,9 m at the larger end.

### **3.2.2.6 Marking and markers**

Runway and taxiway markings need to be provided for asphalt surfaced aerodromes whilst runway and taxiway markers need to be provided for gravel surfaced aerodromes. Each aerodrome type is discussed separately.

(a) Asphalt surfaced runway

The following marking needs to be provided for an asphalt surfaced runway as per Annex 14 Chapter 5. (Refer to Drawing 4.)

- runway marking consisting of centre line marking, threshold marking, designation marking and aiming point marking
- taxiway marking consisting of taxiway centre line, taxiway side stripes, taxiway safety line and taxiway holding position marking
- aerodrome name in 3 m high letters
- a 1,2 m contrasting coloured band with a diameter of 15 m around the windsock as measured from the inside edges of the band.

If a gravel surface is provided for Class B, then the markers indicated for Class C apply.

(b) Gravel surfaced runway

The following markers need to be provided for gravel surfaced runways as per annex 14 Chapter 5. (Refer to Drawing 5).

- runway markers consisting of edge markers, threshold markers and designation markers
- taxiway markers consisting of edge markers
- aerodrome name in 3 m high letters
- a 1,2 m white band with a diameter of 15 m around the windsock.

### **3.2.2.7 Stormwater drainage system**

Stormwater drainage system needs to be provided for each aerodrome to ensure that water is drained away from the aircraft movement area to ensure safe operations. The functions of an aerodrome drainage system are as follows:

- interception and diversion of surface and groundwater flow originating from land adjacent to the aerodrome
- removal of surface run-off from the aerodrome.

The provision of stormwater infrastructure is dependent on the topography of the aerodrome site and the anticipated stormwater run-off.

The stormwater drainage system may consist of a series of culverts, V-drains, manholes and inlet structures of which the sizes will be dependent on the run-off volumes and topography. Under ground systems need to be kept to a minimum as more maintenance is required to keep it operational.

### **3.2.2.8 Aerodrome Services Infrastructure**

Aerodrome services infrastructure for each class of aerodrome is discussed under the following headings:

- Aerodrome Management
- Air Traffic Services
- Refuelling
- Security
- Rescue and Fire Fighting
- Passenger Handling.

#### **(a) Aerodrome Management**

Full time aerodrome management need not be provided for Class B or Class C aerodromes due to the low traffic volumes.

It is anticipated that the airport management function will be provided with a 14 m<sup>2</sup> office and telephone in the terminal building of Class B aerodromes whilst for Class C aerodromes, the airport management function will be rendered from a base located off the aerodrome where a telephone should be available.

(b) Air Traffic Services

No air traffic services need to be provided at either Class B or C airports. It is furthermore anticipated that air traffic services (information or control) will normally not be required at a Class C airport.

However in the case of air traffic control services being provided (high volumes or scheduled route) at a Class B airport a control tower should be provided complying to a minimum standard as presented in Annexure A, Drawing 7, and it should be equipped with the following:

- air traffic signal lights
- signalling pyrotechnics
- short-range radio telephone
- radio direction-finder or radio beacon apparatus
- air/ground radio telegraph or radio telephone communications.

(c) Refuelling

No refuelling facilities need to be provided at class B or C aerodromes. Should facilities be provided it should be done according to applicable standards, as contained in the relevant API, ANSI and SABS specifications.

(d) Aviation Security

No aviation security services will be provided at Class B or C aerodromes.

(e) Rescue and Fire Fighting

No rescue and fire fighting facilities need to be provided at Class C aerodromes owing to the fact that they are not licensed. It is furthermore not possible to store any equipment at such an aerodrome as it is not necessarily fenced off and access is not controlled. In the case of a Class B aerodrome, rescue and fire fighting equipment as required for an aerodrome category 3 should be provided.



This requirement implies that at least one CFR vehicle is stationed at the aerodrome which in turn implies that a building structure should be erected. Example of such a building is presented in Annexure A, Drawing 8.

(f) Passenger Handling

Passenger handling facilities will consist of the aerodrome terminal building and parking areas. It is proposed that a terminal building is only provided at Class B aerodromes as indicated in Drawing 2 if the traffic volumes warrant such a facility. No buildings are proposed for class C as they are unmanned facilities.

The building will be 95 m<sup>2</sup> and will provide the following:

- AM office - ± 14 m<sup>2</sup>
- Female toilet - ± 9 m<sup>2</sup>
- Male toilet - ± 9 m<sup>2</sup>
- Waiting area - ± 63 m<sup>2</sup>

The waiting area of 63 m<sup>2</sup> should be able to accommodate a two-way pax peak of approximately 30 people and which will be able to service the passengers peaks generated by a Beechcraft 1900 (Air Namibian Schedule Service).

The building will have water and power supply, and sewage could be processed by way of a septic tank.

## **4. MAINTENANCE REQUIREMENTS**

This section presents the maintenance activities that are required to ensure the serviceability of the aerodrome network.

The term maintenance as used in this chapter encompasses the following:

- Inspections, carried out at predetermined intervals to establish the condition of infrastructure
- Repairs, carried out to rectify the unacceptable condition of infrastructure
- Maintenance, carried out to ensure the continuous operation of infrastructure triggered by time.

Maintenance activities carried out on an aerodrome in the network are divided into two main groups:

- Pavement maintenance - maintenance of all aircraft and vehicle movement areas
- Off-pavement maintenance - maintenance of all other infrastructure elements and areas within the aerodrome boundary.

Each group is discussed in detail in the following pages with a summary of anticipated cost presented in Section 4.3.

### **4.1 PAVEMENT MAINTENANCE**

The structure and surface condition of a pavement influence its functional characteristics. From an aerodrome point of view the following are of importance:

1. Runway, taxiway and apron pavements should be kept clean of any loose stones or other objects that might cause damage to aircraft structures or engines, or impair the operation of aircraft systems.
2. The wearing course of the runways, taxiways and aprons should be maintained in such a condition to preclude the forming of harmful irregularities and to ensure good contact by aircraft landing wheels to the pavement surface.

The maintenance activities applicable to pavements are discussed under the following headings:

- Inspections
- Pavement cleaning
- Gravel pavement repair
- Rigid pavement repair
- Flexible pavement repair
- Marking

with the following supplied for each activity:

- Description
- Relevance to B and C Class aerodromes and frequency
- Anticipated quantity
- Unit rate
- Annual cost.

#### **4.1.1 Inspections**

##### **(a) General inspection**

###### **(i) Description**

The main purpose of this inspection is to establish whether there are any obvious hindrances present on the movement areas that will endanger the operation of aircraft or vehicles.

###### **(ii) Relevance and frequency**

In the case of Class B aerodromes it needs to be executed on a monthly basis whilst in the case of Class C aerodromes the pilot will do an inspection by way of a low altitude over flight before landing.

(iii) Anticipated quantity

Quantity not relevant as an aerodrome will be investigated as an entity. A lump sum will therefore apply per aerodrome.

(iv) Unit rate

Class C aerodrome will be investigated by pilots using the aerodrome, therefore no cost. For a Class B aerodrome the cost is estimated at N\$150/inspection.

(v) Annual cost

The annual per Class B aerodrome is estimated at N\$1800.

**(b) Pavement condition inspection**

(i) Description

The main purpose of this inspection is to assess the condition of the runway, taxiway, apron, roads and parking area pavements and the following needs to be assessed:

- condition of the wearing course
- surface drainage
- presence of contaminants.

When inspecting the wearing course the items that will be addressed are different types of cracking (longitudinal cracks, transverse cracks, crocodile cracking), stone loss, binder condition, profile of runway surface (e.g. rutting), presence of potholes, etc.

Surface drainage will be mainly on the aircraft movement areas and the purpose thereof is to establish whether ponding will occur on these surfaces.

The presence of contaminants is mainly anticipated on the aprons of the Class B aerodromes.

(ii) Relevance and frequency

Although different detail will be investigated at Class B and C aerodromes due to the difference in surfacing, inspections need to be carried out annually at both aerodrome classes.

(iii) Anticipated quantity

Quantity is not relevant as an aerodrome will be investigated as an entity. A lump sum will therefore apply per aerodrome.

(iv) Unit rate

Unit rate is therefore the cost of an investigation per aerodrome which is estimated at N\$1500/inspection

(v) Annual cost

The annual cost will be N\$1500 per Class B and Class C aerodromes.

#### **4.1.2 Pavement cleaning**

**(a) Cleaning of concrete aprons**

(i) Description

The contamination of surfaced aprons with fuel and oil will in all likelihood be encountered. Depending on the extent of contamination grease solvents and/or high-pressure water cleaners will be used for cleaning operations.

(ii) Relevance and frequency

This activity is only relevant to Class B aerodromes and although it will be executed on a condition prompt it is not anticipated that this type of activity will be required more than once a year.

(iii) Anticipated quantity

The total anticipated annual quantity is 120 m<sup>2</sup> based on the following:

- only Class B aerodromes
- total apron area : 2 400 m<sup>2</sup>/aerodrome
- 5% cleaned on an annual basis.

(iv) Unit rate

The anticipated unit rate is N\$10/ m<sup>2</sup>.

(v) Annual cost

should be in the region of N\$1 200.

#### **4.1.3 Gravel pavement repair**

(a) **Removal of grass, shrubs, large aggregate and ant/termite nests.**

(i) Description

The removal grass, shrubs, large aggregate and ant/termite nests will take place on the aircraft and vehicle movement areas of Class B and Class C airports. These activities will especially be required at those airports that have a low level of use as high levels of use will inhibit the growth and formation of these mentioned items.

(ii) Relevance and frequency

Removal of growth and foreign objects is required biannually at Class B and C airports. The blading of the areas annually will require that this activity only needs to be executed once a year.

(iii) Anticipated quantity

- At Class C aerodromes the aircraft movement area of 22 800 m<sup>2</sup> needs to be cleared.
  - At Class B and C aerodromes. roads and parking areas with areas of :
    - Class B                      7 925 m<sup>2</sup>
    - Class C                      7 525 m<sup>2</sup>
- needs to be cleared.

(i) Unit Rate

Anticipated unit rate for clearing away foreign objects is N\$0.25/ m<sup>2</sup>

(ii) Annual cost

The anticipated annual cost is :

- Aircraft movement area Class C :

$$\text{N\$0.25}^* \quad 22\,800 \text{ m}^2 \quad = \quad \text{N\$5\,700}$$

- Access road Class C :

$$7\,525 \text{ m}^2 \quad * \quad \text{N\$0.25/ m}^2 \quad = \quad \text{N\$ 1\,880}$$

- Access road Class B :

$$7\,925\text{ m} \quad * \quad \text{N\$}0.25/\text{ m}^2 \quad = \quad \text{N\$ } 1\,980$$

**(b) Fixing of Potholes, Filling of Furrows**

(i) Description

Isolated failure of the gravel wearing concourse is anticipated. The execution of pothole repair usually consists of removing a rectangular area of the wearing course, replacing with new material and recompaction .

Filling of furrows created by water run-off is also anticipated and will consist of the placing of new material and compaction thereof.

(ii) Relevance and frequency

These repairs are applicable to the aircraft movement area of Class C aerodromes and the vehicle movement areas of Class B and C aerodromes.

(iii) Anticipated quantity

The anticipated annual quantities are as follows:

- 10 m<sup>2</sup> of the aircraft movement area of Class C aerodromes
- 110 m<sup>2</sup> of the vehicle movement area of Class B aerodromes
- 50 m<sup>2</sup> of the vehicle movement area of Class C aerodromes.

(iv) Unit rate

The anticipated unit rate for executing pothole / furrow repairs in gravel wearing courses is N\$15/ m<sup>2</sup>.

(v) Annual cost



The annual cost of repairing potholes in gravel surfaced areas is :

- aircraft movement area Class C - N\$ 150
- vehicle movement area Class C - N\$ 750
- vehicle movement area Class B - N\$ 1650

**(c) Blading**

**(i) Description**

The periodic grading (blading) of the access roads and gravel movement areas will be required to remove loose aggregate and sand.

**(ii) Relevance and frequency**

The access roads to Class C and B aerodromes will require blading annually. Blading of the runway of Class C aerodromes are budgeted for once every two years due to the low movement figures.

**(iii) Anticipated quantity**

The anticipated annual quantities are:

- Class C : 7 525 m<sup>2</sup> annually (roads)
- Class B : 7 925 m<sup>2</sup> annually.(roads)
- Class C 22 800 m<sup>2</sup> every two years (runway)

**(iv) Unit rates**

The blading cost is anticipated to be N\$ 1 per m<sup>2</sup>

**(v) Cost**

Anticipated costs per aerodrome are as follows:

- Class C :  $7\,525\text{ m}^2 \times \text{N\$ } 1 / \text{m}^2 = \text{N\$ } 7\,525$
- Class B :  $7\,925\text{ m}^2 \times \text{N\$ } 1 / \text{m}^2 = \text{N\$ } 7\,925$
- Class C :  $22\,800\text{ m}^2 \times \text{N\$ } 1 / \text{m}^2 \times 0.5 = \text{N\$ } 11\,400$

**(d) Reworking and regravelling of wearing course**

**(i) Description**

The ripping and recompaction of the wearing surface is usually required due to the displacement of surface materials either by traffic or the environment. The surface layer needs to be scarified, additional aggregate needs to be added to increase thickness back to that originally required and the wearing surface recompacted to the specified density.

**(ii) Relevance and frequency**

Gravel wearing course repair is applicable to Class C aerodrome aircraft movement areas, and Class B and C aerodrome vehicle movement areas.

The frequency for aircraft movement areas of Class C aerodromes is once every 15 years whilst for Class B and C aerodromes' vehicle movement areas the frequency is once every 10 years.

**(iii) Anticipated quantity**

The anticipated annual quantities per aerodrome are as follows:

- Class C aerodrome, aircraft movement area of  $22\,800\text{ m}^2$  needs to be ripped and recompacted every 15 years
- Access roads and parking areas for Class B and C aerodromes (Assume 7.5 m wide, 1 km road which equals  $7\,500\text{ m}^2$  and a parking area of  $425\text{ m}^2$  and  $25\text{ m}^2$  respectively)
  - per Class B aerodrome:  $7\,925\text{ m}^2$  once every ten years
  - per Class C aerodrome:  $7\,525\text{ m}^2$  once every ten years.

(iv) Unit rate

Anticipated unit rate for ripping and recompaction is N\$6/ m<sup>2</sup>

(iii) Cost

The anticipated annual cost is as follows :

- movement areas Class C: N\$ 9 120
- access road and parking Class C : N\$ 4 515
- access road and parking Class B : N\$ 4 755

#### **4.1.4 Rigid pavement repair**

**(a) Joint sealing of rigid pavements**

(i) Description

Joints between concrete slabs must be sealed with fuel resistant two part polysulphide sealant complying with US Federal Specification SS – S – 200 E and SABS 110. The life span of these joints is anticipated to be between 5 and 10 years. The resealing of joints is done by removing all sealing material with a “joint plough” and in setting new joint material after clearing the side of the concrete slabs of all dust, oil and grease.

(ii) Relevance and frequency

Joint replacement will only be executed on the aprons of Class B aerodromes. All joints will be removed once in a 10 year period.

(iii) Anticipated quantity

The anticipated annual quantity is to be replaced every 10 years is 1 210 m.

(Block size of 3.75 m x 4 m)

(iv) Unit rate

The anticipated cost of replacing joints is N\$50/m.

(v) Annual cost

The anticipated cost every 10 years is N\$ 60 500.

**(b) Crack sealing of rigid pavements**

(i) Description

Sealing of cracks in rigid pavements is of importance to inhibit the ingress of water into the pavement layers and subgrade, two part polysulphide sealants should be used. Cracks in concrete slabs should be repaired by transforming cracks into expansion joints. Cracks must be widened by cutting a slot along its length about 15 mm wide and 10 mm deep. The widened crack will then be filled with the mentioned fuel resistant sealing material.

(ii) Relevance and frequency

Crack sealing of rigid pavements will only be done on the aprons of Class B aerodromes and it is anticipated that this work will be done annually.

(iii) Anticipated quantity

It is anticipated that 1% of all slabs will require crack sealing in a given year.

There are 160 slabs at an aerodrome which implies a total annual crack length of (160 slabs  
 $\times 1\% \times 4\text{m}$ ) = 6m.

(iv) Unit rate

The anticipated unit rate for crack repairs in rigid pavements is N\$100/m.

(v) Annual cost

Anticipated annual cost per aerodrome is :  $6 \text{ m} \times \text{N\$}100/\text{m} = \text{N\$}600$ .

**(c) Edge and corner repair**

(i) Description

Edge and corner repairs are of importance as unchecked deterioration of concrete slabs edges and corners will result in propagation of edge deterioration leading to debris on the apron and resulting in possible damage to aircraft. A 50 mm deep saw cut outlining all unsound concrete in rectangular patterns shall be made and the concrete between the saw cut and spalled edge removed. A wet-to-dry concrete epoxy primer will be applied to all surfaces of exposed concrete followed by the placing of the patch mixture.

(ii) Relevance and frequency

Edge and corner repair will only be executed on the concrete aprons of the Class B aerodromes. The repairs will be carried out annually in conjunction with other concrete repairs.

(iii) Anticipated quantity

The total joint length per Class B aerodrome is 1 210 m, it is anticipated that 0,5% of the edges will have to be prepared annually implying a length of 6 m.

(iv) Unit rate

The anticipated unit cost of repairing spalled edges is N\$200/m.

(v) Annual cost

Anticipated annual cost is  $6 \text{ m} \times \text{N\$}200/\text{m} = \text{N\$} 1\,200$

**(d) Surface damage (sealing, map cracking and crazing) repair**

(i) Description

Surface damage usually originates in deficient construction supervision and can be attributed to improper curing or finishing. If surface damage causes the ponding of water, the area in question needs to be treated by breaking out concrete to a depth of 25 mm to 50 mm and replacing it with fresh concrete. If the deficit is shallow, scouring or grinding can usually provide the required surface texture.

(ii) Relevance and frequency

Surface damage repair is only applicable to the concrete aprons of Class B aerodromes. The repairs will be carried out annually in conjunction with other concrete repairs.

(iii) Anticipated quantity

The anticipated quantity of area requiring surface damage repairs is put at 0,25% of all rigid pavement area (6m<sup>2</sup>)

(iv) Unit rate

The anticipated unit rate for executing work of this nature is estimated at N\$200/ m<sup>2</sup>.

(v) Annual cost

Anticipated annual cost is : 6 m<sup>2</sup> x N\$200/ m<sup>2</sup> = N\$ 1 200

**(e) Slab replacement**

(i) Description

Slab replacement will be required when deep cracks are present in a specific slab. Cracking of slabs is usually caused by uneven support, which in turn is caused by ingress of water into the subgrade and pavement layers.

(ii) Relevance and frequency

Slab replacement will only be executed on the aprons of Class B aerodromes and will be undertaken in conjunction with other concrete repairs.

(iii) Anticipated quantity

It is anticipated that not more than 0,25% of all concrete slabs will require replacement in a year, implying a quantity of 6 m<sup>2</sup>.

(iv) Unit rate

The anticipated unit rate for executing work of this nature is N\$350/ m<sup>2</sup>.

(v) Annual cost

The anticipated annual cost for slab replacement is N\$2 100 per Class B aerodrome.

#### **4.1.5 Flexible pavement repair**

Flexible pavement repair encompasses the repair of all pavements that have bituminous surfaces. Maintenance activities belonging to this category are:

- rejuvenation of flexible pavements
- crack sealing
- pothole repair
- rut/undulation filling
- overlay
- reconstruction.

Each activity is discussed separately in the following paragraphs.

**(a) Rejuvenation of flexible pavements**

(i) Description

With flexible pavements the bitumen binder in the asphalt ages and oxidises over time, with a resultant loss of binder from around the stone which affects the wearing surface of the pavement.

An option for treating the wearing surface is a fog spray. A fog spray involves the addition of bitumen emulsions to the surface. Skid resistance criteria must be assessed during the decision making process.



(ii) Relevance and frequency

Rejuvenation will only take place at Class B aerodromes and it is anticipated that it will be required once in a 3 to 5 year period.

(iii) Anticipated quantity

The area that will require rejuvenation is 51 000 m<sup>2</sup>.

(iv) Unit rate

The anticipated unit rate is N\$1/ m<sup>2</sup>.

(v) Annual cost

The anticipated cost is N\$51 000 once every five years.

**(b) Crack sealing of flexible pavements**

(i) Description

The sealing of cracks in flexible pavements is of importance as it inhibits the penetration of water into the sub-base and subgrade. Cracks will be filled up with special emulsions of high fluidity.

(ii) Relevance and frequency

The asphalt surfaced areas of Class B aerodromes will need crack sealing on an annual basis.

(iii) Anticipated quantity

The anticipated quantity of cracks to be sealed is 0,1 m per m<sup>2</sup> of pavement which equals 5 100m annually.

(iv) Unit rate

The anticipated rate is N\$5/m.

(v) Annual cost

The annual cost based on 5 100 m and a unit rate of N\$5/m is N\$25 500.

**(c) Pothole repair of flexible pavements**

(i) Description

Isolated failures of flexible pavements are anticipated. The execution of a pothole repair usually consists of taking out of the suspect pavement layer and replacing it with asphalt.

(ii) Relevance and frequency

Pothole repair will be undertaken on the flexible pavements of the Class B aerodromes. Repairs will be executed when required.

(iii) Anticipated quantity

The quantity of pothole repairs anticipated is 50 m<sup>2</sup>.

(iv) Unit rate

The anticipated unit rate for pothole repair is N\$200/ m<sup>2</sup>.

(v) Annual cost

The annual cost based N\$200/ m<sup>2</sup> and an area of 50 m<sup>2</sup> is N\$10 000.

**(d) Overlay**

(i) Description

It is anticipated, based on experience, that the flexible pavement areas will require strengthening after 10 year period.

The thickness and extent of the overlay will depend on the structural condition of the runway at the time strengthening is required. The thickness will be based on the annually collected falling weight deflections. For estimation purposes a 30 mm overlay has been scheduled within 15 years.

(ii) Relevance and frequency

Overlays are applicable to Class B aerodromes, and should be required once in a 15 year period.

(iii) Anticipated quantity

The anticipated quantity is 51 000 m<sup>2</sup>.

(iv) Unit rate

The anticipated unit rate is N\$50/ m<sup>2</sup>.

(v) Anticipated cost

The anticipated cost is N\$2 550 000 once every 15 years.

**(e) Reconstruction of flexible pavements**

(i) Description

It is anticipated that some localised pavement failure may occur i.e. failure of the supporting layers.. For estimation purposes, it has been assumed that 2% of the total flexible pavement area will be reconstructed over the 10 year period.

(ii) Relevance and frequency

Portions of the flexible pavements of Class B aerodromes will be reconstructed annually.

(iii) Anticipated quantity

The area of pavement to be reconstructed annually is 100 m<sup>2</sup> per aerodrome.

(iv) Unit rate

The anticipated unit rate for the reconstruction of flexible pavements is N\$180/ m<sup>2</sup>.

(v) Annual Cost

The anticipated cost is N\$18 000 per Class B aerodrome per year.

#### **4.1.6 Marking and markers**

Clear marking is of utmost importance for the safe approach, and safe manoeuvring of aircraft on aerodrome pavements. The following three activities have been identified for the maintenance of pavement marking:

- touch-up
- marking removal
- painting and repainting.

Details of these actions are discussed in the following paragraphs.

##### **(a) Touch-up of marking**

###### **(i) Description**

Touch-up is usually required when the pavements are cleared of contaminants as the removal action damages existing paint marking, i.e. localised failure of marking. Road marking paint to be used will be plastic road marking paint, which complies with the requirements of CKS501. The paint will be reflectorised and will be applied in accordance with the manufacturer's instructions.

###### **(ii) Relevance and frequency**

Only Class B aerodromes have marking which need to be touched-up on an adhoc basis.

###### **(iii) Anticipated quantity**

The annual quantity of touch-up to be done by the aerodrome manager is estimated at 12 m<sup>2</sup>, based on total area of marking of 1 200 m<sup>2</sup> and 1% requiring touch-up.

(iv) Unit rate

The anticipated unit rate for touching-up marking is N\$70/m<sup>2</sup>.

(v) Annual cost

The annual cost based on an area of 12 m<sup>2</sup> and a rate of N\$70/ m<sup>2</sup> is N\$ 840.

**(b) Removal of marking**

(i) Description

Should marking require changing existing marking will be removed by way of mechanical grinding or black paint will be used to paint out marking instead of removal.

(ii) Relevance and frequency

Removal of marking is only relevant to Class B aerodromes and will take place on an ad hoc basis.

(iii) Anticipated quantity

The annual quantity per aerodrome is put at 15 m<sup>2</sup>.

(iv) Unit rate

The anticipated unit rate for the removal of marking is N\$60/ m<sup>2</sup>.

(v) Annual cost

The anticipated annual cost of executing marking removal is N\$900 per Class B aerodrome.

**(c) Painting and repainting of marking**

(i) Description

The difference between painting and repainting of marking is that painting requires pre-marking. Painting of both lines and symbols are anticipated.

(ii) Relevance and frequency

Painting and repainting will be required for Class B aerodromes and it is anticipated that it will be executed on an annual basis.

(iii) Anticipated quantity

The anticipated area of symbols and lines to be painted annually is 15 m<sup>2</sup>.

(iv) Unit rate

The anticipated unit rate is N\$50/ m<sup>2</sup>.

(v) Annual cost

The anticipated annual cost per Class B aerodrome based on the stated unit rate and quantity is N\$750.

**(d) Painting of markers**

(i) Description

Painting of markers encompasses the painting of runway markers, taxiway markers, the aerodrome name and the band around the windcone.

(ii) Relevance and frequency

The painting of the different items mentioned in paragraph (i) apply to Class C aerodromes whilst only the aerodrome name and band around the windsock applies to Class B

aerodromes. Colour of the paint used for markers, will depend on the colour of surrounding soil, orange, red or white paint can be used.

Painting will take place on an ad hoc basis as required but is anticipated that no marker will be painted more than once per year.

(iii) Anticipated quantity

The anticipated quantities are:

208 m<sup>2</sup> for Class C aerodromes - once a year

91 m<sup>2</sup> for Class B aerodromes. - once a year.

(iv) Unit rates

The anticipated unit rate for painting is N\$10/m<sup>2</sup>.

(v) Annual cost

The anticipated annual costs for Class B and C aerodromes are as follows:

Class B : N\$910

Class C : N\$2 080.



## **4.2 OFF-PAVEMENT MAINTENANCE**

Off-pavement maintenance refers to the maintenance of infrastructure elements and areas within the aerodrome boundary excluding paved areas. The infrastructure elements that have to be maintained area:

- fencing
- surface wind indicator
- drainage
- green areas
- buildings and services.

The maintenance of the different elements are discussed in detail in the following paragraphs.

### **4.2.1 Fencing**

Fencing maintenance consists of the:

- inspection of fences
- painting of straining posts, corner posts, standards, gates, etc.
- mesh maintenance
- mesh repair.

#### **(a) Inspection of fences**

##### **(i) Description**

The boundary fences that delineate the aircraft movement area need to be inspected to ensure that the fences are in an acceptable condition and not damaged in any way.

(ii) Relevance and frequency

Fences of Class B aerodromes need to be inspected on a weekly basis.

(iii) Anticipated quantity

Included.

(iv) Unit rate

Not applicable

(v) Annual cost

Included.

**(b) Mesh maintenance**

(i) Description

Mesh maintenance in the context of this report means the following:

1. The re-tightening of existing straining wires
2. The re-fastening of mesh
3. The filling of holes dug under the fence by animals.

(ii) Relevance and frequency

Mesh will be maintained on an ad hoc basis at class B aerodromes.

(iii) Anticipated quantity

A lump sum will be allowed to cover the cost incurred to maintain existing mesh.

(iv) Unit rate

Not applicable.

(v) Annual cost

The annual cost payable for mesh maintenance is estimated at:

Class B : N\$3 000.

**(c) Mesh repair**

(i) Description

Mesh repair will consist of:

1. Replacement of straining wires
2. Replacement of mesh sections.

(ii) Relevance and frequency

Mesh repairs will be undertaken on Class B aerodromes on a six-monthly basis.

(iii) Anticipated quantity

The anticipated quantity is:

150 m<sup>2</sup> per Class B aerodrome.

(iv) Unit rate

The anticipated unit rate applicable to mesh repairs are N\$50/m<sup>2</sup>.

(v) Annual cost

The anticipated annual cost per aerodrome is:  
N\$7 500 for a Class B aerodrome.

#### **4.2.2 Surface wind indicator**

The maintenance of surface wind indicators consist of:

- inspection and repair of windcones
- replacement of windcones.

##### **(a) Inspection of windcones**

###### **(i) Description**

Windcones need to be checked for any sign of deterioration in material or other damage and also for minor repairs.

###### **(ii) Relevance and frequency**

Windcones at both Class B aerodromes need to be checked on a weekly basis, and pilots will report deficiencies at Class C aerodromes.

###### **(iii) Anticipated quantity**

Not applicable.

###### **(iv) Unit rate**

Not applicable.

- (v) Annual cost

Included.

**(b) Replacement of windcones**

- (i) Description

If a windcone at a specific aerodrome is damaged beyond repair it will be replaced by the MWTC.

- (ii) Relevance and frequency

Windcones at both Class B and C aerodromes will be replaced once a year or in the case of irreparable damage.

- (iii) Anticipated quantity

Once a year.

- (iv) Unit rate

Cost of a windcone is estimated at N\$1 000 including installation.

- (v) Annual cost

N\$1 000 once a year.

**4.2.3 Drainage**

The maintenance of the drainage system will consist of the following:

- inspection of surface drainage of aircraft movement areas

- inspection of drainage channels, (V-drains), and culverts under the access road and surface drainage of roads and parking areas
- clearing of obstacles and sediment from drainage
- repair of surface drainage deficiencies on aircraft movement areas, and roads and vehicle parking areas.

**(a) Inspection of surface drainage of aircraft movement areas**

**(i) Description**

The investigation will consist of identifying areas of water ponding on the movement area and the identification of possible causes e.g. encroachment of plants and remedial action.

**(ii) Relevance and frequency**

Surface drainage of aircraft movement areas of Class B and C aerodromes will be undertaken before the start of the wet season.

**(iii) Anticipated quantity**

One inspection per aerodrome per year.

**(iv) Unit rate**

The cost of the inspections are included in the inspection scheduled for the pavement condition assessment.

**(v) Annual cost**

Included.

**(b) Inspection of drainage system**

**(i) Description**

The inspection of the airport drainage system will consist of the following:

- drainage channels
- culverts
- manholes
- surface drainage of roads and parking areas.

(ii) Relevance and frequency

Drainage system of Class B and C aerodromes need to be inspected at the start of the wet season.

(iii) Anticipated quantity

One inspection per aerodrome per year.

(iv) Unit rate

Anticipated cost of a drainage inspection is N\$1 000.

(v) Annual cost

The anticipated annual cost is N\$1 000 per aerodrome per year.

**(c) Cleaning of drainage system**

(i) Description

The cleaning of the drainage system will consist of the removal of sediment and obstacles from the drainage system.

(ii) Relevance and frequency

The drainage systems of Class B and C aerodromes need to be cleaned and it will be done following the inspections as indicated in (b).

(iii) Anticipated quantity

The cleaning of the drainage system will consist of ad hoc activities for which a lump sum, based on the infrastructure in question, needs to be allowed. For estimating purposes we have allowed N\$12 000 per year for Class B and N\$6 000 per year for Class C aerodromes.

(iv) Unit rate

Not applicable.

(v) Annual cost

As indicated in (iii).

**(d) Repair of surface drainage deficiencies**

(i) Description

The repair of surface drainage deficiencies will be addressed under the maintenance activities described in 4.1.3.

(ii) Relevance and frequency



-

(iii) Anticipated quantity

-

(iv) Unit rate

-

(v) Annual cost

-

#### **4.2.4 Green areas**

Two types of green areas are found within an aerodrome boundary. The areas are:

- green areas within runway and taxiway strips
- grass outside strip but within boundary.

The height of the grass inside the runway strip should be kept in check as it has an influence on the quantity of animal life within the aerodrome.

##### **(a) Mowing of grass inside runway strip**

(i) Description

Grass inside the runway strip must be limited to height of 10 cm and cuttings must be baled. Baling is important as grass cuttings attract insects which in turn attracts bird life which is hazardous to aircraft operations.

(ii) Relevance and frequency

Mowing of grass inside the runway strip is of relevance for Class B aerodromes. It is anticipated that grass will be mowed once a year.

(iii) Anticipated quantity

The anticipated quantity at the different aerodromes are as follows:

Class B: 13 ha.

(iv) Unit rate

The unit rate for mowing inside the runway strip is N\$1 500/ha.

(v) Annual cost

The annual cost based on the areas, frequency and unit rates are as follows:

Class B :  $13 \text{ ha} \times \text{N\$}1\,500/\text{ha} = \text{N\$}19\,500$ .

**(b) Mowing of grass outside runway strip**

(i) Description and responsibility

As for (a)(i) but length of grass will be restricted to 20 cm.

(ii) Relevance and frequency

Mowing of grass outside the runway strip is of relevance for Class B aerodromes. To restrict the grass length to 20 cm mowing of the area will be undertaken annually.

(iii) Anticipated quantity

The anticipated quantity is 8,5 ha.

(iv) Unit rate

The unit rate for mowing outside the runway strip is N\$1 500/ha.

(v) Annual cost

The anticipated annual cost based on the areas frequency and unit rate is:

Class B : 8,5 ha x N\$1 500/ha = N\$12 750.

#### **4.2.5 Buildings and services**

(i) Description

The maintenance of buildings and services encompasses the terminal building, fire station and services such as water, sewerage and electricity.

(ii) Relevance and frequency

Only applicable to Class B airports and will be executed on a *ad hoc* monthly basis.

(iii) Anticipated quantity

The maintenance required will vary from year to year and should be based on an annual survey whereby once-off items are identified.

(iv) Unit rate

For ease of control the contractor should be given a performance contract with a lump sum monthly payment (allowance should however be made for emergency response).

(v) Annual cost

Anticipated annual cost is N\$30 000.

### **4.3 ANTICIPATED ANNUAL MAINTENANCE COSTS**

The anticipated annual maintenance cost is as contained in Tables 5.1 and 5.2.

Table 5.1 presents the maintenance cost for Class B aerodromes and Table 5.2 presents the maintenance cost for Class C aerodromes.

The total anticipated maintenance cost for the aerodrome network consisting of two Class B aerodromes and 31 Class C aerodromes is:

|                           |                 |
|---------------------------|-----------------|
| Class B : 2 x N\$ 322 185 | = N\$ 644 370   |
| Class C : 31 x N\$ 50 355 | = N\$ 1 561 005 |
| TOTAL                     | = N\$ 2 205 375 |

Where a Class C aerodrome has certain infrastructure that is of a Class B level its infrastructure will be maintained with the financial allocation of a Class C aerodrome.

It can therefore be assumed that the quality of the infrastructure at a Class C aerodrome if currently at a too high standard will deteriorate unless funding from another source is found, e.g. flying club, municipality, etc.

**ANNEXURE A**  
**DRAWINGS**

**ANNEXURE B**  
**GLOSSARY OF TERMINOLOGY**

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

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

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

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

**MWTC : Ministry of Works Transport and Communications.**

**NTMPS : National Transportation Master Plan Study.**

**Class A aerodrome.** Aerodrome capable of handling large jet aircraft and a high volume of traffic, and facilities to handle international flights and passengers.

**Class B aerodrome.** Infrastructure capable of handling smaller aircraft (commuter type) and volumes. Not a point of entry.

**Class C aerodrome.** Minimum facility for access by air.

**AM : Aerodrome Manager**

**AS : Aerodrome Supervisor**

**Marking.** Symbols on the movement area to convey aeronautical information.

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

**Obstacle limitation surfaces.** The defined spaces around aerodromes that need to be maintained free of obstacles so as to permit the intended aeroplane operations at the aerodrome to be conducted safely and to prevent the aerodrome from becoming unusable by the growth of obstacles around the aerodrome.

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

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

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

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

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

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

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

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

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

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

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



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

**Declared distances.**

- a) *Take-off run available (TORA).* The length of runway declared available and suitable for the ground run of an aeroplane taking off.
- b) *Take-off distance available (TODA).* The length of the take-off run available plus the length of the clearway, if provided.
- c) *Accelerate-stop distance available (ASDA).* The length of the take-off run available plus the length of the stopway, if provided.
- d) *Landing distance available (LDA).* The length of runway which is declared available and suitable for the ground run of an aeroplane landing.

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

**Frangible object.** An object of low mass designed to break, distort or yield on impact so as to present the minimum hazard to aircraft.

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

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

- a) *Non-precision approach runway.* An instrument runway served by visual aids and a non-visual aid providing at least directional guidance adequate for a straight-in approach.
- b) *Precision approach runway, category I.* An instrument runway served by ILS and/or MLS and visual aids intended for operations with a decision height not lower than 60m (200ft) and either a visibility not less than 800m or a runway visual range not less than 550m.
- c) *Precision approach runway, category II.* An instrument runway served by ILS and/or MLS and visual aids intended for operations with a decision height lower than 60m (200ft) but not lower than 30m (100ft) and a runway visual range not less than 350m.

- d) *Precision approach runway, category III.* An instrument runway served by ILS and/or MLS to and along the surface of the runway and:
- A - intended for operations with a decision height lower than 30m (100ft), or no decision height and a runway visual range not less than 200m.
  - B - intended for operations with a decision height lower than 15m (50ft), or no decision height and a runway visual range less than 200m but not less than 50m.
  - C - intended for operations with no decision height and no runway visual range limitations.

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

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

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

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

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

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

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

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

**Road.** An established surface route on the movement area meant for the exclusive use of vehicles.

**Road-holding position.** A designated position at which vehicles may be required to hold.

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

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

**Runway guard lights.** A light system intended to caution pilots or vehicle drivers that they are about to enter an active runway.

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

- a) to reduce the risk of damage to aircraft running off a runway; and
- b) to protect aircraft flying over it during take-off or landing operations.

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

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

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

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

**Taxi-holding position.** A designated position at which taxiing aircraft and vehicles shall stop and hold position, unless otherwise authorized by the aerodrome control tower.

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

- a) *Aircraft stand taxilane.* A portion of an apron designated as a taxiway and intended to provide access to aircraft stands only.
- b) *Apron taxiway.* A portion of a taxiway system located on an apron and intended to provide a through taxi route across the apron.
- c) *Rapid exit taxiway.* A taxiway connected to a runway at an acute angle and designed to allow landing aeroplanes to run off at higher speeds than are achieved on other exit taxiways thereby minimizing runway occupancy times.

**Taxiway intersection.** A junction of two or more taxiways.

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

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

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

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

**ANNEXURE C**  
**OVERVIEW OF AERODROME NETWORK**

## OVERVIEW OF AERODROME NETWORK

This Annexure recapitulates the point of the Namibian National Aerodrome Network that will be the responsibility of the method by which the network was arrived at is presented in the following reports as part of the NTMPS:

1. Policy Principles Underlying an Aerodrome Master Plan for Namibia, 22 February 1997
2. Framework for a National Aerodrome Master Plan, 26 February 1997

## CLASS B AERODROMES

The following aerodromes were identified as B Class aerodromes (excluding aerodromes operated by the NACo):

| NAME        | POSITION          | SURFACE TYPE |
|-------------|-------------------|--------------|
| Tsumeb      | 19°16'S / 17°44'E | Asphalt      |
| Otjiwarongo | 20°26'S / 16°40'E | Gravel       |

## CLASS C AERODROMES

The following aerodromes were identified as Class C aerodromes.

| NAME      | POSITION          | SURFACE TYPE     |
|-----------|-------------------|------------------|
| Aminuis   | 23°38'S / 19°20'E | Gravel           |
| Aroab     | 26°48'S / 19°40'E | Gravel           |
| Bagani    | 18°10'S / 21°40'E | Gravel           |
| Bethanie  | 26°33'S / 17°11'E | Gravel           |
| Eenhana   | 17°29'S / 16°20'E | Asphalt          |
| Gobabis   | 22°31'S / 18°58'E | Gravel           |
| Kamanjab  | 19°31'S / 14°49'E | Gravel           |
| Karasburg | 28°02'S / 18°44'E | Gravel           |
| Karibib   | 21°52'S / 15°52'E | Asphalt / Gravel |
| Khorixas  | 20°24'S / 14°59'E | Gravel           |
| Maltahohe | 24°47'S / 17°01'E | Gravel           |
| Mariental | 24°36'S / 17°55'E | Asphalt / Gravel |
| Nepara    | 17°50'S / 18°25'E | Gravel           |
| Okakarara | 20°38'S / 17°29'E | Gravel           |
| Okaukuejo | 19°10'S / 15°56'E | Gravel           |
| Okangwati | 17°26'S / 13°15'E | Gravel           |

NTMPS  
Aerodrome Standards

| NAME         | POSITION          | SURFACE TYPE     |
|--------------|-------------------|------------------|
| Opuwo        | 18°04'S / 13°49'E | Gravel           |
| Oranjemund   | 28°35'S / 16°27'E | Asphalt          |
| Oshakati     | 17°48'S / 15°42'E | Asphalt          |
| Otjinene     | 21°10'S / 18°45'E | Gravel           |
| Otjitutuo    | 19°42'S / 18°33'E | Gravel           |
| Rietfontein  | 21°55'S / 20°55'E | Gravel           |
| Rosh Pinah   | 27°58'S / 16°42'E | Asphalt / Gravel |
| Sesfontein   | 19°07'S / 13°37'E | Gravel           |
| Sesriem      | 24°35'S / 15°50'E | Gravel           |
| Swakopmund   | 22°39'S / 14°34'E | Gravel           |
| Terrace Bay  | 19°59'S / 13°02'E | Gravel           |
| Tsumkwe      | 19°33'S / 20°25'E | Gravel           |
| Tweerivieren | 25°30'S / 19°25'E | Gravel           |
| Uutapi       | 17°30'S / 15°0'E  | Closed           |
| Zais         | 23°55'S/16°15'E   | Gravel           |

**TABLE 5.1 : COST OF MAINTENANCE ACTIVITIES**

| Item         | Description   | Detail  | Annual Frequency                                | Relevance                     | Unit                           | Quantity                          | Rate           | Amount                      |
|--------------|---|---|---|-------------------------------|--------------------------------|-----------------------------------|----------------|-----------------------------|
| <b>4.1.1</b> | <b><u>Inspections</u></b>   |   |   |                               |                                |                                   |                |                             |
| (a)          | <b>General inspection</b><br>Establish obvious hindrances on aircraft movement areas                          |   | Monthly<br>Per movement                         | Class B<br>Class C            | per inspection<br>N/A          | 12.00<br>N/A                      | 150<br>N/A     | 1 800<br>-                  |
| (b)          | <b>Pavement condition inspection</b><br>Assess condition of runway, taxiway, apron, roads and vehicle parking | Condition of wearing course, surface drainage, presence of contaminants | Annually<br>Annually                            | Class B<br>Class C            | per aerodrome<br>per aerodrome | 1.00<br>1.00                      | 1 500<br>1 500 | 1 500<br>1 500              |
| <b>4.1.2</b> | <b><u>Pavement cleaning</u></b>   |   |   |                               |                                |                                   |                |                             |
| (a)          | <b>Cleaning of concrete aprons</b><br>Cleaning of contaminants on concrete aprons                             | Grease solvent and/or high-pressure water cleaners                      | Annually  | Class B                       | m2                             | 120.00                            | 10             | 1 200                       |
| <b>4.1.3</b> | <b><u>Gravel pavement repair</u></b>  |   |   |                               |                                |                                   |                |                             |
| (a)          | Removal of grass, shrubs, large aggregate and ant/termite nests   | Access road<br>Access road<br>Runway and Apron                          | Annually<br>Annually<br>Annually                | Class B<br>Class C<br>Class C | m2<br>m2<br>m2                 | 7 925.00<br>7 525.00<br>22 800.00 | 0<br>0<br>0    | 1 981<br>1 881<br>5 700     |
| (b)          | Fixing of potholes, Filling of Furrows  | Access road<br>Access road<br>Runway and Apron                          | Annually<br>Annually<br>Annually                | Class B<br>Class C<br>Class C | m2<br>m2<br>m2                 | 110.00<br>50.00<br>10.00          | 15<br>15<br>15 | 1 650<br>750<br>150         |
| (c)          | Blading af aircraft movement areas and access road  | Access road<br>Access road<br>Runway and Apron                          | Annually<br>Annually<br>Bi-annually             | Class B<br>Class C<br>Class C | m2<br>m2<br>m2                 | 7 925.00<br>7 525.00<br>22 800.00 | 1<br>1<br>1    | 7 925<br>7 525<br>22 800    |
| (d)          | Reworking and regraveling of wearing course   | Access road<br>Access road<br>Runway and Apron                          | 1 in 10 years<br>1 in 10 years<br>1 in 15 years | Class B<br>Class C<br>Class C | m2<br>m2<br>m2                 | 7 950.00<br>7 525.00<br>22 800.00 | 6<br>6<br>6    | 47 700<br>45 150<br>136 800 |
| <b>4.1.4</b> | <b><u>Rigid pavement repair</u></b>   |   |   |                               |                                |                                   |                |                             |
| (a)          | Joint sealing   | Replacing old sealant with new  | 1 in 10 years                                   | Class B                       | m                              | 1 210.00                          | 50             | 60 500                      |
| (b)          | Crack sealing   | Cutting top of cracks wider and inserting sealant                       | Annually  | Class B                       | m                              | 6.00                              | 100            | 600                         |
| (c)          | Edge and corner repair  | Replacing spalled edges with patch mixture                              | Annually  | Class B                       | m                              | 6.00                              | 200            | 1 200                       |
| (d)          | Surface damage repair   | Replacind damaged concrete with fresh concrete                          | Annually  | Class B                       | m2                             | 6.00                              | 200            | 1 200                       |
| (e)          | Slab replacement  |   | Annually  | Class B                       | m2                             | 6.00                              | 350            | 2 100                       |
| <b>4.1.5</b> | <b><u>Flexible pavement repair</u></b>  |   |   |                               |                                |                                   |                |                             |
| (a)          | Rejuvenation of flexible pavements  | Treating of wearing course with fog spray                               | 1 in 5 years                                    | Class B                       | m2                             | 51 000.00                         | 1              | 51 000                      |
| (b)          | Crack sealing   | Filling cracks with special emulsion of high fluidity                   | Annually  | Class B                       | m                              | 5 100.00                          | 5              | 25 500                      |
| (c)          | Pothole repair  | Replacing suspect pavement layer with asphalt                           | Adhoc   | Class B                       | m2                             | 50.00                             | 200            | 10 000                      |

**TABLE 5.1: COST OF MAINTENANCE ACTIVITIES (CONT.)**



| Item         | Description                             | Detail   | Frequency            | Relevance          | Measure              | Quantity     | Rate           | Amount               |
|--------------|---|--|----------------------|--------------------|----------------------|--------------|----------------|----------------------|
| (d)          | Overlay                                 | 30 mm asphalt overlay                                | 1 in 15 years        | Class B            | m2                   | 51 000.00    | 50             | 2 550 000            |
| (e)          | Reconstruction of pavement              | Reconstruction of pavement layers                    | Ad hoc               | Class B            | m2                   | 100.00       | 180            | 18 000               |
| <b>4.1.6</b> | <b>Marking and markers</b>              |  |                      |                    |                      |              |                |                      |
| (a)          | Touch-up of marking                     | Repair od damaged marking after surface clean-up     | Adhoc                | Class B            | m2                   | 12.00        | 70             | 840                  |
| (b)          | Removal of marking                      | Mechanical grinding or painting out with black paint | Adhoc                | Class B            | m2                   | 15.00        | 60             | 900                  |
| (c)          | Painting and repainting of marking      |  | Annually             | Class B            | m2                   | 15.00        | 50             | 750                  |
| (d)          | Painting of markers                     |  | Annually             | Class B            | m2                   | 91.00        | 10             | 910                  |
|              |   |  | Annually             | Class C            | m2                   | 208.00       | 10             | 2 080                |
| <b>4.2</b>   | <b><u>Off-pavement maintenance</u></b>  |  |                      |                    |                      |              |                |                      |
| <b>4.2.1</b> | <b>Fencing</b>                          |  |                      |                    |                      |              |                |                      |
| (a)          | Inspection of fences                    | Condition and damages to boundary fence              | Weekly               | Class B            |                      |              |                | Included             |
| (b)          | Mesh maintenance                        | Re-tightening straining wires, refastening of mesh   | Adhoc                | Class B            | Lump sum             |              |                | 3 000                |
| (c)          | Mesh repair                             | Re-placement of straining wires and mesh             | Bi-annually          | Class B            | m2                   | 150.00       | 50             | 7 500                |
| <b>4.2.2</b> | <b>Surface wind indicator</b>           |  |                      |                    |                      |              |                |                      |
| (a)          | Inspection and minor repairs            |  | Weekly<br>Adhoc      | Class B<br>Class C |                      |              |                | Included<br>Included |
| (b)          | Replacement of windcones                | Replacement if damaged beyond repair                 | Annually<br>Annually | Class B<br>Class C | no<br>no             | 1.00<br>1.00 | 1 000<br>1 000 | 1 000<br>1 000       |
| <b>4.2.3</b> | <b>Drainage</b>                         |  |                      |                    |                      |              |                |                      |
| (a)          | Inspection of surface drainage          | Identifying areas of water ponding on surfacing      | Annually<br>Annually | Class B<br>Class C |                      |              |                | Included<br>Included |
| (b)          | Inspection of drainage system           | Identifying blockages in channels, culverts, inlets  | Annually<br>Annually | Class B<br>Class C | No<br>No             | 1.00<br>1.00 | 1 000<br>1 000 | 1 000<br>1 000       |
| (c)          | Cleaning of drainage system             | Removal of sediment and obstacles                    | Annually<br>Annually | Class B<br>Class C | Lump sum<br>Lump sum |              |                | 12 000<br>6 000      |
| (d)          | Repair of surface drainage deficiencies | See 5.1.3, 5.1.4(d)                                  |                      |                    |                      |              |                |                      |
| <b>4.2.4</b> | <b>Green areas</b>                      |  |                      |                    |                      |              |                |                      |
| (a)          | Mowing grass inside runway strip        | Grass limited to height of 10 cm                     | Annually             | Class B            | ha                   | 13.00        | 1 500          | 19 500               |
| (b)          | Mowing grass outside runway strip       | Grass limited to height of 20 cm                     | Annually             | Class B            | ha                   | 8.50         | 1 500          | 12 750               |
| <b>4.2.5</b> | <b>Buildings and services</b>           | Maintenance of buildings , sewer, water, power       | Adhoc/monthly        | Class B            | Lump sum             | 12.00        | 2 500          | 30 000               |

**TABLE 5.2 : MAINTENANCE COST FOR CLASS B AIRPORT**

|              |   | COST/YEAR |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|--------------|---|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|              |   | 1         | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     |
| <b>4.1</b>   | <b>Pavement Maintenance</b>                                     |           |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| <b>4.1.1</b> | <b>Inspections</b>  |           |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 4.1.1(a)     | General Inspections   | -         | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      | -      |
| 4.1.1(b)     | Pavement Condition Inspection                                   | 1 500     | 1 500  | 1 500  | 1 500  | 1 500  | 1 500  | 1 500  | 1 500  | 1 500  | 1 500  | 1 500  | 1 500  | 1 500  | 1 500  | 1 500  |
| <b>4.1.2</b> | <b>Pavement Cleaning</b>  |           |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 4.1.2(a)     | Cleaning of Concrete Apron                                      | 1 200     | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  |
| <b>4.1.3</b> | <b>Gravel Pavement Repair</b>                                   |           |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 4.1.3(a)     | Removal of grass, shrubs, large aggregate and ant/termite nests | 1 980     | 1 980  | 1 980  | 1 980  | 1 980  | 1 980  | 1 980  | 1 980  | 1 980  | 1 980  | 1 980  | 1 980  | 1 980  | 1 980  | 1 980  |
| 4.1.3(b)     | Fixing of potholes, Filling of furrows                          | 1 650     | 1 650  | 1 650  | 1 650  | 1 650  | 1 650  | 1 650  | 1 650  | 1 650  | 1 650  | 1 650  | 1 650  | 1 650  | 1 650  | 1 650  |
| 4.1.3(c)     | Blading of access road  | 7 925     | 7 925  | 7 925  | 7 925  | 7 925  | 7 925  | 7 925  | 7 925  | 7 925  | 7 925  | 7 925  | 7 925  | 7 925  | 7 925  | 7 925  |
| 4.1.3(d)     | Reworking and regravelling of wearing course                    |           |        |        |        |        |        |        |        |        | 47 700 |        |        |        |        |        |
| <b>4.1.4</b> | <b>Rigid Pavement Repair</b>                                    |           |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 4.1.4(a)     | Joint Sealing   |           |        |        |        |        |        |        |        |        | 60 500 |        |        |        |        |        |
| 4.1.4(b)     | Crack Sealing   | 600       | 600    | 600    | 600    | 600    | 600    | 600    | 600    | 600    | 600    | 600    | 600    | 600    | 600    | 600    |
| 4.1.4(c)     | Edge and Corner Repair  | 1 200     | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  |
| 4.1.4(d)     | Surface Damage Repair   | 1 200     | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  | 1 200  |
| 4.1.4(e)     | Slab Replacement  | 2 100     | 2 100  | 2 100  | 2 100  | 2 100  | 2 100  | 2 100  | 2 100  | 2 100  | 2 100  | 2 100  | 2 100  | 2 100  | 2 100  | 2 100  |
| <b>4.1.5</b> | <b>Flexible Pavement Repair</b>                                 |           |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 4.1.5(a)     | Rejuvenation  |           |        | 51 000 |        |        |        |        | 51 000 |        |        |        |        | 51 000 |        |        |
| 4.1.5(b)     | Crack Sealing   | 25 500    | 25 500 | 25 500 | 25 500 | 25 500 | 25 500 | 25 500 | 25 500 | 25 500 | 25 500 | 25 500 | 25 500 | 25 500 | 25 500 | 25 500 |
| 4.1.5(c)     | Pothole Repair  | 10 000    | 10 000 | 10 000 | 10 000 | 10 000 | 10 000 | 10 000 | 10 000 | 10 000 | 10 000 | 10 000 | 10 000 | 10 000 | 10 000 | 10 000 |
| 4.1.5(d)     | Overlay   |           |        |        |        |        |        |        |        |        |        |        |        |        |        | #####  |
| 4.1.5(e)     | Reconstruction of pavement                                      | 18 000    | 18 000 | 18 000 | 18 000 | 18 000 | 18 000 | 18 000 | 18 000 | 18 000 | 18 000 | 18 000 | 18 000 | 18 000 | 18 000 | 18 000 |
| <b>4.1.6</b> | <b>Marking and Markers</b>                                      |           |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 4.1.6(a)     | Touch-up of marking   | 840       | 840    | 840    | 840    | 840    | 840    | 840    | 840    | 840    | 840    | 840    | 840    | 840    | 840    | 840    |
| 4.1.6(b)     | Removal of marking  | 900       | 900    | 900    | 900    | 900    | 900    | 900    | 900    | 900    | 900    | 900    | 900    | 900    | 900    | 900    |
| 4.1.6(c)     | Painting and Repainting of marking                              | 750       | 750    | 750    | 750    | 750    | 750    | 750    | 750    | 750    | 750    | 750    | 750    | 750    | 750    | 750    |
| 4.1.6(d)     | Painting of markers   | 910       | 910    | 910    | 910    | 910    | 910    | 910    | 910    | 910    | 910    | 910    | 910    | 910    | 910    | 910    |

|              |                                   | COST/YEAR      |                |                |                |                |                |                |                |                |                |                |                |                |                |              |
|--------------|-----------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|
|              |                                   | 1              | 2              | 3              | 4              | 5              | 6              | 7              | 8              | 9              | 10             | 11             | 12             | 13             | 14             | 15           |
|              |                                   |                |                |                |                |                |                |                |                |                |                |                |                |                |                |              |
| <b>4.2</b>   | <b>Off Pavement Maintenance</b>   |                |                |                |                |                |                |                |                |                |                |                |                |                |                |              |
| <b>4.2.1</b> | <b>Fencing</b>                    |                |                |                |                |                |                |                |                |                |                |                |                |                |                |              |
| 4.2.1(a)     | Inspection of fences              |                |                |                |                |                |                |                |                |                |                |                |                |                |                |              |
| 4.2.1(b)     | Mesh Maintenance                  | 3 000          | 3 000          | 3 000          | 3 000          | 3 000          | 3 000          | 3 000          | 3 000          | 3 000          | 3 000          | 3 000          | 3 000          | 3 000          | 3 000          | 3 000        |
| 4.2.1(c)     | Mesh Repair                       | 7 500          | 7 500          | 7 500          | 7 500          | 7 500          | 7 500          | 7 500          | 7 500          | 7 500          | 7 500          | 7 500          | 7 500          | 7 500          | 7 500          | 7 500        |
| <b>4.2.2</b> | <b>Surface Wind Indicator</b>     |                |                |                |                |                |                |                |                |                |                |                |                |                |                |              |
| 4.2.2(a)     | Inspection and minor repairs      |                |                |                |                |                |                |                |                |                |                |                |                |                |                |              |
| 4.2.2(b)     | Replacement of windcones          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000        |
| <b>4.2.3</b> | <b>Drainage</b>                   |                |                |                |                |                |                |                |                |                |                |                |                |                |                |              |
| 4.2.3(a)     | Inspection of surface drainage    |                |                |                |                |                |                |                |                |                |                |                |                |                |                |              |
| 4.2.3(b)     | Inspection of drainage system     | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000          | 1 000        |
| 4.2.3(c)     | Cleaning of drainage system       | 12 000         | 12 000         | 12 000         | 12 000         | 12 000         | 12 000         | 12 000         | 12 000         | 12 000         | 12 000         | 12 000         | 12 000         | 12 000         | 12 000         | 12 000       |
| 4.2.3(d)     | Repair of surface drainage        |                |                |                |                |                |                |                |                |                |                |                |                |                |                |              |
| <b>4.2.4</b> | <b>Green Areas</b>                |                |                |                |                |                |                |                |                |                |                |                |                |                |                |              |
| 4.2.4(a)     | Mowing grass inside runway strip  | 19 500         | 19 500         | 19 500         | 19 500         | 19 500         | 19 500         | 19 500         | 19 500         | 19 500         | 19 500         | 19 500         | 19 500         | 19 500         | 19 500         | 19 500       |
| 4.2.4(b)     | Mowing grass outside runway strip | 12 750         | 12 750         | 12 750         | 12 750         | 12 750         | 12 750         | 12 750         | 12 750         | 12 750         | 12 750         | 12 750         | 12 750         | 12 750         | 12 750         | 12 750       |
| <b>2.5</b>   | <b>Building and services</b>      | 30 000         | 30 000         | 30 000         | 30 000         | 30 000         | 30 000         | 30 000         | 30 000         | 30 000         | 30 000         | 30 000         | 30 000         | 30 000         | 30 000         | 30 000       |
|              |                                   |                |                |                |                |                |                |                |                |                |                |                |                |                |                |              |
|              | <b>TOTAL</b>                      | <b>163 005</b> | <b>163 005</b> | <b>214 005</b> | <b>163 005</b> | <b>163 005</b> | <b>163 005</b> | <b>163 005</b> | <b>214 005</b> | <b>163 005</b> | <b>271 205</b> | <b>163 005</b> | <b>163 005</b> | <b>214 005</b> | <b>163 005</b> | <b>#####</b> |
|              |                                   |                |                |                |                |                |                |                |                |                |                |                |                |                |                |              |

Annual average per aerodrome

350 418

2 aerodromes: average annual total

700 837