Advisory Circular
AC139- 6

Aerodrome design, Aeroplanes at or Below 5700 kg MCTOW **Revision 02**

Date: 12 February 2015

GENERAL

Civil Aviation Safety Authority Advisory Circulars (AC) contains information about standards, practices and procedures that the Director has found to be an Acceptable Means of Compliance (AMC) with the associated rule.

An AMC is not intended to be the only means of compliance with a rule, and consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices or procedures are found to be acceptable, they will be added to the appropriate Advisory Circular.

PURPOSE

This Advisory Circular provides methods, acceptable to the Director, for showing compliance with the aerodrome requirements of Part 139 and for the guidance of non-certificated aerodrome operators and explanatory material to assist in showing compliance.

RELATED CAR

This AC relates specifically to Civil Aviation Rule Part 91, 125, 135 and for the guidance of non-certificated aerodrome operators and aircraft operators.

CHANGE NOTICE

This AC replaces AC139-6 Revision 01.

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Chapter 1 — General

1.1 Introduction

1.1.1 In accordance with the requirements of Rule 125.81 and 135.77, Use of Aerodromes, no place may be used as an aerodrome unless the place is suitable for the purpose of taking off or landing of the aircraft concerned.

1.1.2 This advisory Circular, which is based on CAR Part 139 standards and requirements for aerodromes and taking into account Papua New Guinea's aviation environment, details the physical characteristics, the types of equipment and installations, and the associated standards that are acceptable to the Director for ensuring compliance with the requirements of Parts 125 and 135 for air operations and with Part 91 for private operations of aeroplanes at or below 5700 kg MCTOW.

1.2 Applicability

1.2.1 This Advisory Circular provides an acceptable means of compliance to the aerodromes standards of which Rule Part 139.5 (b) refers.

1.2.2 Operations at these aerodromes are limited to daylight hours and visual meteorological conditions with aeroplanes at or below 5700 kg MCTOW>

1.2.3 Common features of these aerodromes are that the majority are located in remote areas, without access to electrical power and with unpaved runways.

1.2.4 Definitions

For a complete list of aviation definitions refer to Civil Aviation Rule Part 1.

Aerodrome —

a) means any defined area of land or water intended or designed to be used either wholly or partly for the landing, departure, and surface movement of aircraft; and
b) includes any buildings, installations, and equipment on or adjacent to any such area used in connection with the aerodrome or its administration.

Aerodrome reference field length means the minimum field length required for an aircraft to take-off at MCTOW, sea level, standard atmospheric conditions, still air, and zero runway slope.

Aerodrome reference aeroplane means the largest and/or most limiting aeroplane that the aerodrome is designed to accommodate.

Air transport operation means, inter alia, an operation for the carriage of passengers or goods by air for hire and reward except a commercial transport operation. This definition is sufficient for the context of operations on PNG's non-certificated aerodromes. Refer to Civil Aviation Rule Part 1 for a full definition.

Aircraft parking bay means a defined area on a land aerodrome intended to accommodate aircraft for the purpose of loading or unloading passengers or cargo, refuelling, parking, or maintenance.

Air operation means, inter alia, an operation for the carriage of passengers or goods by air for hire or reward, whether the operation is scheduled or unscheduled and where the passengers or goods are carried to or from a remote aerodrome. This definition is sufficient for the context of PNG's non-certificated aerodromes. Refer to Civil Aviation Rule Part 1 for a full definition.

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

Inner horizontal surface means a specified portion of a horizontal plane located above an aerodrome and its immediate environment. This surface establishes the height above which it may be necessary to restrict the creation of new obstacles, or remove or mark existing obstacles, to ensure the safety of aircraft visually manoeuvring in the aerodrome circuit prior to landing.

Instrument runway means a runway intended for the operation of aircraft using instrument approach procedures.

Manoeuvring area —

a) means that part of an aerodrome to be used for the take-off and landing of aircraft and for the surface movement of aircraft associated with takeoff and landing; but
b) does not include areas set aside for loading, off-loading, or maintenance of aircraft.

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

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

Movement area means that part of an aerodrome intended to be used for the take-off and landing of aircraft and for the surface movement of aircraft, and includes the manoeuvring area, maintenance areas, and aircraft parking bays.

Obstacle means 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 limitation surfaces mean defined areas about and above an aerodrome intended for the protection of aircraft in the vicinity of an aerodrome.

Outer main gear wheel span means the distance between the outside edges of the main gear wheels.

Private operations mean that the aeroplane is used privately and is not carrying passengers or goods for hire or reward.

Remote aerodrome means any structure or area of land or water used for take-off or landing –

a) to which access by road or water is restricted, limited or obstructed by geographical conditions; and
b) that does not meet the standards for aerodromes that are acceptable to the Director under Part 139.

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

Runway strip means a defined area including the runway, and stopway (if a stopway is provided), that is intended -

a) to reduce the risk of damage to an aircraft running off the runway; and
b) to provide obstacle protection for aircraft flying over the runway strip during takeoff or landing operations:

Runway starter extension means an additional runway length made available for take-off, prior to the normal runway end at the commencement of the takeoff run.

Surface category means a number or letter corresponding to the MCTOW of an aircraft, its wheel configuration and tyre pressures if the system is used.

Taxiway means 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.

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

CHAPTER 2 — Physical Characteristics

2.1 Runways

Width of runways

2.1.1 The preferred minimum runway width should be 10 m but not less than twice the external wheelbase of the aircraft to be used.

Note: Runway width should give sufficient width for the aeroplane using the aerodrome to ground manoeuvre on the runway.

Length

2.1.2 The runway length required is determined by the performance criteria of the aeroplane. This includes the intended payload, strip surface and the current meteorological conditions.

Runway surface

2.1.3 The runway surface should be without irregularities and of sufficient strength for the takeoff and landing of aeroplanes taking into consideration wheel configuration, tyre pressure and MCTOW.

Note: Runway surfaces can be paved or natural soil but defined for contrast with surroundings.

2.1.4 On unpaved runways the grass should be maintained to preferably below 240 mm in height however can be up to a maximum of 240 mm provided the performance of the aircraft is considered and appropriate penalties are applied for the long grass. Refer to section 6.1, aerodrome maintenance performance standards.

Location of threshold

2.1.5 The landing threshold is normally located at the start of a runway, if there are no obstacles penetrating above the approach obstacle limitation surface. For details on obstacle limitation surfaces refer to Section 3.2 and Appendix 2.

2.1.6 In determining that no obstacle penetrates above the approach surface, account should be taken of roads that are in the approach area. If they are present, a height of 4.5 m should be allowed for road vehicles.

2.1.7 If an object extends above the approach surface *and it cannot be removed*; the threshold should be displaced to a position on the runway that provides the required obstacle free approach surface. Refer to figure 2-1.

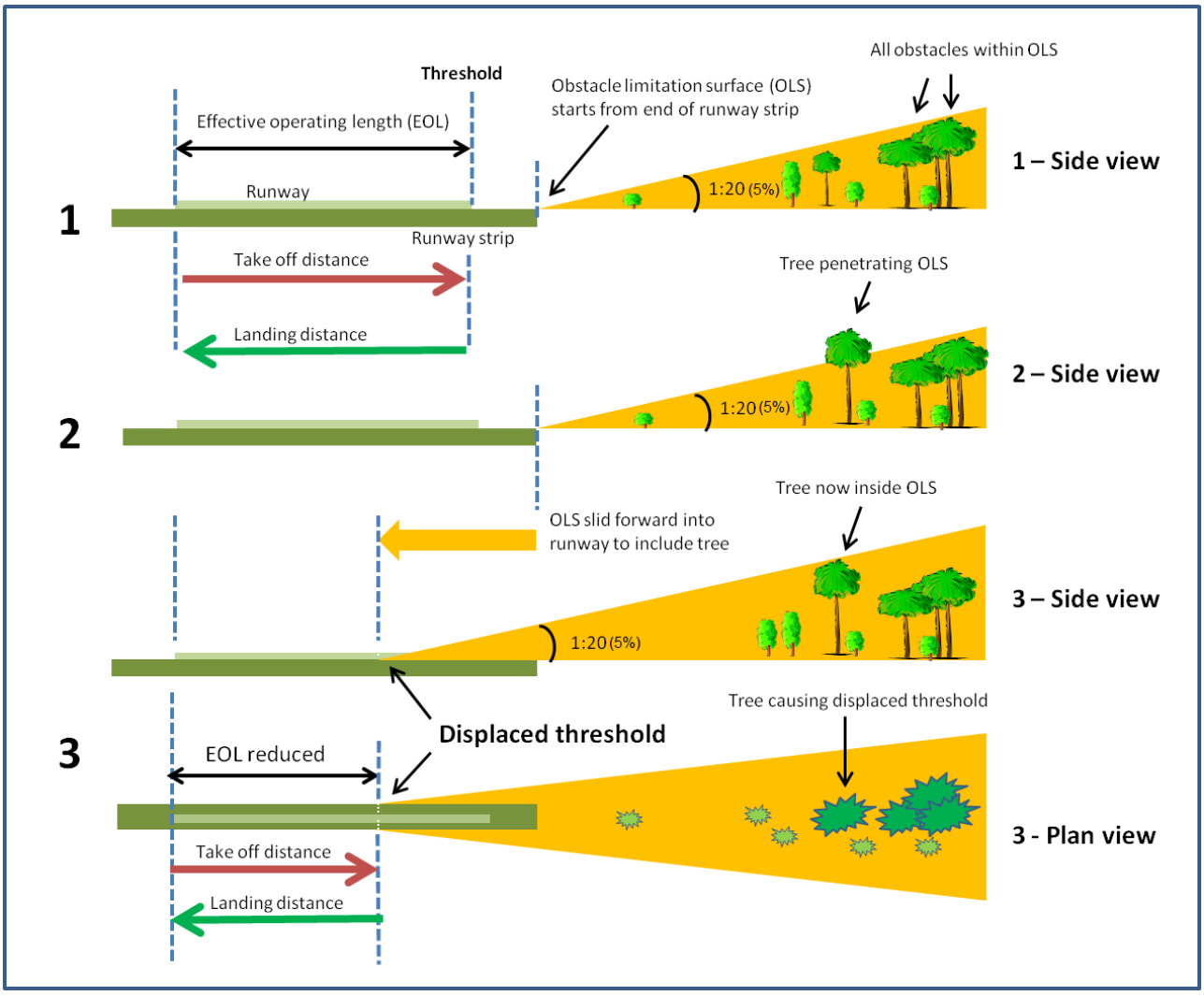


Figure 2-1 – Displaced threshold

Slopes on runways

2.1.8 The average slope over the length of the runway should not exceed 1:50 (2%) for a two directional runway or 1:6 (17%) for a one directional runway.

2.1.9 Where local slope changes occur along the length of a runway, they should not exceed 1:5 (20%).

2.1.10 Where slope transitional changes cannot be avoided, the air operator needs to assess the affect of the transitional slope of the operational of the specific aircraft type (i.e. to avoid such conditions as tail strike).

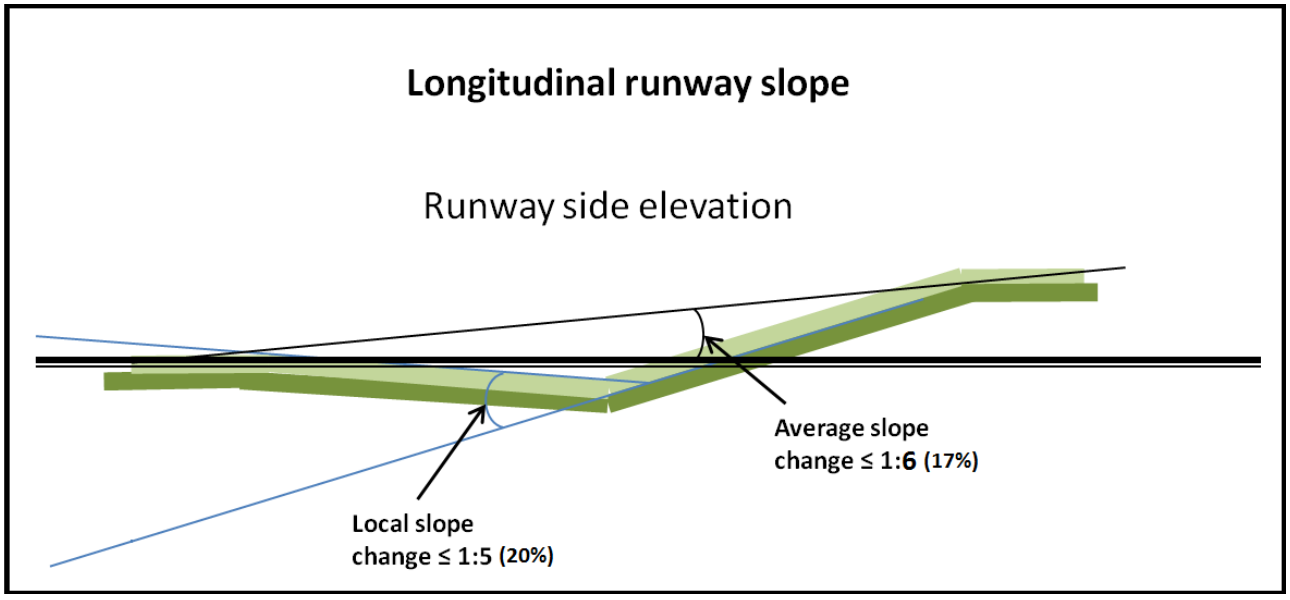


Figure 2.2 – Longitudinal runway slope

2.1.11 The transverse slope should be such as to prevent the collection of water at any point and to this end should not exceed 1:16 (6%).

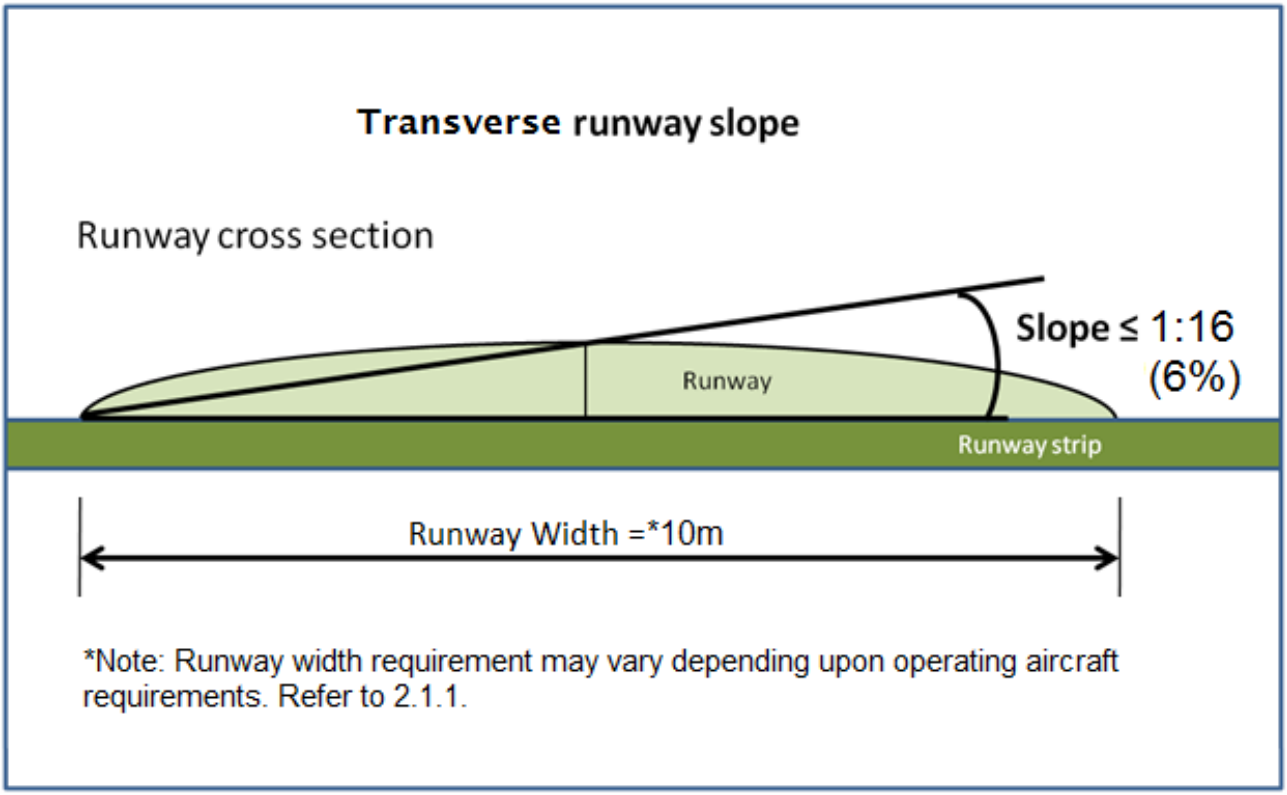


Figure 2-3 – Transverse slopes on runways

2.2 Runway Strip

General

2.2.1 A runway should be symmetrically included in a runway strip. Runway strips are designed to reduce the risk of damage to aircraft should they veer off the runway during take-off and landing.

Width of runway strips

2.2.2 The minimum width of the runway strip should be 20 m.

Note: A 20 m wide runway strip width will give sufficient space for manoeuvrability for the aeroplane when considering the allowance for obstacle free transitional side surface – refer 3.3.

Length of runway strips

2.2.3 A runway strip should extend beyond each end of the runway for a distance of at least 30 m unless the runway ends in a significant drop-off, then the 30 m extends into space.

Slope of runway strips

2.2.4 All slopes should not exceed those for the runway by more than a slope value of up to 1:5 (20%).

Strength and grading of runway strips

2.2.5 The runway strip should be constructed to minimise the hazards, or significant damage, to aircraft in the event of an accidental run off from the runway. The surface of the runway strip should be flush with the edge of the runway.

2.2.6 The vegetation within the runway strip should be maintained to below 240 mm in height. Refer to section 6.1, aerodrome maintenance performance standards. Figure 2-4 depicts a cross section and partial plan view of the runway strip and runway.

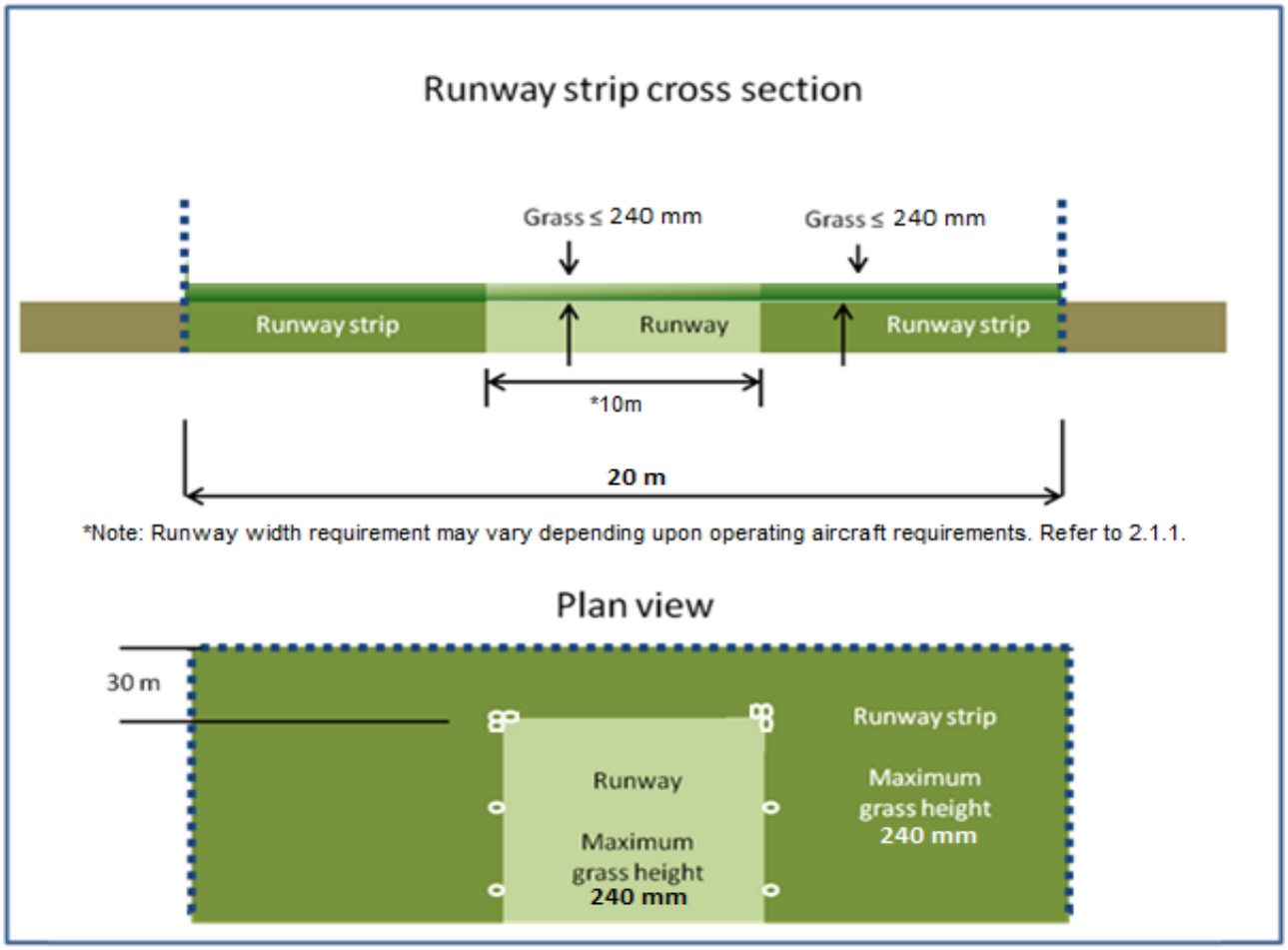


Figure 2-4 – Runway strip cross section

2.3 Runway Starter Extensions and Dog Leg Runway Strips

2.3.1 A runway starter extension may be established where additional takeoff distance, takeoff run or accelerate-stop distance is required but physical limitations do not allow provision of the mandatory runway strip or runway width.

2.3.2 Specifications:

a) A runway starter extension should be of sufficient strength for the aeroplane to be operated, and if possible in line with the runway.
b) Provided the length of the extension does not exceed 150 m, it may be narrower than the runway but not less than two thirds of the runway width or less than twice the outer main gear wheel span of the aeroplane to be operated.
c) The starter extension strip width should not be less than the wing span of the largest aircraft to be operated plus 8 m.

2.3.3 Starter extensions may require a taxiway lead-in or widening at the end to allow aircraft to turn.

Note: In PNG, some remote airstrips have starter extensions in the shape of a dog leg due to inadequate land space to construct a proper runway strip. In such a situation, the dog leg should have a deviation not in excess of 25 degrees from the extended centreline of the runway strip and not be more than 25% of the length of runway strip.

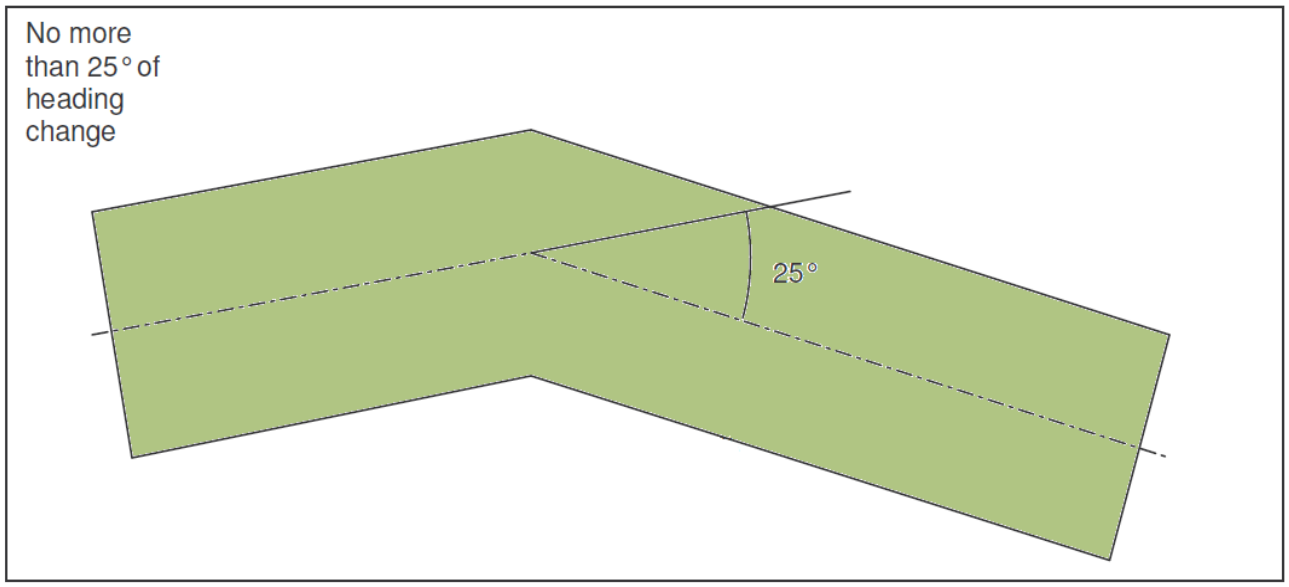


Figure 2-5 – An example of a dog leg airstrip

2.4 Taxiways

General

2.4.1 Aerodromes are not required to have a aircraft parking bay and consequently are not required to have a taxiway. However, if a taxiway is constructed it should have the following characteristics

Width of taxiways

2.4.2 The width of a taxiway should be 7.5 m.

Surface of taxiways

2.4.3 The surface of a taxiway should not have irregularities that may cause damage to the aeroplane structure.

2.4.4 The profile of the taxiway should facilitate water drainage away from the taxiway.

Strength of taxiways

2.4.5 The strength of a taxiway should be at least equal to that of the runway it serves.

Slope on taxiways

2.4.6 The surface of the strip should be flushed at the edge of the taxiway and the graded portion should not have an upward transverse slope exceeding 1:40 (2.5 %).The upward slope being measured with reference to the transitional slope of the adjacent taxiway surface and not the horizontal.

2.4.7 The downward transverse slope should not exceed 1:40 (2.5 %) measured with reference to the horizontal.

2.4.8 The transverse slopes on any portion of a taxiway strip beyond that to be graded should not exceed an upward slope of 1:40 (2.5 %) as measured in the direction away from the taxiway.

2.5 Aircraft parking bay

General

2.5.1 Although an aircraft parking bay is not required, consideration for one should be based on the volume of traffic and simultaneous use of the aerodrome. If an aircraft parking bay exists, it should meet the following criteria:

.**Size of aircraft parking bay**

2.5.2 Aircraft parking bay should be able to cater for at least one aircraft and depending on the volume of traffic may need to cater for more than one at a time. Refer to figure 2-6.

Note: Figure 2.6 is for illustration purposes only. Aircraft parking bay may be directly adjacent to the airstrip and may vary in shape and dimension depending upon the geographical location of the airstrip. Terminal and vehicle access may or may not be provided.

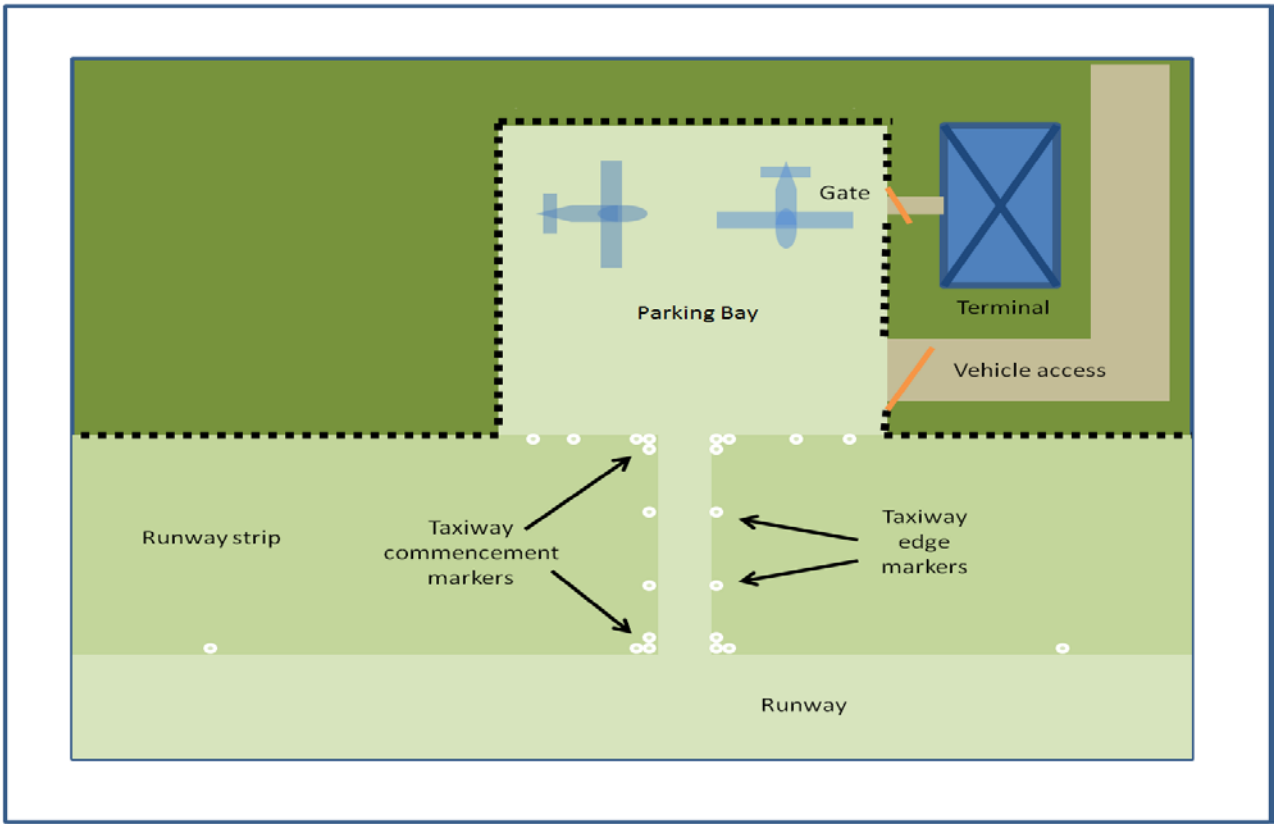


Figure 2-6 – An example of an Aerodrome aircraft parking bay

Surface of aircraft parking bay

2.5.3 The surface of the aircraft parking bay should not have irregularities that may cause damage to aeroplane structures.

Strength of aircraft parking bay

2.5.4 The strength of the aircraft parking bay should be at least equal to that of the runway and taxiway it serves.

Slope of aircraft parking bay

2.5.5 Slopes on aircraft parking bays should be sufficient to prevent accumulation of water on the surface of the aircraft parking bay but should be kept as level as drainage requirements permit.

2.6 Fencing

General

2.6.1 Fencing is not required however, based on volume and risk factors, consideration could be given to fencing the aerodrome in order to prevent animals and deter people from entering the runway strip or aircraft parking bay area during aircraft operations.If aircraft traffic demands then there should be further safeguards to mitigate the hazards imposed on safety and security at an aerodrome.

2.6.3 Aerodromes may be fenced round the runway strip and aircraft parking bay area if considered necessary in the interest of safety and security.

Type of fence

2.6.4 The recommended fence is a 1.2 m high, pig proof fence.

2.7 Drainage

General

2.7.1 PNG's non-certificated aerodromes are usually served with unpaved runways which are prone to surface erosion and soft wet surfaces during periods of heavy rain.

2.7.2 Aerodromes should have open unlined drains constructed outside the flight strip to drain water away from affected areas of the runway strip.

2.7.3 Aerodromes should have a minimum degree of camber, not to exceed 1:40 (2.5 %), to facilitate runoff of surface moisture to the open unlined drains outside the flight strip.

2.7.4 Where required it is recommended that herringbone or fishbone drains are in place along the length of the airstrip, and therefore allowing surface water to more easily drain into the open unlined drains.

CHAPTER 3 — Obstacle Limitation Surfaces

3.1 General

3.1.1 Each runway/strip should be provided with take-off climb and approach surfaces, such that aeroplanes taking off, or landing have a clear obstacle-free surface over which to carry out the initial phase of the climb, or final part of the approach.

3.1.2 Any boundary fence or hedge should be sited so as not to penetrate the take-off climb/approach surface.

3.2 Take-off Climb/ Approach Surface

3.2.1 Each runway should have a takeoff climb and approach surface which should:

a) Rise from the end of the runway strip; and
b) Be obstacle free above a gradient of 1:20 (5%) and
c) Extend horizontally 600m from the inner edge and
d) Have sides that are splayed outwards at the rate of 1:20 (5%) and
e) Not turn before 300 m from the inner edge, if a turn is necessary.

3.2.2 If the 1:20 (5%) gradient rising from the runway strip end does not clear all obstacles, a displaced landing threshold should be marked at the position necessary to ensure that the approach surface clears the obstacles. Refer to section 2.1.7.

3.3 Transitional Side Surface

3.3.1 Each runway strip should have a surface clear of obstructions extending sideways and upwards from the sides of the runway strip and the approach/take-off surfaces. The surface should be at a gradient of 1:5 (20%) till it reaches a height of 2 m above the runway strip. Refer to figure 3-1 for a depiction of obstacle limitation surfaces.

Note: When allowance for the transitional side surface obstacle limitation requirements are taken into account, this increases the width of the runway environment to 40 m. Refer to figure 3.1.

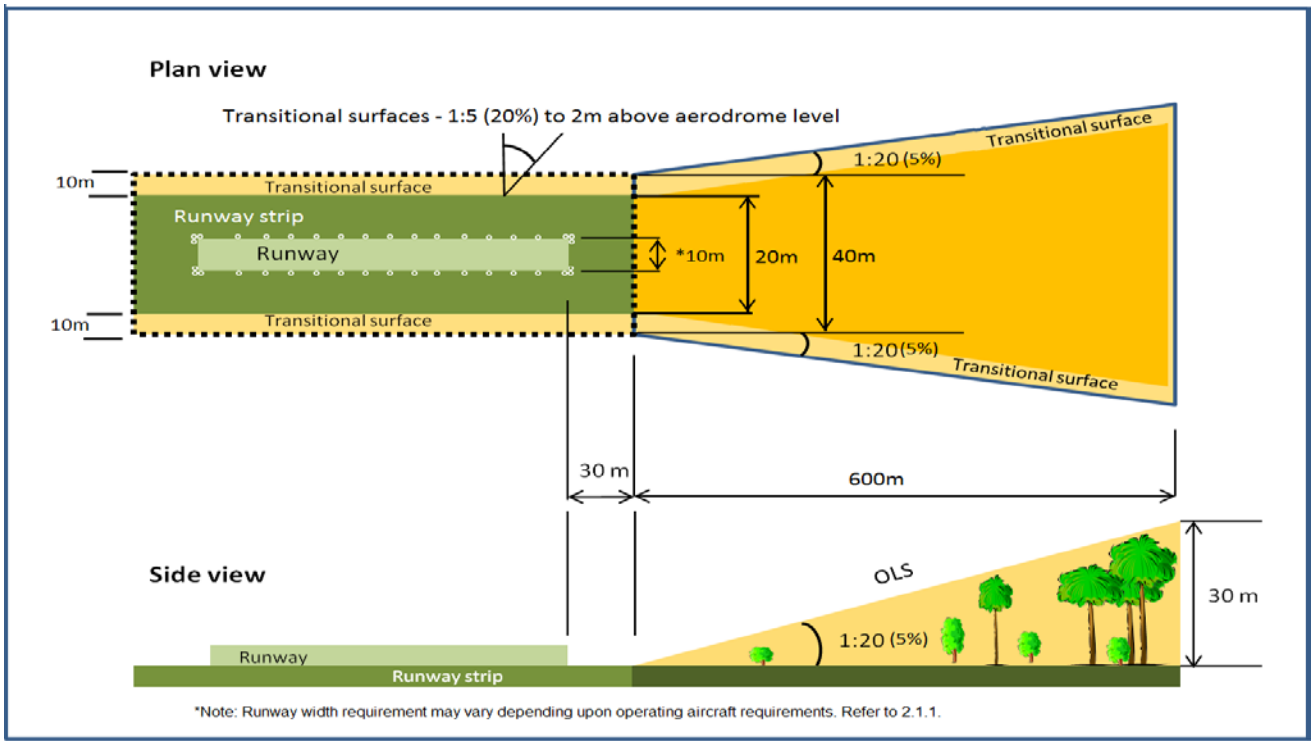


Figure 3-1 - Obstacle limitation surfaces

CHAPTER 4 — Water Aerodromes

4.1 General

4.1.1 Any place used as an aerodrome in a tract of water should comply with the following specifications.

4.2 Water Channel

4.2.1 The area of water used for the takeoff and landing of aeroplanes is called a water channel.

Water channel width

4.2.2 The minimum width of the water channel should be 60 m.

Water channel depth

4.2.3 The depth of the water channel should provide 1 m clearance below the hull or floats of the aeroplane when it is stationary at its maximum all-up weight.

4.2.4 A water channel should be clear of both stationary or moving vessels and other objects during flight operations.

Water channel additional area

4.2.5 There should be an additional area 30 m wide symmetrically surrounding the water channel to act as a protective buffer. This additional area need not consist of water but where it does, that area should be clear of moving objects, or vessels under way.

4.3 Obstacle Limitation Surfaces

4.3.1 Each water channel should have takeoff climb and approach obstacle free surfaces as prescribed for land aerodromes except that they should extend from the full width of the water channel ends. Refer Figure 4-1.

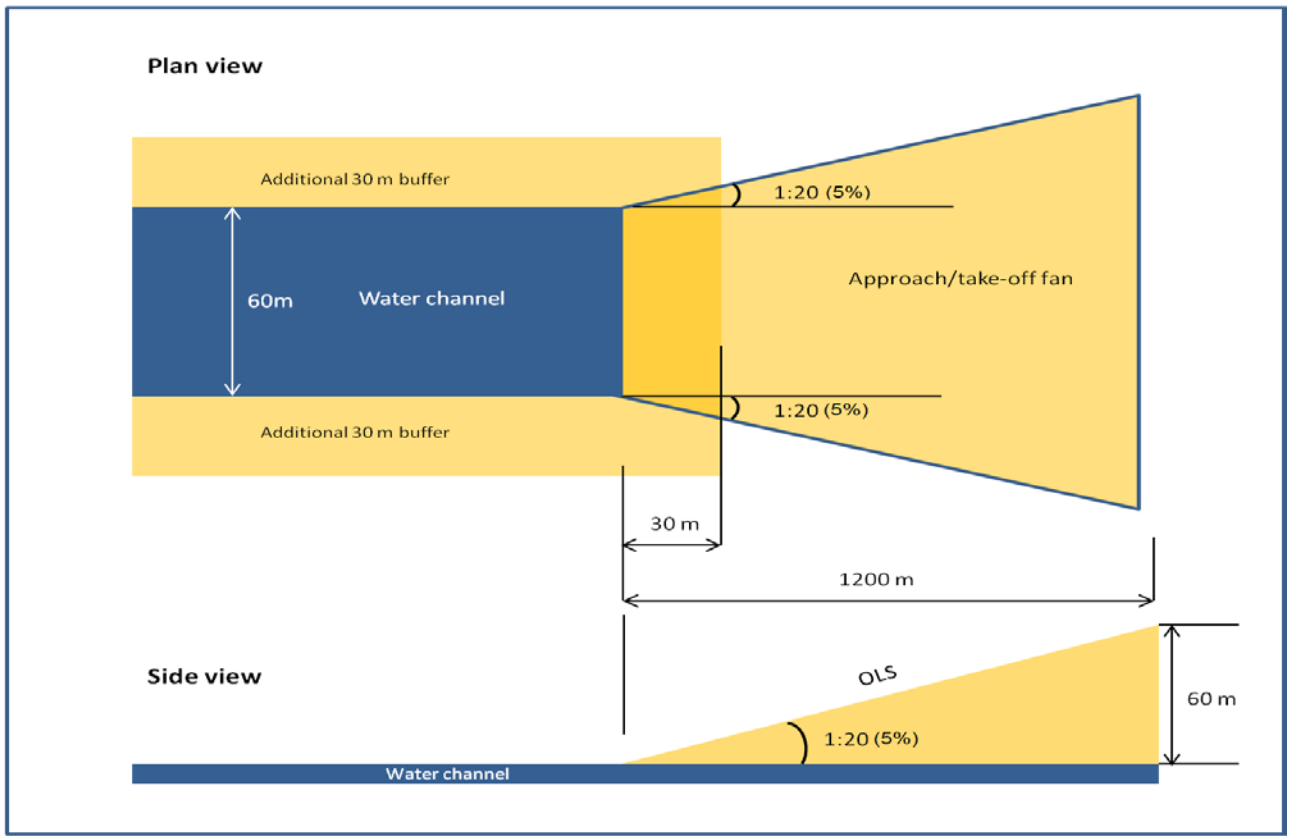


Figure 4-1. Water aerodrome obstacle limitation surfaces

CHAPTER 5 — Visual Aids for Navigation

5.1 Wind Direction Indicator (Windsock)

5.1.1 Each runway should be provided with at least one windsock.

5.1.2 The windsock should be located in an open space most suited to the prevailing wind conditions.

5.1.3 The windsock should be located at least 20 m from the runway centreline.

5.1.4 The windsock should be located in such a way as to be free from the effects of air disturbances caused by nearby objects.

5.1.5 The windsock should be in the form of a truncated cone made of fabric. It should be coloured white, yellow or light orange and constructed so that it gives a clear indication of the direction of the surface wind and a general indication of wind speed when seen from a height of 300 m (1,000 ft).

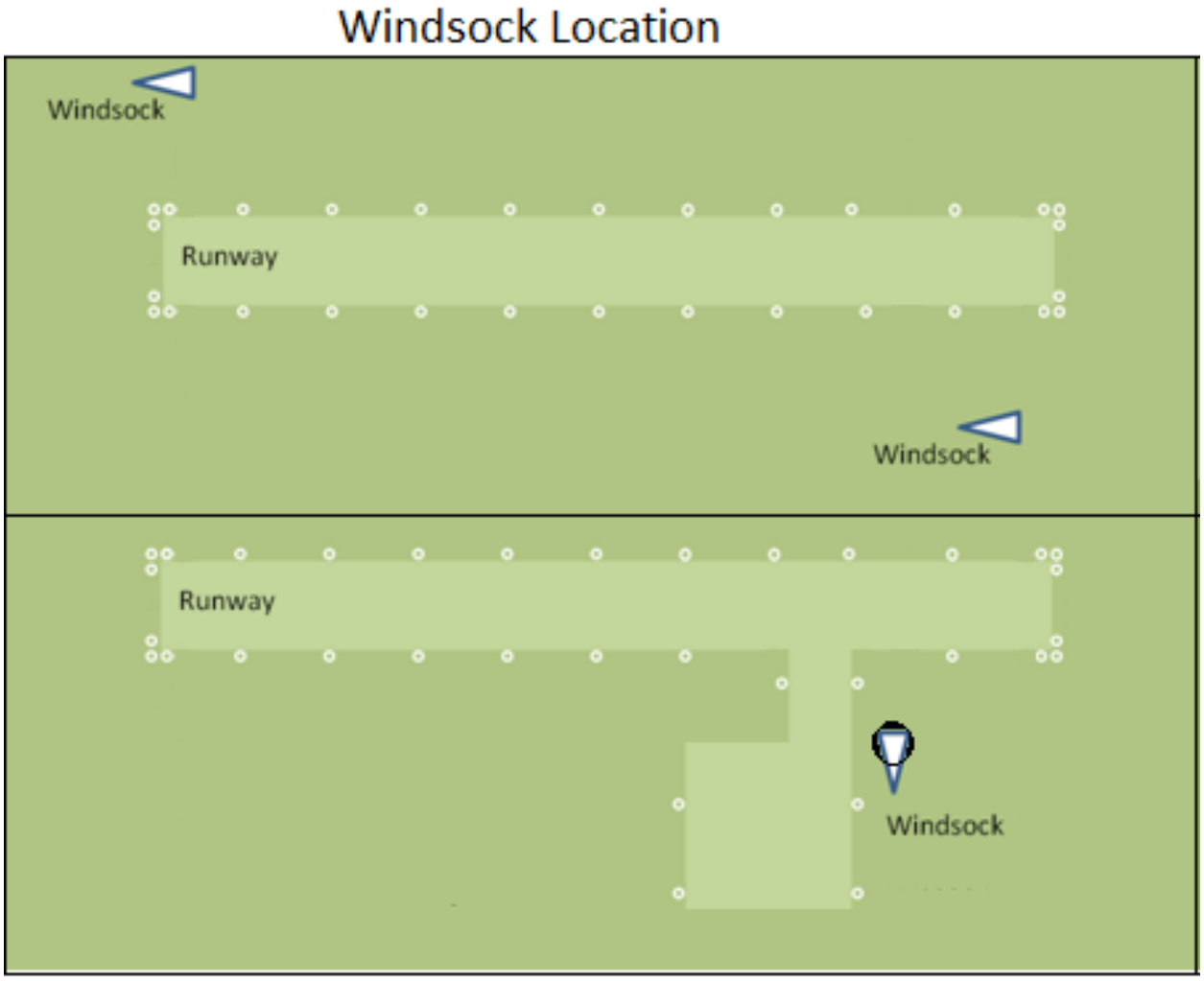


Figure 5-1- Windsock Locations

5.1.6 The circle around the wind indicator must be 15 meters diameter, blackened and the boundary marked with painted white stones or cone markers.

5.2 Unpaved Runway - Markers

Markers for general use

5.2.1 Markers should not pose a hazard to aircraft. It is recommended that markers be standard cone markers. Specific markers should be cone markers.

Runway end markers

5.2.2 On unpaved runway/strip, runway/strip end markers should be an L shaped group of 3 white cone markers located at each runway end corner, for a total of 4 end markers per runway. Two runway end markers are shown at figure 5-2.

Note: End markers can suffice for runway threshold markers where both the end of the runway and the threshold are co-located.

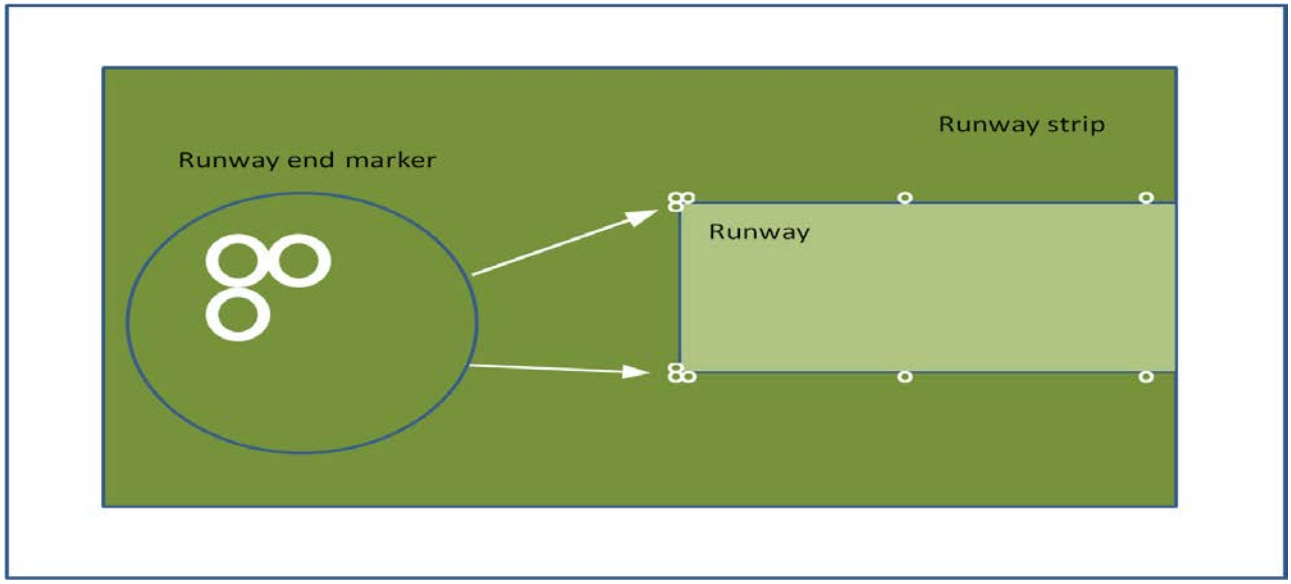


Figure 5-2. Runway end markers on unpaved runways

Displaced threshold

5.2.3 On unpaved runways, displaced threshold markers should be indicated by a row of 3 cones on either side of a runway at right angles to the centreline, located at the beginning of that portion of the runway useable for landing, as indicated in figure 5-4.

Note: The portion of runway between the runway end markers and the displaced threshold is not available for landing

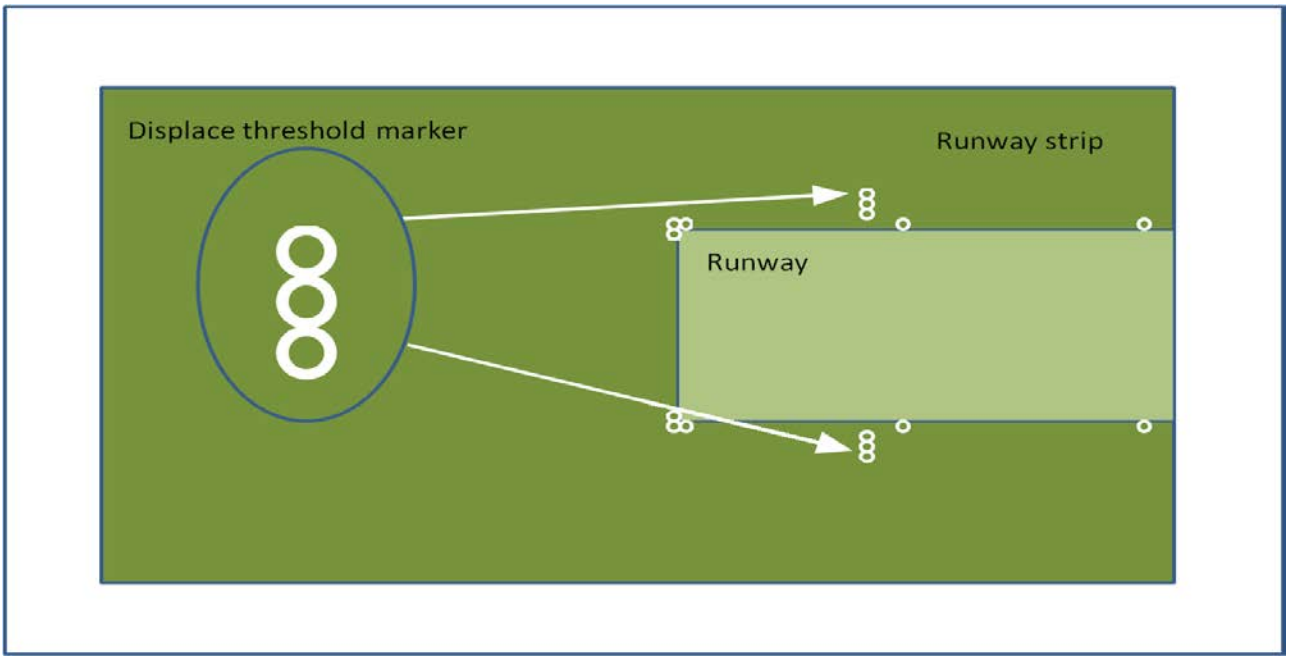


Figure 5-4. Displaced threshold markers on unpaved runways

Runway edge markers

5.2.4 Runway edge markers, consisting of single cone markers should be provided in pairs every 90 m along both long sides of the runway. Refer to figure 5-5 for an example of runway markers at an unpaved runway.

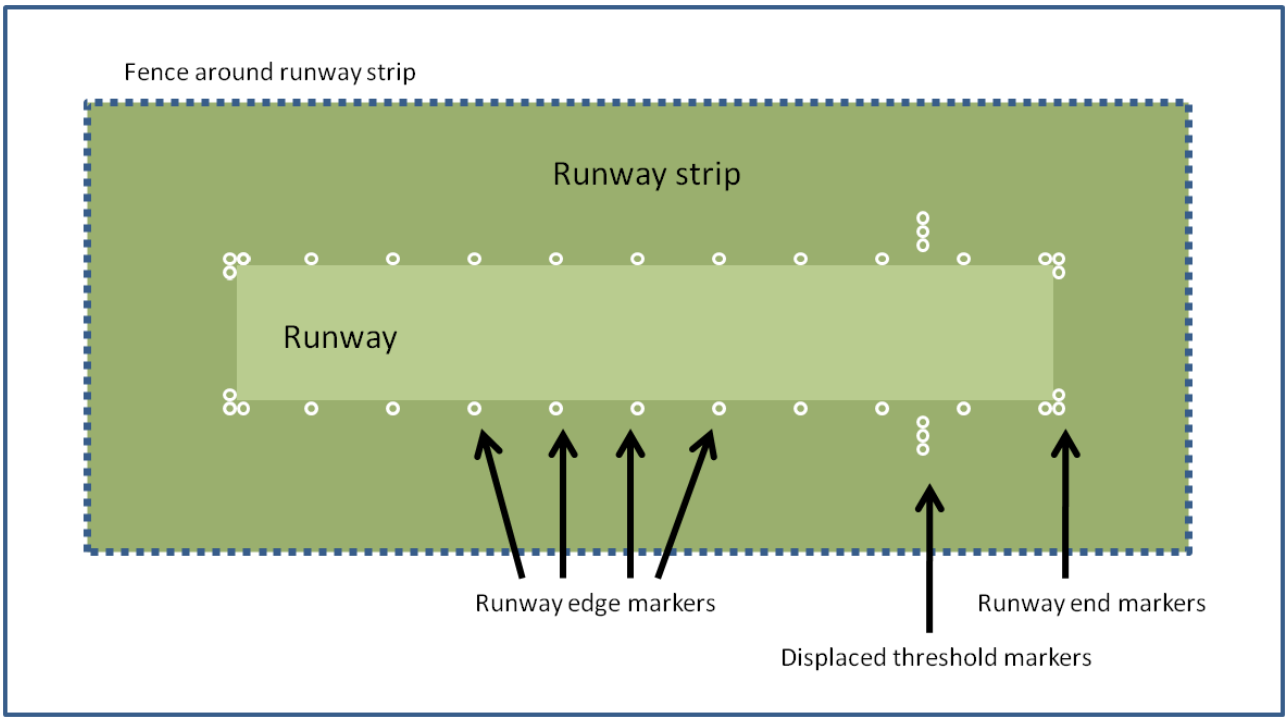


Figure 5-5. Runway markers on unpaved runway

Taxiway markers

5.2.5 Taxiway edge markers, consisting of cone markers should be provided in pairs every 10m along both long sides of the taxiway. Refer to figure 5.6 for an example of taxiway markers at an unpaved runway.

5.2.6 Taxiway commencement markers should consist of 3 yellow cones, shaped in a small L. Similar to the L array for runway edge markers, the taxiway commencement markers will assist pilots to locate the taxiway coming off the runway, and also when leaving the aircraft parking bay for the runway. Refer to figure 5-6.

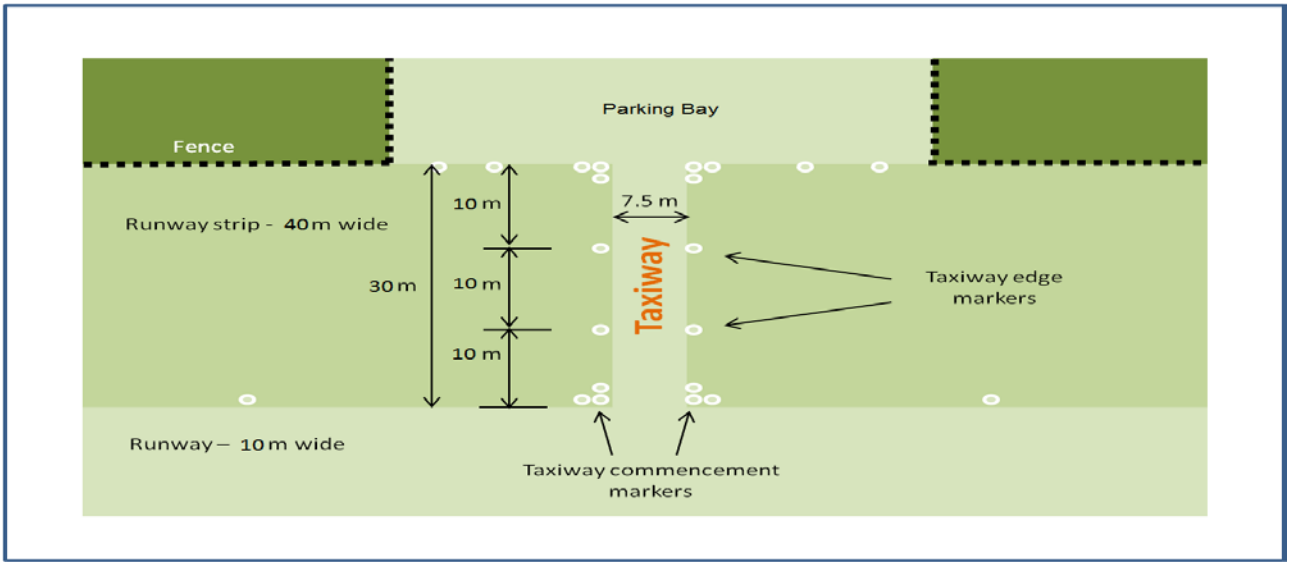


Figure 5-6. Taxiway markers on unpaved runway

CHAPTER 6 — Maintenance

6.1 Performance Standards – All Aerodromes

General

6.1.1 Aerodrome maintenance is critical to ensure that the physical characteristics outlined in Chapter 2 are preserved, and that the safety of flight operations at aerodromes is not put at risk.

6.1.2 For aerodromes in Papua New Guinea one of the most critical maintenance requirements is the control of the growth of vegetation. Long grass on runways can significantly affect aircraft performance, slowing aircraft acceleration during take-off run, and using more runway distance to reach take off safety speed. Shrubs and trees growing through the obstacle limitation surface at either end of the runway become hazards to aircraft taking off and landing.

Maintenance responsibility

6.1.3 The responsibility for maintenance is with the aerodrome operator, but can be contracted as appropriate.

Table of performance standards

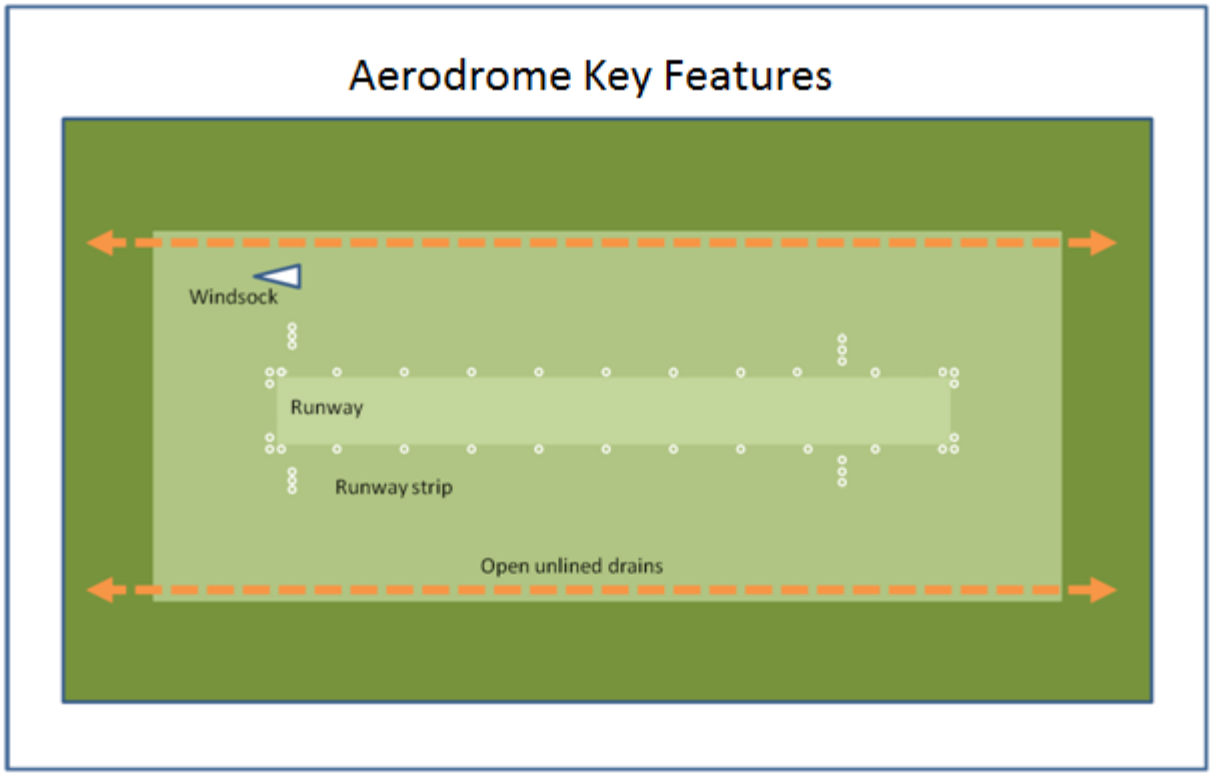
6.1.4 The following table of maintenance performance standards prescribes the standards that should be met at all non-certificated aerodromes, unless otherwise stated.

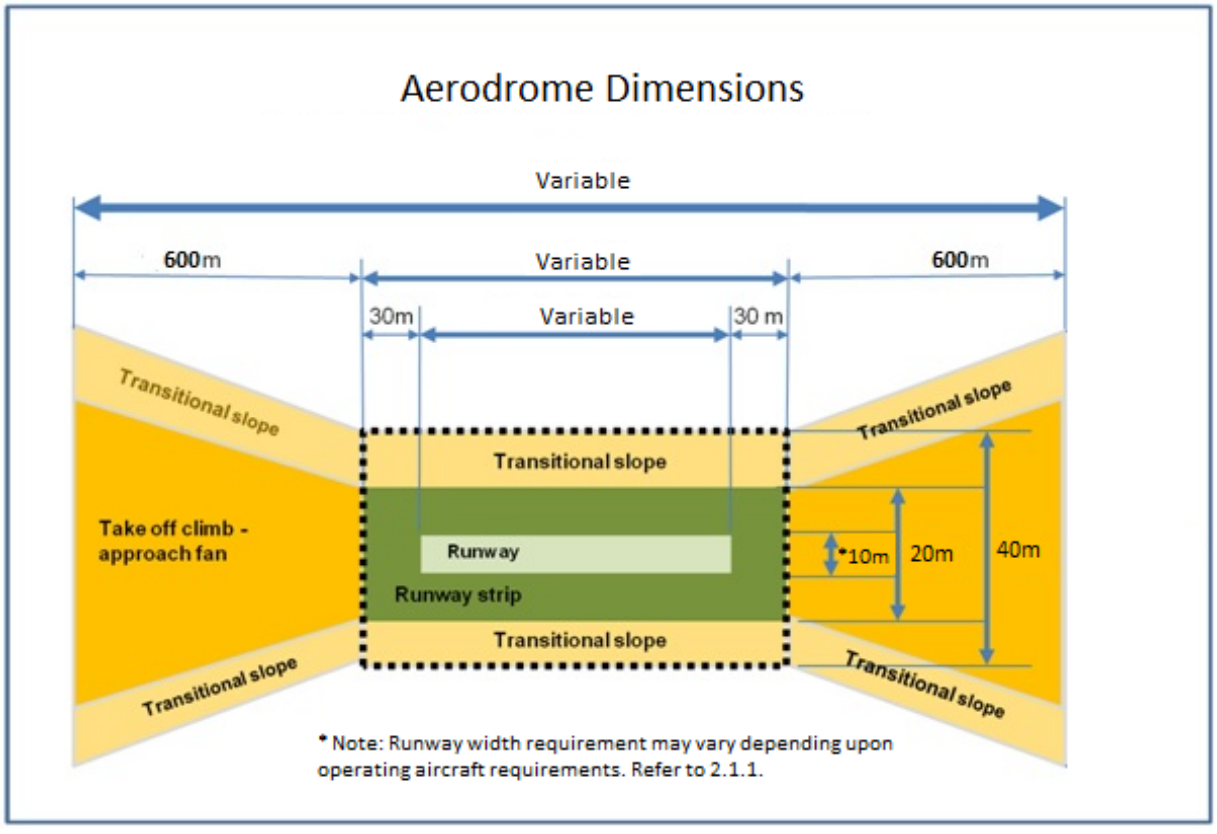
Aerodrome maintenance performance standards		
No	**Item**	**Performance standard**
1	Runway surface	Smooth and free of debris On unpaved runways, any wheel ruts or animal damage to be repaired, compacted and made smooth and even with the surrounding surface
2	Taxiway and aircraft parking bay surface	The same as for runways
3	Runway – grass height	To be maintained below 240 mm
4	Runway strip – grass height	To be maintained below 240 mm
5	Taxiway & aircraft parking bay – grass height (if applicable)	Same as for runways; maintained below 240 mm
6	Obstacle limitation surfaces	Shrubs and trees maintained below the obstacle limitation surfaces *Note - The obstacle limitation surfaces begin from the end of runway strip extending vertically and laterally at 1:20 (5%) from runway strip end.*
7	Aerodrome markers	Maintained clear of vegetation and painted. *Note – aerodrome markers include runway end markers, runway edge markers, threshold markers, taxi way markers and the aerodrome unserviceability indicator.*
8	Windsock	Sock free of tears and rips

Aerodrome maintenance performance standards		
No	**Item**	**Performance standard**
		Mast head able to easily rotate to indicate wind direction Free of surrounding vegetation that would affect airflow
9	Drainage	Free of vegetation greater than 240 mm Free of debris and soil accumulation
10	Fencing (if applicable)	Free of vegetation around fence posts and wires Maintained animal proof

Table 6.1 – Aerodrome maintenance performance standards

Appendix 1 Minimum Aerodrome Features and Dimensions





Appendix 2 –Rural Airstrip Standards: Obstacle Limitation Surfaces

No.	Items			
1	Runway Width (m)			10
2	Runway strip length (m)			variable
3	Strip Width (m)			20
4	Slopes	Longitudinal for 2-way operations	Maximum overall (%)	2.0
			Maximum any section (%)	3.0
		Longitudinal for 1-way operations	Maximum overall (%)	18
			Maximum any section (%)	20
5	OLS	Approach Areas	Width of inner edge (m)	40
			Divergence-Splay (%)	5.0
			Length (m)	600
			Maximum Gradient (%)	5.0
			Gradient Desirable (%)	5.0
		Take off Areas	Width of inner edge (m)	40
			Divergence-Splay (%)	5.0
			Length (m)	600
			Maximum Gradient (%)	5.0
			Gradient Desirable (%)	5.0
6	Transitional surfaces Slopes (%)			20.0
7	Transverse Slopes (%)			2.5

Note:

1. *Runway reference field length is dependent on the design aircraft or the aerodrome reference aeroplane that has been nominated to use the aerodrome at MCTOW, standard atmosphere, still air, sea level and zero runway slope.*
2. *Runway width requirement may vary depending upon operating aircraft requirements. Refer to 2.1.1.*