UGANDA

ADVISORY CIRCULAR

CAA-AC-AGA401

AUGUST 2022

CONTROL OF OBSTACLES

1. Purpose

The purpose of this Advisory Circular (AC) is to provide guidance to aerodrome operators, excluding heliports, on the control of obstacles at and in the vicinity of aerodromes in order to comply with the requirements of the Civil Aviation (Aerodromes) Regulations.

2. Introduction

2.1. The effective utilization of an aerodrome may be adversely influenced by natural features and manmade objects inside and outside the aerodrome boundary. Uncontrolled growth or development of such obstacles may result in limitations on the distance available for take-off and landing, higher weather minima for aircraft operations, restriction in the take-off mass and therefore the payload of aircraft, and restrictions on certain types of aircraft or the possible closure of aerodromes.

2.2. Obstacle limitation surfaces (OLS) is defined as:

"A series of surfaces that define the volume of airspace at and around an aerodrome to be kept free of obstacles in order to permit the intended aircraft operations to be conducted safely and to prevent the aerodrome from becoming unusable by the growth of obstacles around the aerodrome."

2.3. To ensure safety and efficiency of aircraft operations, certain areas of the local airspace must be regarded as integral parts of the aerodrome environment. The degree of freedom from obstacles in these areas is as important to the safe and efficient use of the aerodrome as are the more obvious physical requirements of the runways and their associated strips and runway end safety areas.

2.4. The Republic of Uganda is obliged to comply with the international requirements for the monitoring and control of obstacles as a signatory to the Convention on International Civil Aviation (Chicago 1944), under which the requirements are published in the form of standards and recommended practices in Annex 14 to the Convention, and which is adopted in full by Uganda in its Civil Aviation (Aerodromes) Regulations.

2.5. The criteria for controlling obstacles is to be based on Obstacle Limitation Surfaces (OLS) and PANS OPS surfaces as detailed in Civil Aviation (Aerodromes) Regulations and PANS

OPS Document 8168 respectively.

3. Criteria for assessment of obstacles using Civil Aviation (Aerodromes) Regulations

3.1. General

3.1.1. The broad purpose of the OLS is to define the volume of airspace that is required by the Regulations to be kept free from obstacles in order to minimise the dangers presented by obstacles to aircraft, either during an entirely visual approach or during the visual segment of an instrument approach. The OLS are based on the aerodrome reference code and thus directly related to the critical aeroplane intended to operate at a particular aerodrome.

3.1.2. The surfaces established shall allow not only for existing operations, but also for the ultimate development envisaged for each aerodrome by its operator. The OLS are permanent features of the aerodrome, and, to be effective, they must be observed by all entities involved. Such entities involved include, but are not limited to:

a) The aerodrome operator

b) The Civil Aviation authority

c) Communication companies

d) Power transmission companies

e) Local authorities

f) Other Government Organisations

g) Local industries

h) Local developers

i) Uganda Peoples Defence Force

3.1.3. The OLS provided by the Regulations for the control of obstacles include:

a) Outer Horizontal surface,

b) Inner Horizontal Surface,

c) Conical surface,

d) Approach surface,

e) Transitional surfaces,

f) Inner Approach Surface,

g) Inner Transitional Surface, and

h) Balked landing surface

i) Take-off climb surface

3.1.4. It should be noted that not all surfaces apply to all aerodromes. The operation of the aerodrome determines the applicability of the different OLS, as indicated in table 1 below.

Obstacle limitation Surface	**Non-instrument runway**	**Non-precision approach runway**	**Precision Approach Runway category I**	**Precision approach runway category II or III**	**Take-off runway**
Outer horizontal	-	Required	Required	Required	-
Conical	Required	Required	Required	Required	-
Inner horizontal	Required	Required	Required	Required	-
Approach	Required	Required	Required	Required	-
Transitional	Required	Required	Required	Required	-
Inner transitional	-	-	Required	Required	-
Inner approach	-	-	Required	Required	-
Balked landing	-	-	Required	Required	-
Take-off climb surface	-	-	-	-	Required

Table 1: Requirement for Obstacle Limitation Surfaces

3.1.5. The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in table 2 below.

Table 2: Dimensions and slopes of approach obstacle limitation surfaces

	RUNWAY CLASSIFICATION									
								Precision approach category		
	Non-instrument Code number				Non-precision approach Code number			I Code number		II or III Code number
Surface and dimensions[a]	1	2	3	4	1,2	3	4	1,2	3,4	3,4
(1)	(2)	(3)	(4)	(5)	(6) (7)		(8)	(9)	(10)	(11)
CONICAL										
Slope	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Height	35 m	55 m	75 m	100 m	60 m	75 m	100 m	60 m	100 m	100 m
INNER HORIZONTAL										
Height	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m
Radius	2 000 m	2 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m
INNER APPROACH										
Width	—	—	—	—	—	—	—	90 m	120 me	120 m[e]
Distance from threshold	—	—	—	—	—	—	—	60 m	60 m	60 m
Length	—	—	—	—	—	—	—	900 m	900 m	900 m
Slope								2.5%	2%	2%
APPROACH										
Length of inner edge	60 m	80 m	150 m	150 m	140 m	280 m	280 m	140 m	280 m	280 m
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
First section										
Length	1 600 m	2 500 m	3 000 m	3 000 m	2 500 m	3 000 m	3 000 m	3 000 m	3 000 m	3 000 m
Slope	5%	4%	3.33%	2.5%	3.33%	2%	2%	2.5%	2%	2%
Second section										
Length	—	—	—	—	—	3 600 m[b]	3 600 m[b]	12 000 m	3 600 mb	3 600 m[b]
Slope	—	—	—	—	—	2.5%	2.5%	3%	2.5%	2.5%

Horizontal section										
Length	—	—	—	—	—	8 400 m[b]	8 400 m[b]	—	8 400 mb	8 400 m[b]
Total length	—	—	—	—	—	15 000 m	15 000 m	15 000 m	15 000 m	15 000 m
TRANSITIONAL										
Slope	20%	20%	14.3%	14.3%	20%	14.3%	14.3%	14.3%	14.3%	14.3%
INNER TRANSITIONAL										
Slope	—	—	—	—	—	—	—	40%	33.3%	33.3%
BALKED LANDING SURFACE										
Length of inner edge	—	—	—	—	—	—	—	90 m	120 me	120 m[e]
Distance from threshold	—	—	—	—	—	—	—	c	1 800 md	1 800 m[d]
Divergence (each side)	—	—	—	—	—	—	—	10%	10%	10%
Slope	—	—	—	—	—	—	—	4%	3.33%	3.33%

3.1.6. Significant operational problems can arise from the erection of tall structures in the vicinity of aerodromes beyond the areas currently recognised in the Regulations as areas in which restriction of new construction may be necessary. The operational implications fall broadly under the headings of safety and efficiency.

3.1.7. In view of these potentially important operational considerations, aerodrome operators are required to adopt measures to ensure that they have advance notice of any proposals to erect tall structures. This will enable them to study the aeronautical implications and take such action as may be at their disposal to protect aviation interests.

3.2. Description of the Obstacle Limitation Surfaces

4.2.1 The outer horizontal surface

4.2.1.1 This surface represents the level above which consideration needs to be given to the control of new obstacles in order to facilitate practicable and efficient instrument approach procedures, and, together with the conical and inner horizontal surfaces, to ensure the availability of safe visual maneuvering in the vicinity of an aerodrome. An outer horizontal surface is established for every aerodrome where the aerodrome reference code is 3 or 4.For aerodrome reference codes 3 and 4, the outer horizontal surface extends from the outer and upper periphery of the conical surface to a minimum radius of 15 000 m from the aerodrome reference point.

A diagrammatic view of the outer horizontal surface and its connecting surfaces down to the runway strip is shown in figure 2 below.

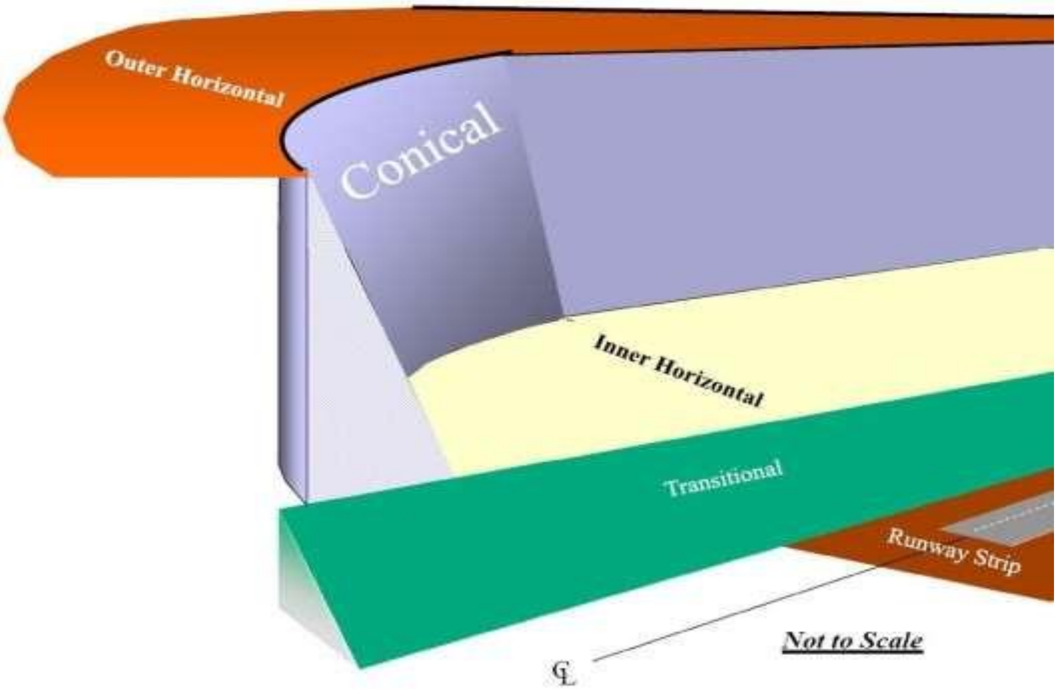


Figure 1: Outer, conical, inner horizontal and transitional surfaces.

4.2.1.2 As a broad specification for the outer horizontal surface, tall structures can be considered to be of possible significance if they are higher than 30 m above local ground level, or higher than 150 m above aerodrome elevation within a radius of 15 000 m of the centre of the aerodrome where the runway code number is 3 or 4. The area of concern may need to be extended to coincide with the obstacle-accountable areas of PANS OPS for the individual approach procedures at the aerodrome under consideration, see section 5 below.

It is particularly desirable to carefully consider the erection of high masts, skeletal structures and power transmission lines in areas which would otherwise be suitable for use by aircraft on wide visual circuits, on arrival routes towards the aerodrome or circuit, or on departure or missed approach climb-paths. Avoidance by marking or lighting cannot be relied upon in view of the relatively inconspicuous character of these structures, especially in conditions of reduced visibility such as in rain or mist, and notification to pilots of their existence will similarly not guarantee avoidance of a collision.

4.2.2 Inner Horizontal Surface and Conical Surfaces

4.2.2.1 The purpose of the conical and inner horizontal surfaces is to protect airspace for visual circling prior to landing, possibly after a descent through cloud aligned with a runway other than that in use for landing. An inner horizontal surface is established for every aerodrome. Whilst visual circling protection for slower aircraft using shorter runways may be achieved by a single circular inner horizontal surface, with an increase in speed it becomes essential to adopt a race-track pattern and use circular arcs centred on runway strip ends joined tangentially by straight lines, as illustrated below. To protect two or more runways, a more complex pattern becomes necessary, involving four or more circular arcs, as shown in the figures below.

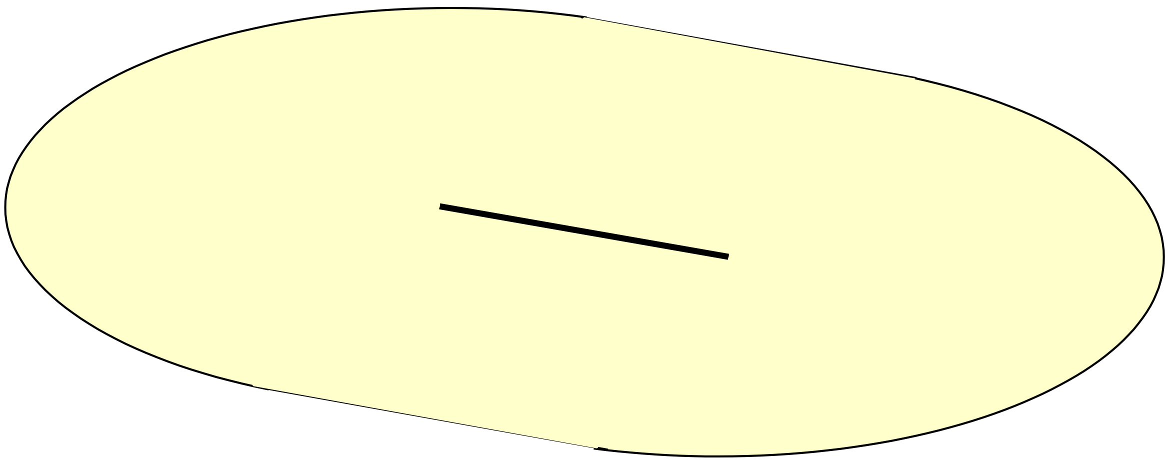


Figure 2: Inner horizontal surface (only) layout, single runway

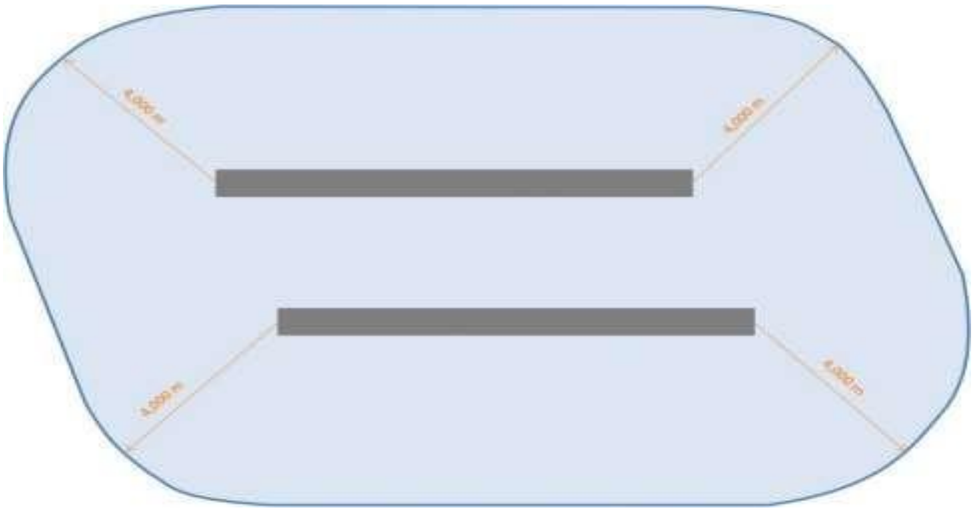


Figure 3: Inner horizontal surface (only) layout, staggered parallel runways

4.2.2.2 The height of the inner horizontal surface is 45m above the mid-point of the lowest runway threshold existing or proposed for the aerodrome.

Conical surface

4.2.2.3 A conical surface is established for every aerodrome. The conical surface continues upward and outward from the outer edge of the inner horizontal surface, as illustrated below. It connects with the outer horizontal surface, where provided for code 3 and 4 aerodromes, at a height above aerodrome elevation of 100m. At code 1 and 2 aerodromes it continues to the height above aerodrome elevation as indicated in the Regulations. The conical surface represents the level above which consideration needs to be given to the control of new obstructions and the removal or marking of existing obstructions so as to ensure safe visual maneuvering in the vicinity of an aerodrome. The slope of the conical surface measured in the vertical plane above the horizontal is 5% (1:20).

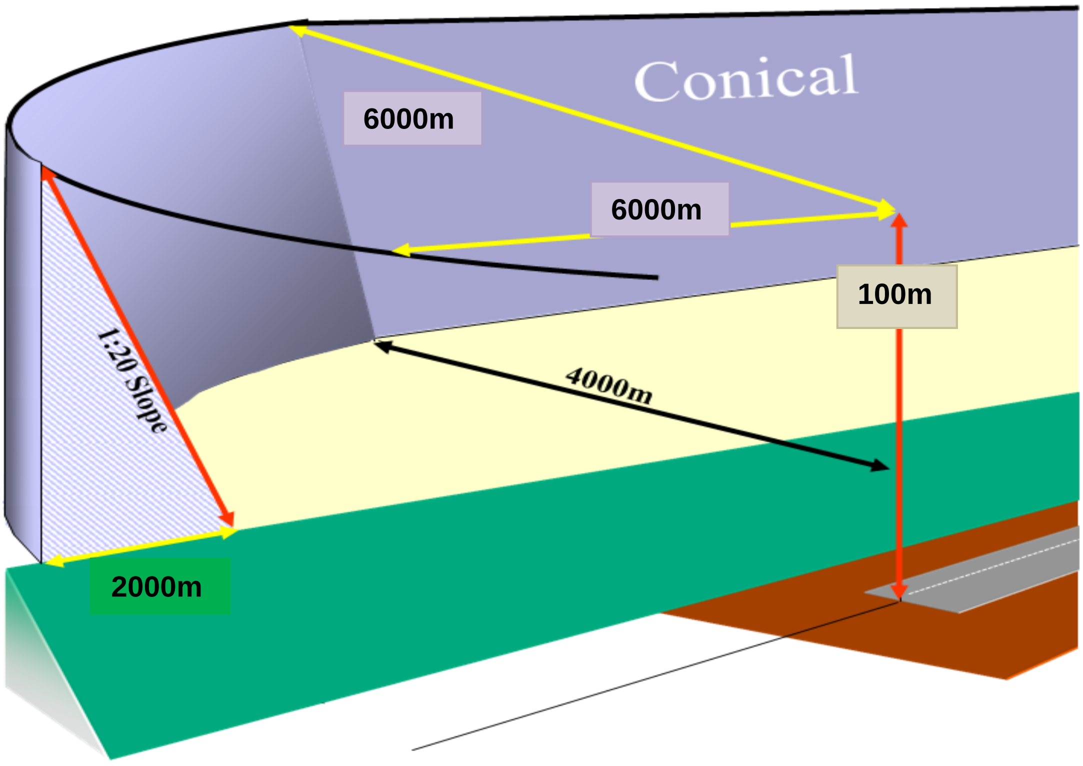


Figure 4: Conical surface dimensions and connection to inner horizontal surface

4.2.3 Approach and Transitional Surfaces

4.2.3.1 Approach and transitional surfaces are established for every aerodrome. They define the volume of airspace that should be kept free from obstacles to protect an aeroplane in the final phase of the approach- to-land and manoeuvre in the event of any disruption to a straight flight path immediately after take-off. Such deviations from centreline are illustrated overleaf.

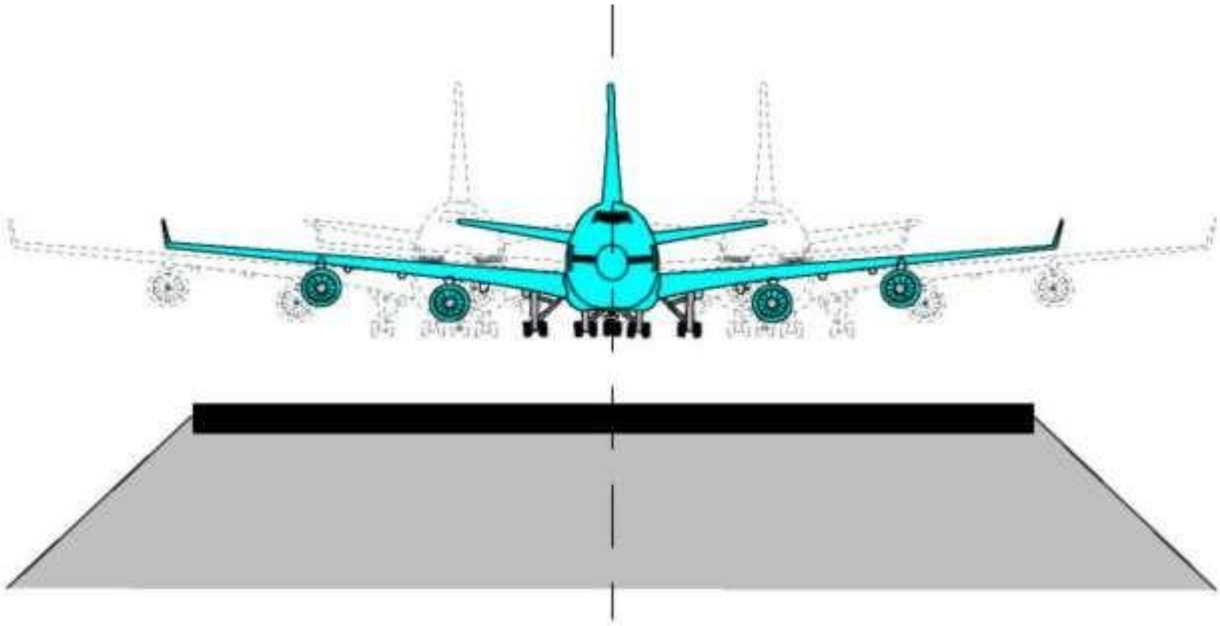


Figure 5: Deviation from centreline after a balked landing

4.2.3.2 The transitional surface is a complex surface sloping up to the inner horizontal surface from the side of the runway strip and from part of the side of the approach surface. It starts at the elevation of the runway centreline, following the profile of the runway centreline. Hence, it is a complex surface that is usually not level at either its base along the strip edge or its upper edge at the inner horizontal surface. The transitional surface must be clear of obstacles, except for approved (by the Directorate of Safety, Security and Economic Regulation) frangible, marked and lit obstacles that must be located within the transitional surface for safety or navigational purposes. The slopes and dimensions of approach and transitional surfaces will vary with the aerodrome reference code and whether the runway is used for visual, non-precision or precision approaches, as stated in the Regulations, and are illustrated below for an instrument approach code 4 runway. The plan and sectional views of the transitional, and approach surfaces is shown below.

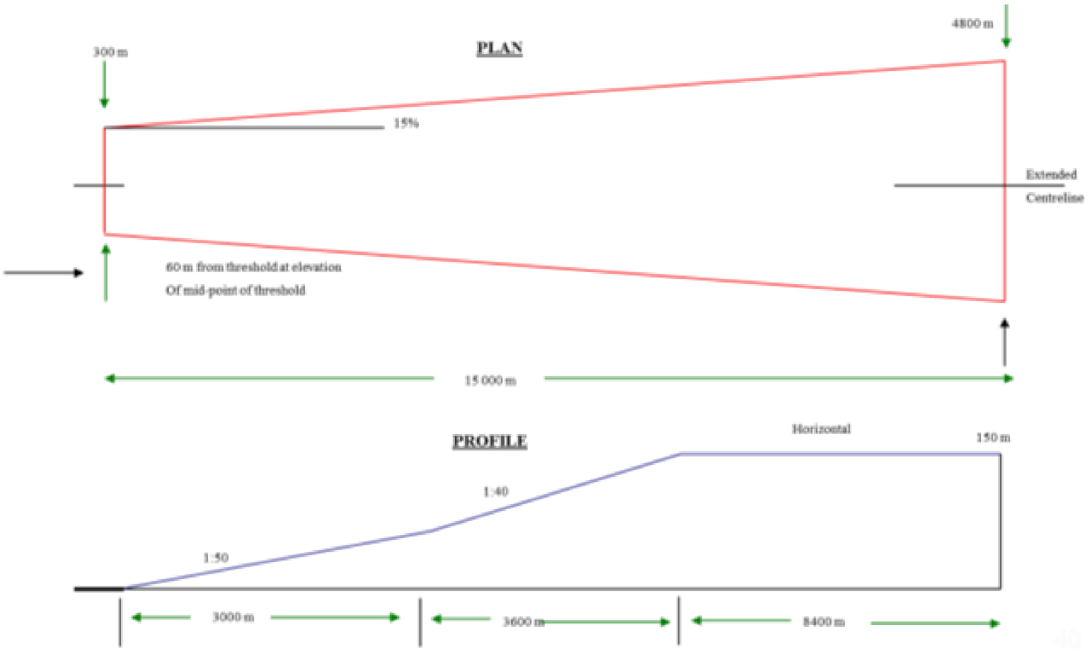


Figure 6: Approach surface plan and profile view, sample: Instrument runway code 4

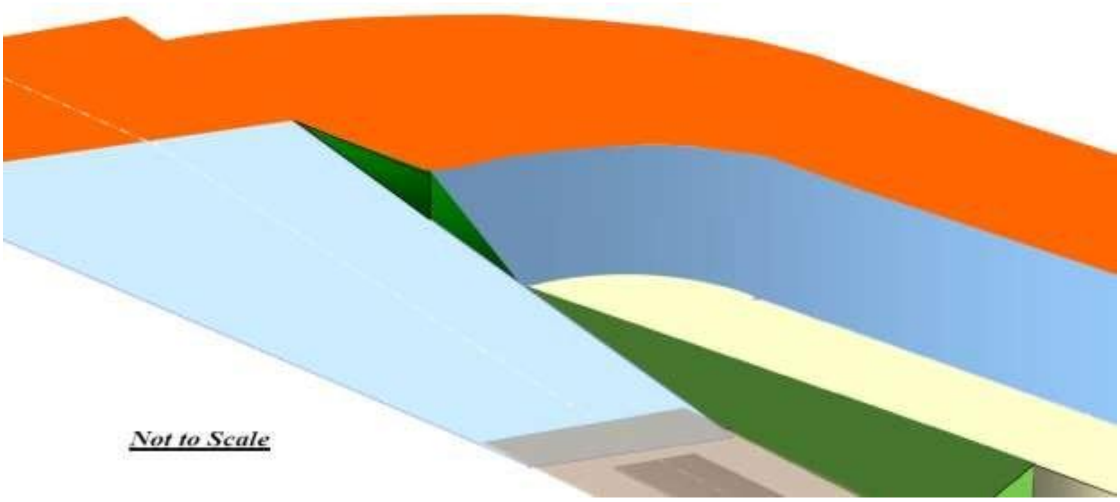


Figure 7: Approach surface within the transitional, inner horizontal, conical and outer horizontal surfaces.

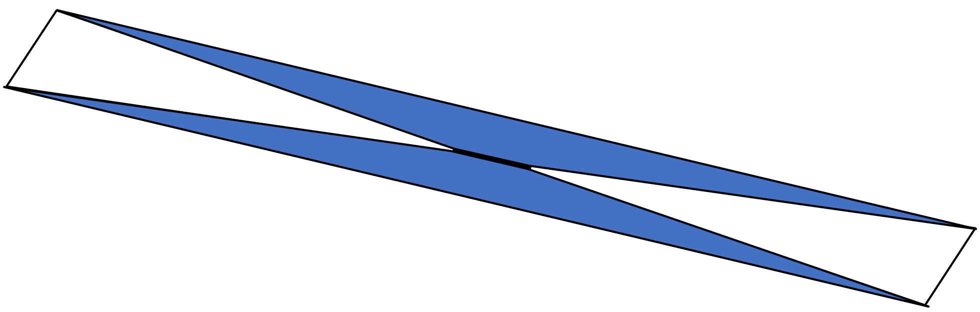


Figure 8: approach and transitional surface, plan view

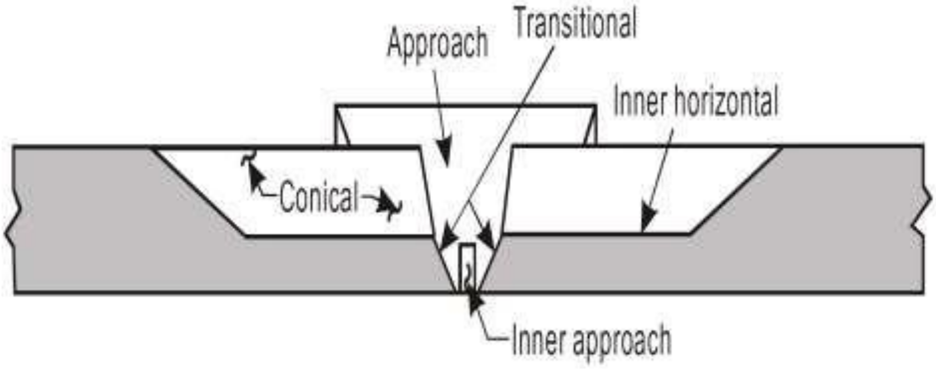


Figure 9: Looking back down the runway towards the approach surface

4.2.4 Obstacle free zone

4.2.4.1 Obstacle free zones are established for all aerodromes with a precision instrument approach runway. Together, the Inner Approach, Inner Transitional and Balked Landing surfaces define a volume of airspace in the immediate vicinity of a precision approach runway, such as a Cat 1 ILS approach, which is known as the obstacle-free zone (OFZ). The OFZ is intended to afford aeroplanes protection from obstacles when approaches are continued below the Decision Height and throughout a subsequent missed approach, with all engines operating normally, until a point is reached at which other prescribed obstacle clearance surfaces become effective. The balked landing scenario is illustrated below. The OFZ shall be kept free from fixed objects, other than lightweight frangible aids that are essential to air navigation or safety which must be near the runway to perform their function, and from transient objects such as aircraft and vehicles when the runway is being used for category II or III ILS approaches. When an OFZ is established for a precision approach runway category I, it shall be clear of such objects when the runway is used for category I ILS approaches.

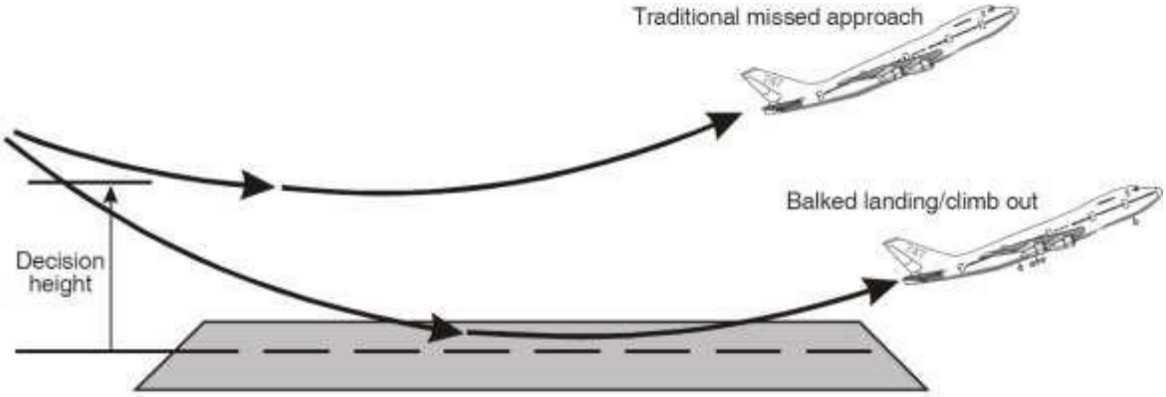


Figure 10: Lower height of an aircraft after a balked landing

4.2.4.2 The OFZ provided on a precision approach runway where the code number is 3 or 4 is designed to protect an aeroplane with a wingspan of 65 m on a precision approach below a height of 30 m having been correctly aligned with the runway at that height, to climb at a gradient of 3.33 per cent and diverge from the runway centreline at a splay no greater than 10 per cent. The gradient of 3.33 per cent is the lowest permitted for an all-engine-operating balked landing. A horizontal distance of 1,800 m from threshold to the start of the balked landing surface assumes that the latest point for a pilot to initiate a balked landing is the end of the touchdown zone lighting, and that changes to aircraft configuration to achieve a positive climb gradient will normally require a further distance of 900 m which is equivalent to a maximum time of about 15 seconds. A slope of 33.33 per cent for the inner transitional surfaces results from a 3.33 per cent climb gradient with a splay of I0 per cent. Aerodromes with precision instrument approaches for use by aeroplanes in approach categories F with a wing span up to 80m the width is increased from 120m to 155m, as shown overleaf. The sectional, plan and profile views of the OFZ are illustrated.

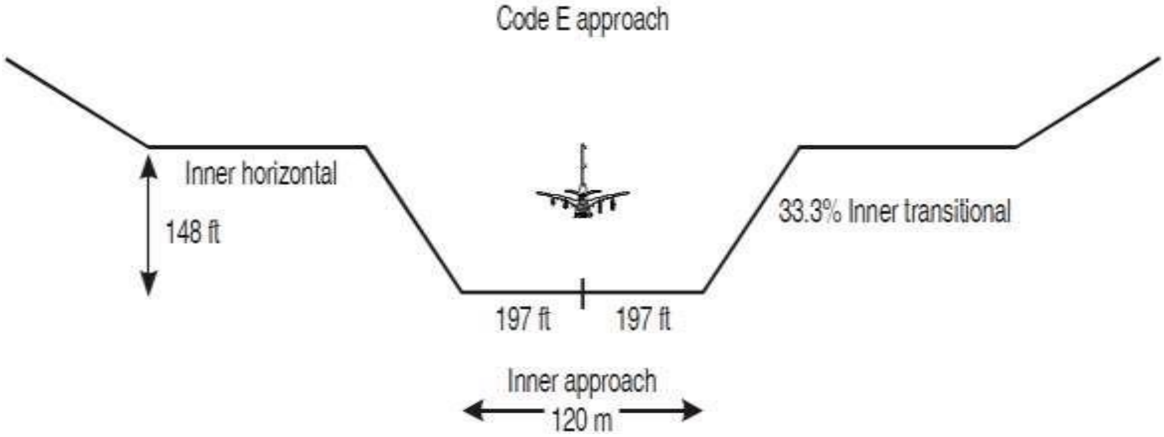


Figure 11: Obstacle free zone, section view (Code E)

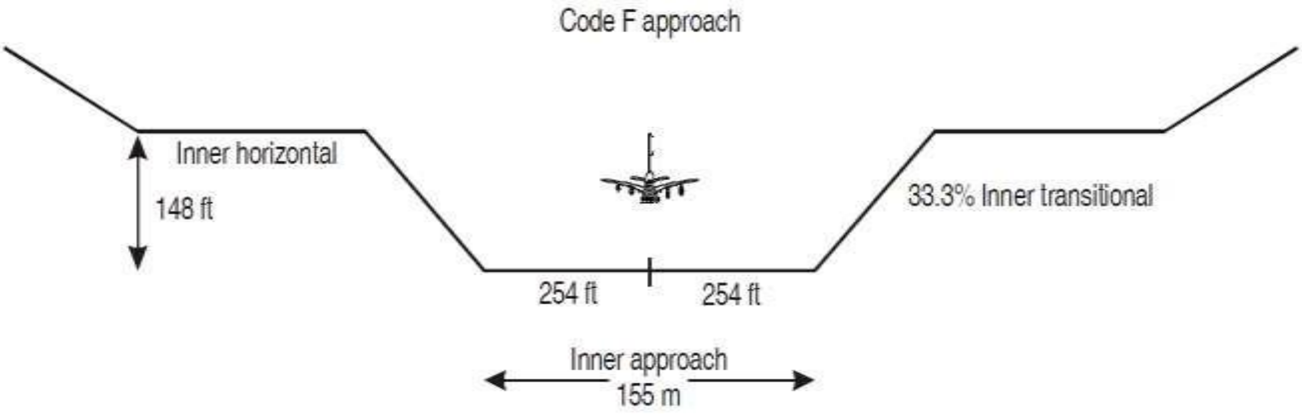


Figure 12: Obstacle free zone, section view (Code F)

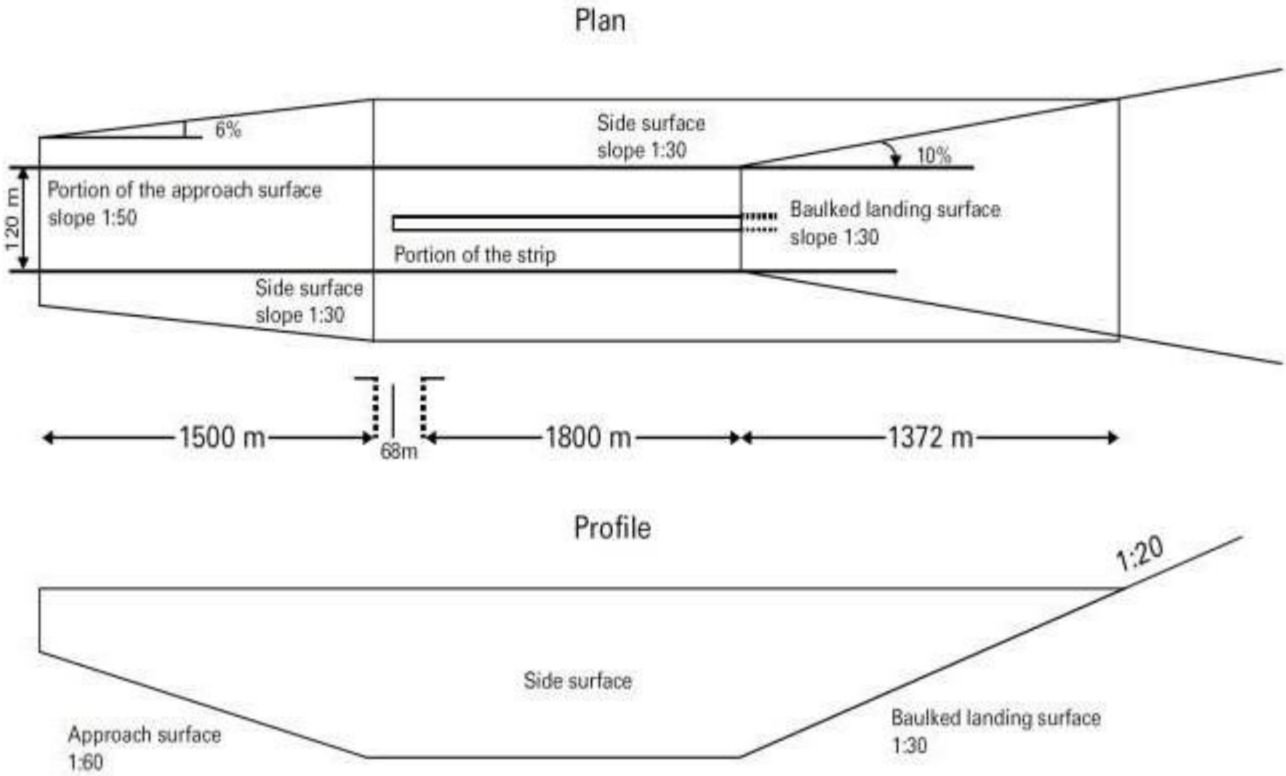


Figure 13: Obstacle free zone plan and longitudinal profile view, sample.

4.2.5 Take off Climb Surfaces

4.2.5.1 A take-off climb surface is established for every aerodrome, and for every take-off runway. The take off and climb surface provides protection for an aircraft on take-off by indicating which obstacles should be prevented and removed. The slopes and dimensions will vary with the aerodrome reference code, but are NOT dependent on instrument or non-instrument status of the approaches. There is no transitional surface associated with the take-off climb surface.

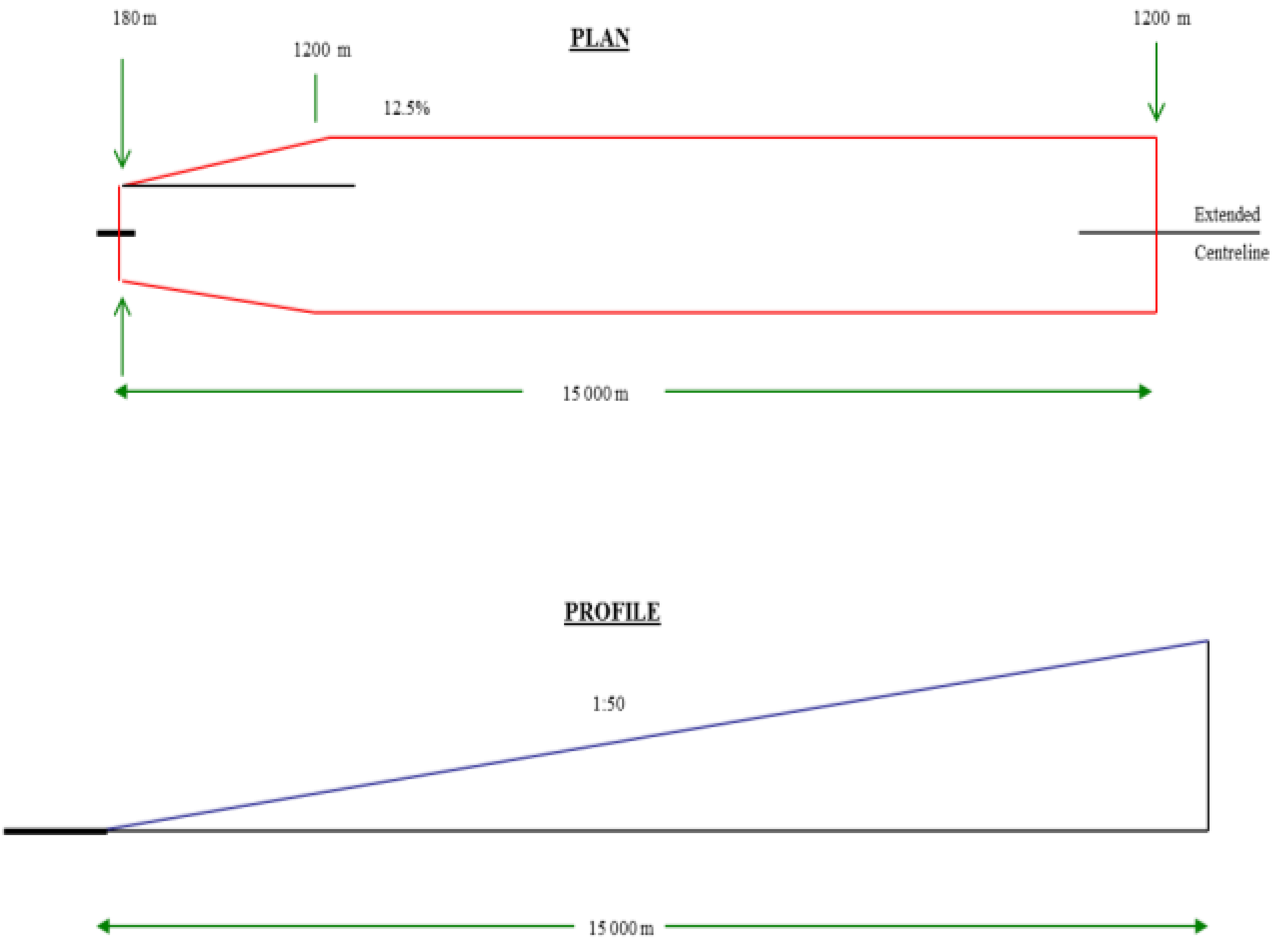


Figure 14: Take-off climb surface plan and profile views for code 4 runway

4.2.6 ICAO Type A Chart Surface

4.2.6.1 In addition to the Obstacle Limitation Surfaces, an additional surface is established and published for all aerodromes regularly or intended to be used by International Civil Aviation. A Type A Chart is provided for all such aerodromes, except for those aerodromes where there are no obstacles in the take-off flight path areas or where an Aerodrome Terrain and Obstacle Chart - ICAO (Electronic) is provided. An aerodrome operator may choose to safeguard its aerodrome to the more demanding slope limitations of the Type A chart surface in order to protect the aerodromes operation or future development. Obstacles that infringe the Type A Chart surface, but that do not infringe the approach or take-off climb surface above the Type A Chart surface do not affect the certification status of the aerodrome, but must be published in the Type A chart in the AIP, or the electronic Aerodrome Terrain and Obstacle Chart. Such publication enables an aircraft operator to comply with its operating limitations obligations. A sample type A chart is illustrated below, for Entebbe.

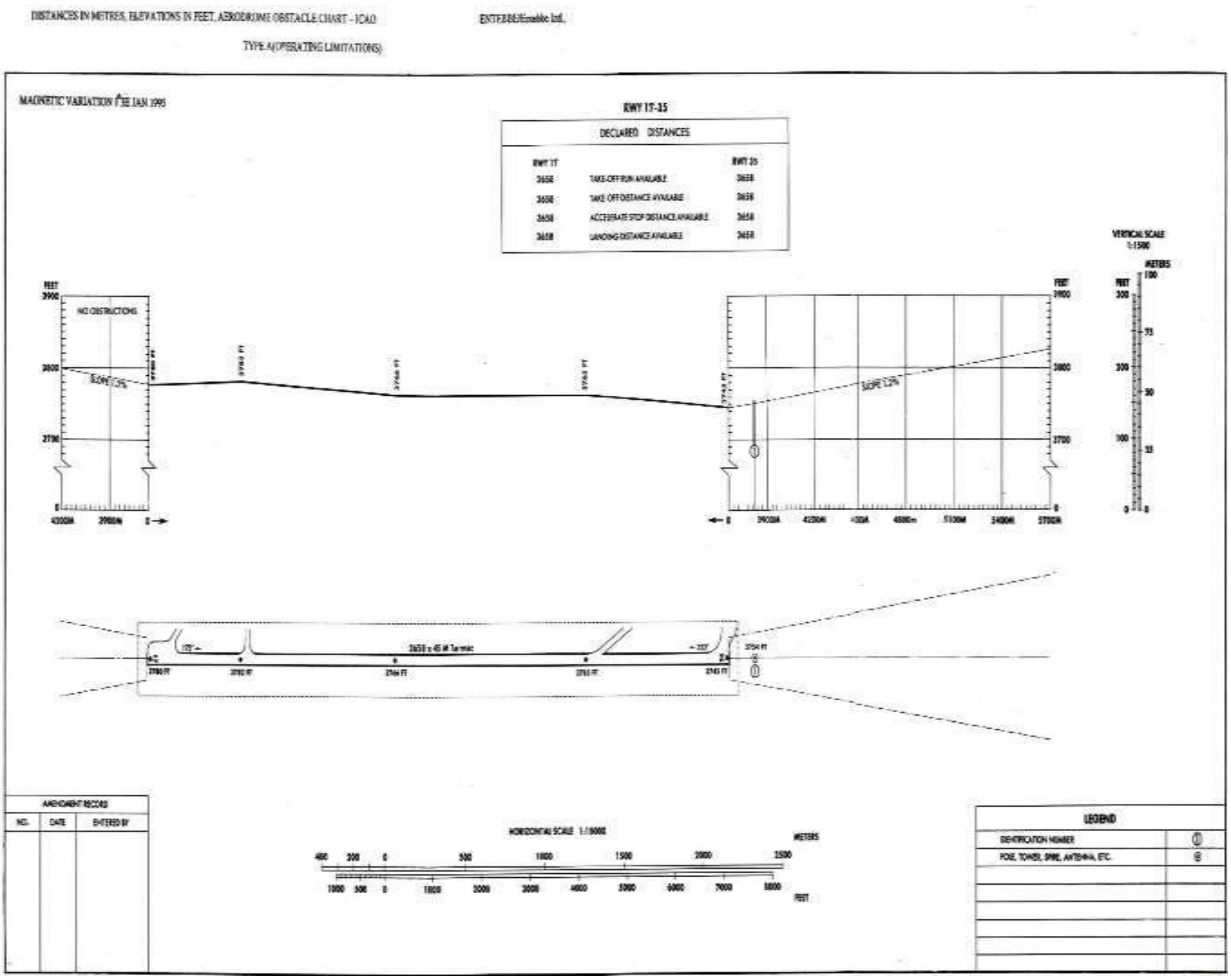


Figure 15: Sample ICAO Type A Chart

3.3. Establishment of obstacle limitation surfaces

The aerodrome operator shall establish the obstacle limitation surfaces and include such details in its aerodrome manual in accordance with the First Schedule to the Civil Aviation (Aerodromes) Regulations, and provide the Directorate of Safety Security and Economic Regulation, and local districts with pertinent information about the aerodrome, including: location, orientation, length and elevation of all runways; Aerodrome reference code of each runway; locations and elevations of all reference points used in establishing obstacle limitation surfaces; proposed categories of runway use - non-instrument, non-precision approach or precision approach (category I, II or III) plans for future runway extension or change in category. It is desirable to base all obstacle limitation surfaces on the most critical aerodrome design features anticipated for future development. This protects the airspace and obstacle environment for such future development. A plan view of the composite obstacle limitation surfaces is illustrated overleaf.

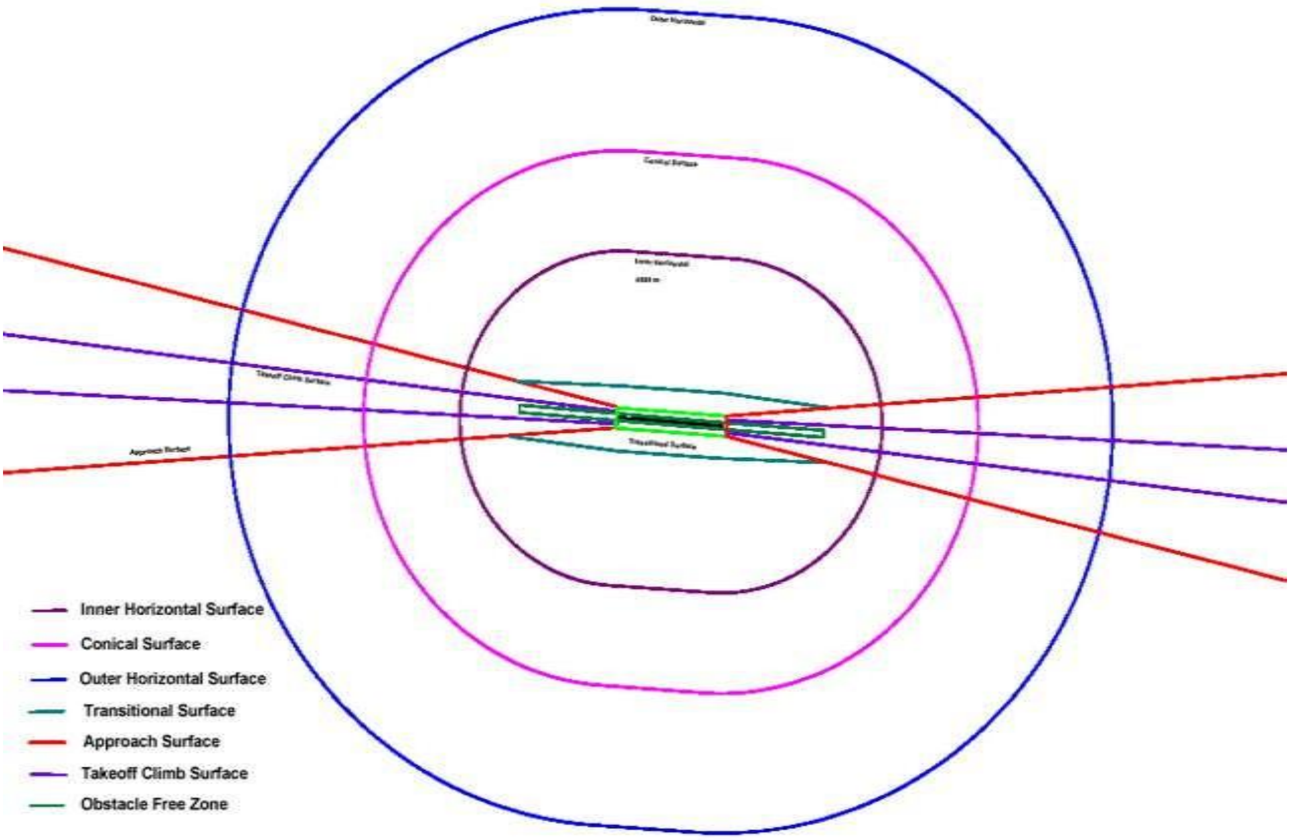


Figure 16: Obstacle limitation surfaces

5 Criteria for assessment of obstacles using PANS OPS surfaces

5.1 General

5.1.2 PANS OPS surfaces are implemented at aerodromes with instrument approach and/or departure or arrival procedures, whether using traditional land based navigation aids such as VOR or satellite based procedures such as PBN.

5.1.3 The PANS OPS surfaces specify areas used by aircraft in holding, approach, visual circling and missed approach and enable aerodrome operators to institute obstacle control measures beyond the above detailed Civil Aviation (Aerodromes) Regulations surfaces in order to accommodate current and future demands in instrument approach. Missed approach and departure operations.

5.1.4 The PANS OPS surfaces are intended for use by instrument flight procedure designers in the construction of instrument flight procedures and for specifying minimum safe altitudes and heights in order to safeguard aeroplanes from collision with obstacles when flying on instruments, and include the procedure design for the following instrument approach procedures:

a) Holding procedure

b) Standard arrival,

c) Instrument approach, such as ILS, VOR, VOR/DME, NDB, NDB/DME, PBN

d) Visual circling;

e) Missed approach

f) Standard instrument departure

g) Radar approach

5.1.5 Within the above procedures there may be several segments each with different criteria for obstacle separation, some of which will be stricter than the limitations imposed by the obstacle limitation surfaces.

5.1.6 Where an aerodrome has such instrument procedures, the aerodrome operator should employ or contract a competent instrument flight procedure designer to both maintain these procedures, and also to provide the technical support necessary to supplement the obstacle limitation surface, Type A chart surface limitations for the aerodrome.

5.2 Visual manoeuvring (circling procedure)

5.2.1 Visual manoeuvring described in the PANS OPS, is a visual extension of an instrument approach procedure. The size of the area for a visual manoeuvring varies with the speed of aircraft, as illustrated below. Where a prominent obstacle exists, it will be necessary to eliminate from consideration a particular sector by establishing appropriate operational procedures.

5.2.2 The size of the area will be considerably larger than that covered by the inner horizontal, conical and outer horizontal surfaces. Therefore, circling altitudes/heights calculated according to PANS OPS for actual operations at an aerodrome may need to be increased if obstacle in these areas have not been adequately controlled. These circling areas for different speed categories of aircraft are illustrated below;

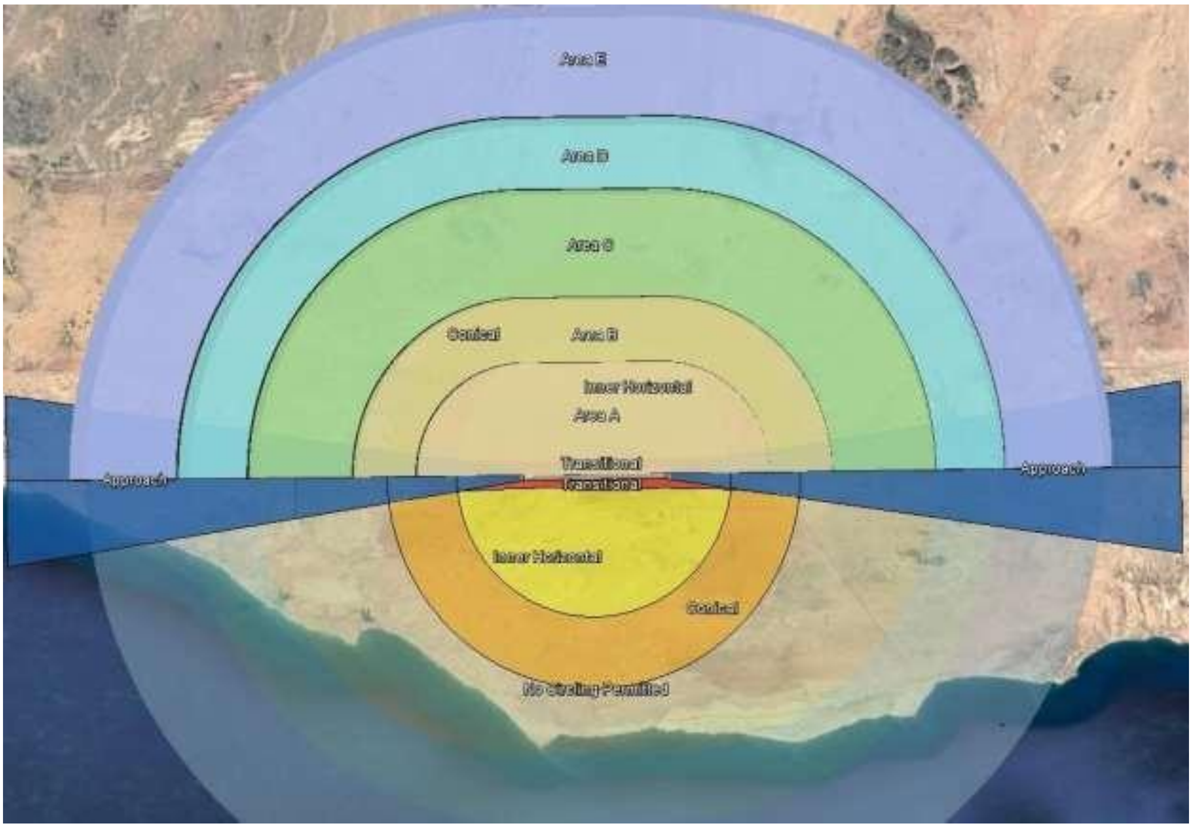


Figure 17: Circling areas (aircraft categories A to E)

5.2.3 Therefore, the aerodrome operator of aerodromes with instrument flight procedures existing or planned, must protect the PANS OPS surfaces from penetration by obstacles, regardless of whether or not they penetrate an Aerodrome Regulation obstacle limitation surface, as such obstacles may result in an operational penalty

6 Protection of navigation and radio aids

6.1 General

6.1.2 Electronic devices used for both air navigation and aeronautical radio and digital communication must be protected to ensure that they function correctly. Generally, this protection is to ensure that there is a clear line-of-sight between the transmitter or receiver and the aircraft that is using it.

6.1.3 This protection applies to all radio, navigation and other aeronautical electronic aids, including:

a) Instrument landing systems (ILS) transmitters and monitors

b) Distance measuring equipment (DME) transceivers

c) Very high frequency Omni - range (VOR) transmitters

d) VHF AM radio transmitters and receivers

e) Non Directional beacons (NDB)

6.1.4 The protection required is not just the limitation of obstacles, but also the avoidance of radio interference such as from VHF AM and FM transmissions, reflection of radio waves from buildings or other structures, electromagnetic interference, and the effect of wind generators on radar and VORs. Every aeronautical radio station requires a technical area to be safeguarded against the possibility that buildings or other structures erected within the safeguarded area cause interference to the signal radiated or received by that station. The size of the areas to be restricted, critical and sensitive areas, depends on a number of factors including the type of antenna, the topography, and the size and orientation of any man-made objects. Sample dimensions for these protection areas are listed here:

a) VOR and co-located DME: At ground level a circle of 230 metres radius from the site centre with a further slope at 2% (1:50) out to 900 metres radially from the site centre.

b) DME not co-located with a VOR: a 2% (1:50) slope surface originating at the site ground level extending 300 metres radially.

c) VHF / UHF Receivers / Transmitters: Ground level safeguarding of circle radius 91 metres centred on the base of the main aerial tower (or equivalent structure). Additionally, from an elevation of 9 metres on this circle a 2% (1:50) slope out to a radius of 610 metres.

d) NDB: From the centre of the aerial, at a height of 5 metres out to 30 metres radius, with a further slope to a height of 14 metres above ground, out to 90 metres radius. In addition, live NDB masts present an electrocution hazard to persons.

e) Radar, including 10 cm, 23 cm, 50 cm and secondary surveillance radar (SSR): The radar system must be safeguarded with criteria based upon operational range, base of coverage, operational usage, and the radar equipment manufacturer's recommended clearances to prevent deterioration of the system's performance. This will include the following for all radar systems:

i. A precisely defined Sterile Zone around the antenna with respect to a clear reference point on the antenna to permit clean, uninterrupted beam formation, and which should be derived from the vertical and horizontal beam patterns of the antenna type, and be specified by both vertical and horizontal extents.

ii. A safeguarded slope of specified gradient that should be defined around the system which shall assure the system's performance such that it continues to support the operational requirement;

iii. The criteria should also include consideration of the construction, shape, location, orientation and materials used in any application

6.1.5 The above are only examples, the aerodrome and air navigation service operators will need to obtain specific criteria from the manufacturer or supplier of their equipment.

7 Wind farms

The height and location of a wind farm, or even a single wind generator turbine, has the potential to become an obstacle within the safeguarding surfaces and interfere with electronic navigation aids (radar and VOR). The aerodrome and air navigation service operator must consider the construction of any wind turbine within a range of 30 km of an aerodrome, VOR or radar installation.

8 Aeronautical Ground Lighting

8.1 Aeronautical ground lighting, whether within the aerodrome boundary, or, as may be the case with approach lights, outside the boundary, can be affected in several ways:

a) Obstruction between the light source and the aircraft

b) Dilution of the light source by glare from other lights, such as floodlights on sports field, or street lights.

c) Confusion, such as a row of street lights parallel with, or before a runway with edge lights.

d) Dazzle to either pilots or air traffic controllers

8.2 The solution in many cases is to ensure that such lights are designed and installed with a horizontal cut-off of light so that light from non-aeronautical lighting in the vicinity of an aerodrome that is used at night does not shine above the horizontal.

9 Other developments

Such developments include:

- waste disposal sites,
- reservoirs, or other water features,
- wetlands,

- sewage works,
- major landscaping schemes,
- bird sanctuaries,
- nature reserves,
- food processing plants

10 Use of cranes

Should a crane be used within 6 km of the aerodrome and its height exceeds 10 m or that of the surrounding structures or trees or the heights shown on the safeguarding map, the crane operator should seek permission from the aerodrome operator, preferably giving one month’s notice. It may be necessary for the crane to be marked, flagged and/or lit, and to be lowered for certain aircraft movements if it would create a hazard to aircraft.

11 Roads or rail vehicles crossing the Approach and take off paths

Road or rail vehicles that cross the approach and take-off climb paths of an aerodrome, may be potential obstructions to aircraft. In assessing obstacle control, the aerodrome operator should consider a road or railway to be a mobile obstruction of 5.4 metres. Road signs, signal gantries, lighting poles and other associated structures should also be the subject of assessment appropriate to their height.

12 Controlling obstacles at an Aerodrome

12.1 General Principles

12.1.1 All of the above factors should be considered by an aerodrome operator in its assessment of obstacles on and in the vicinity of an aerodrome.

12.1.2 Pursuant to the Aerodromes (Control of Obstructions) Act the Minister may impose prohibitions or restrictions on the use of any area of land or water in the vicinity of aerodromes as may be necessary to ensure safe and efficient aircraft operations. This can be effective for up to 40km from the runway(s) if instrument approach procedures are involved.

12.1.3 The ultimate responsibility for limitation and control of obstacles must, rest with the aerodrome operator. This includes the responsibility for controlling obstacles on aerodrome property and for arranging the removal or lowering of existing obstacles outside the aerodrome boundaries.

12.1.4 Each aerodrome operator should designate a member of his staff to be both the focal point for enquiries and also to be responsible for monitoring the growth of obstacles at and in the vicinity of aerodromes and coordinate with local authorities prevent unauthorized growth of obstacles.

12.1.5 The aerodrome operator should establish a programme of regular and frequent visual inspections of all areas around the aerodrome in order to be sure that any construction activity or natural growth (i.e. trees) likely to infringe any of the obstacle limitation surfaces is discovered before it may become a problem and cause restrictions to the runway operation.

12.2 The obstacle control process

The aerodrome operator should minimally consider the following elements for its obstacle control process:

(a) Frequency and timing of obstacle surveys;

(b) Marking and lighting of obstacles other than natural growths;

(c) Staff competency and training;

(d) Calibration of equipment required for obstacle surveys;

(e) Conduct of day obstacle surveys;

(f) Conduct of night obstacle surveys;

(g) Documentation and follow-ups;

(h) Promulgation of information on obstacles; and

(i) Obstacle data analysis and continuous improvement.

12.2.1 Frequency and timing of obstacle surveys

The aerodrome operator should conduct regular day and night obstacle surveys within his aerodrome and its vicinity, and should consider, but not limited to, the following when determining the frequency and timing of such surveys:

a) Locations and types of activities e.g. construction works, operating or
b) flying a kite or model aircraft;
c) Timing at which the activities are being carried out;
d) Area of coverage and scope of each survey;
e) For tree surveys, the species of natural growths (e.g. species of trees); and
f) Records on previous penetrations, non-compliances and / or unauthorized aerial activities.

12.2.2 Marking and lighting of obstacles other than natural growths

The aerodrome operator should make every effort to have the obstacles removed or reduced in height so that they no longer pose danger to aircraft operations.

Where it is impractical to remove an obstacle or to have an obstacle reduced in height, it should be appropriately marked and / or lit so as to be clearly visible to pilots in all weather and visibility conditions. The Civil Aviation (Aerodromes) Regulations contains detailed requirements concerning marking and / or lighting of obstacles.

It should be noted that the marking and lighting of obstacles is intended to reduce hazards to aircraft by indicating their presence. It does not necessarily reduce operating limitations which may be imposed by the obstacle.

Vehicles and other mobile objects, excluding aircraft, on movement area of an aerodrome are obstacles and should be marked and if the vehicles and aerodrome are used at night or in conditions of low visibility, lighted, except that aircraft servicing equipment and vehicles used only on aprons may be exempt.

The airport operator should inspect all obstacle lights and markings within the aerodrome and its vicinity, and take necessary steps to have unserviceable lights repaired or replaced, and faded markings painted or replaced.

12.2.3 Staff competency and training

In this regard, for obstacle control within the aerodrome and its vicinity, the aerodrome operator is to ensure that his staff is able to perform the surveys competently through sufficient and appropriate training.

The aerodrome operator should put in place a formal and structured training programme for his staff involved in obstacle control. The training programme should include recurrent training so as to keep the staff updated on new knowledge and technology which may enhance his work.

The relevant aerodrome staff should also be conversant with the following:

a) Correct use of equipment as required for the obstacle surveys;
b) Familiar with the aerodrome layout and its surroundings;
c) Identify different types of tall construction equipment used at sites;
d) Identify different species of trees and their characteristics found within the aerodrome and its vicinity;
e) Read obstacle charts and be able to accurately relate obstacles in the chart to their actual ground locations;
f) Calculate and measure the range and bearing of an obstacle from the aerodrome reference point; and
g) Promulgate a Notice to Airmen (NOTAM) to inform air traffic service and pilots of an obstacle and its location.

12.2.4 Calibration of equipment required for obstacle surveys

The equipment required for obstacle surveys such as height measuring equipment and Global Positioning System (GPS) device should be calibrated to ensure its accuracy and integrity before using. In most cases, calibration may be done in-house i.e. by the aerodrome staff. Hence, the staff should be familiar with the self-calibration process. In other cases, calibration can only be done by the manufacturer. In this regard, the equipment should be sent to the manufacturer for calibration as recommended before its due date.

The aerodrome staff should ensure that the equipment is properly calibrated at all times and its calibration records are retained.

The aerodrome staff should also ensure that there is spare equipment available to be used for obstacle surveys when the main equipment is found to be unserviceable.

12.2.5 Conduct of day obstacle surveys

The aerodrome staff conducting the obstacle surveys should be aware of the developments within the aerodrome and its vicinity. He should also be aware of the outcomes of the previous surveys conducted, i.e. any penetrations, non-compliances and / or unauthorised aerial activities noted, to effectively plan his survey route. As the route may change from time to time, the staff should record down the changes and their reasons in the checklists used. Being the one to conduct the day obstacle survey, the aerodrome staff should be familiar with the area to be surveyed and the locations of sites to be checked.

12.2.6 Conduct of night obstacle surveys

The aerodrome staff conducting the obstacle survey should be aware of the developments within the aerodrome and its vicinity. He should also be aware of the outcomes of the previous surveys conducted, i.e. any penetrations, non-compliances and / or unauthorized aerial activities noted, to effectively plan his survey route. As the route may change from time to time, the staff should record down the changes and their reasons in the checklists used. Being the one to conduct the night obstacle survey, the aerodrome staff should be familiar with the area to be surveyed and the locations of sites to be checked.

12.2.7 Documentation and follow-ups

In all cases, it is important that the aerodrome staff records down all the survey information and outcomes in the checklists as they may be used for subsequent surveys or obstacle data analysis. For NOTAM promulgation, geographical coordinates of the location of the penetration / unauthorized aerial activity should be determined in terms of World Geodetic System –1984 (WGS-84) format using a calibrated GPS device.

The aerodrome operator should annotate in the up-to-date aerodrome obstacle charts, locations of the on-going activities near the aerodrome as well as the penetrations, non-compliances and unauthorized aerial activities noted during the surveys. For the latter, the aerodrome staff should conduct follow-ups including revisiting the site the next day or two to ensure proper closures of these penetrations, non-compliances and unauthorized aerial activities, and subsequently inform DSSER on their closures.

12.2.8 Promulgation of information on obstacles

The geographical coordinates, top elevation, type, marking and lighting, if any of the obstacles within the aerodrome and its vicinity should be measured and reported by the aerodrome operator to the Aeronautical Information Service (AIS).

Whenever a penetration, either temporary or permanent in nature, is identified, the aerodrome operator is required to report the penetration immediately to DSSER and the air traffic service units and other appropriate authorities.

To this end, the aerodrome operator conducting the obstacle surveys is responsible to ensure that information on obstacles is promptly transmitted to the AIS. The aerodrome operator has the most direct interest in seeing that information is properly disseminated, and through the periodic surveys, the aerodrome operator is most likely to be aware of the presence of new obstacles.

It is in his best interest for the aerodrome operator to report all data on obstacles, including marking and lighting, if any to the AIS for promulgation. Such data should be amended at regular intervals as may be necessary to keep it up-to-date.

12.2.9 Obstacle data analysis and continuous improvement

The aerodrome operator should make use of the obstacle data collected and conduct periodic data analysis. This should allow the aerodrome operator to review the overall effectiveness of the obstacle control process.

Through such analysis, the aerodrome operator should also be able to identify potential risks and hotspots, and develop mitigating measures to address them.

The aerodrome operator should seek continuous improvement in the obstacle control process to ensure that safe aircraft operations can be carried out safely and efficiently at his aerodrome. The aerodrome operator should review the process and ensure that it is in compliance with the Civil Aviation (Aerodrome) Regulations at all times

13 Safeguarding Process

13.1 General. The aerodrome operator may use a number of tools to assist in the safeguarding process, including:

b) Safeguarding map

c) Proprietary software and electronic mapping

d) Individual surveys

13.2 Safeguarding map. The safeguarding map is one of the most user-friendly methods an aerodrome operator may compile to indicate whether any particular development or construction may affect an aerodrome. These maps reflect the need to protect surfaces around the aerodromes and have a squared format superimposed on the local (UTM) grid. In this system each square of the grid is coloured to represent the most critical interaction between the obstacle limitation surface and ground height within that square.

14.2.1 A safeguarding map also shows a circle of 13-kilometre radius about the aerodrome reference point representing the need for consultation about potential bird attractant developments. The safeguarding map should also take into account existing and planned navigation and radio aids, or plans to move such aids. If, for example, a radar is to be moved to a new position at some time in the future, both positions can be marked on the map and safeguarded simultaneously. If a runway is going to be extended, then the approach and take-off climb surfaces should be established for the extended runway's declared distances. The map may also be designed to take other special considerations into account, which affect the use of the airspace around the aerodrome, such as planned instrument approach procedures whether using land based aids such as VOR/DME or satellite based procedures such as performance based navigation (PBN).

14.2.2 The following chart illustrates such a safeguarding map for an international airport with a single runway with precision instrument approaches in both directions. The shapes of the colours on the map do not look the same as the obstacle limitation surfaces because of the local changes in ground level surrounding the airport.

The following colour coding is used:

a) Grey: All developments require approval

b) Red: All buildings, structures, erections and works exceeding 10 m (32.8 ft) in height above the local ground level require approval

c) Green: All buildings, structures, erections and works exceeding 15 m (49.2 ft) in height above the local ground level require approval

d) Yellow: All buildings, structures, erections and works exceeding 45 m (147.6 ft) in height above the local ground level require approval

e) Blue: All buildings, structures, erections and works exceeding 90 m (295.3 ft) in height above the local ground level require approval

f) ◌ : All applications for developments likely to attract birds, including water features, waste, and food processing, and all applications connected with an aviation use require approval

Note: "approval" indicates that the developer should consult the aerodrome operator for approval of its building, tower, power transmission line, Mobile crane, tower crane, other *erections and works up to the height shown. These heights take into account the ground level within each of the grid squares coloured on the map.*

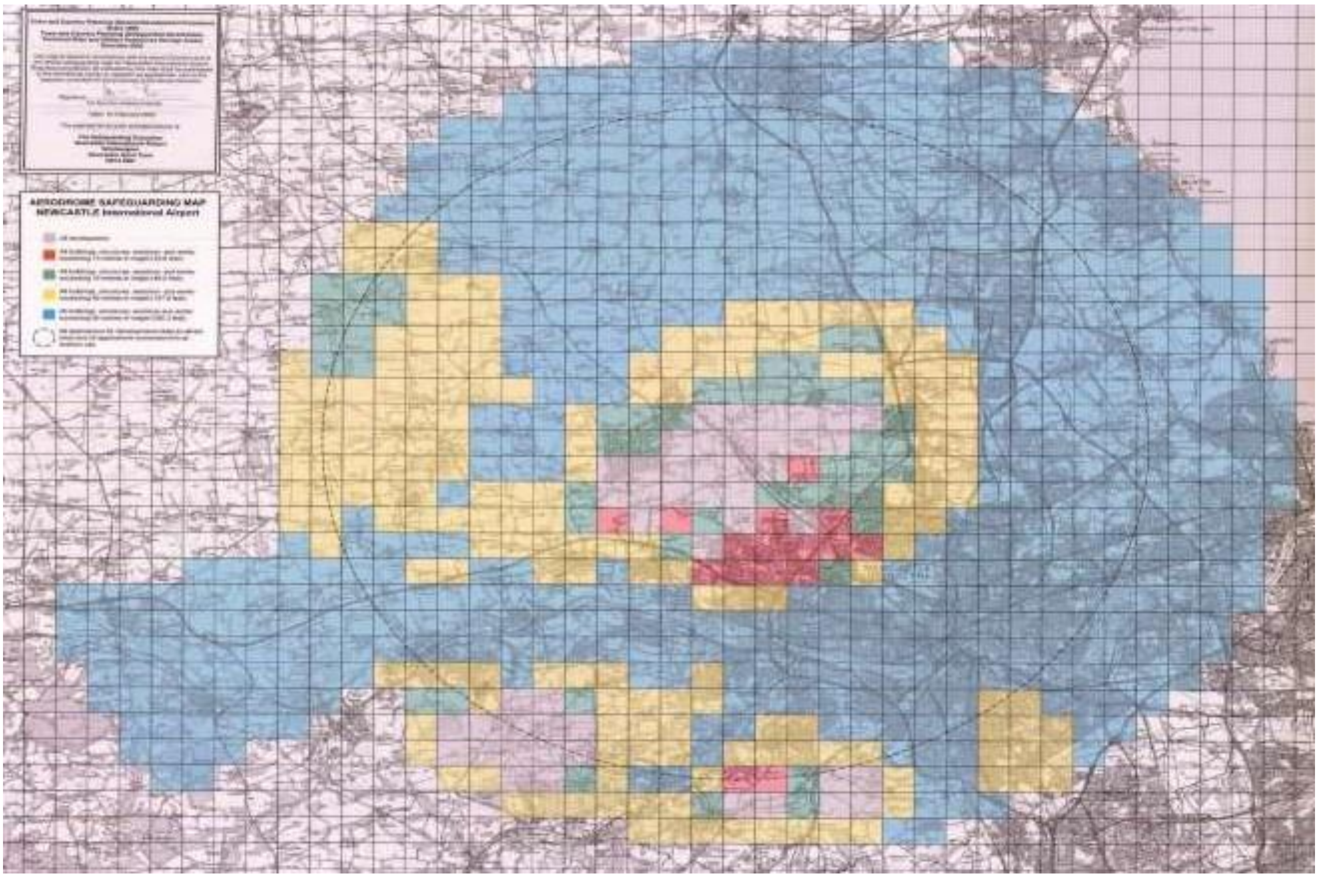


Figure 18: Safeguarding chart, sample

14.2.3 To develop a safeguarding map the following information is required:

a) Aerodrome Reference Code
b) Consider the following for each runway:
   i. runway designation and magnetic heading;
   ii. whether the runway is Instrument or non-instrument, and if instrument code 1 or 2, whether it is precision or non-precision;
   iii. UTM grid reference and elevation, in metres AOD, of the following:
   iv. threshold;
   v. Current or planned end of Take Off Run Available (TORA);
   vi. Current or planned end of Take Off Distance Available (TODA).
   vii. UTM Grid Reference of the mid-point of main runway (if less than 1800 m long) for the determination of the Inner Horizontal and Conical Surfaces;
c) UTM coordinates and elevation of any navigation and radio aids;

d) The map should be based on the most demanding elements of the existing and planned aerodrome features. This will enable the map to protect all intended future development of the aerodrome.

14.2.4 The above information and data is now used to plot the runway, declared distances and runway strip on the map. Using the aerodrome reference code and each runway instrument approach status, plot the runway strip and the start of each of the following obstacle limitation surfaces:

a) add the runway strip width, measured from the runway centreline (30 to 150m depending on the runway) and

b) add the runway strip ends (usually 60m from threshold, and end of TORA)

c) add the ends of TORA or TODA (if TODA is longer).

Note: ASDA has no effect upon the obstacle limitation surfaces.

d) Then add the approach surface slope and dimensions, and

e) add the take-off climb surface slope and dimensions, and

f) add the transitional surfaces

g) add the inner horizontal surface

h) add the conical surface

i) add the outer horizontal surface

j) add the location of any navigation aids

k) add the location of any radio aids

l) Instrument Flight Procedures

14.2.5 The protected areas for instrument flight procedures are complex and, if they are to be safeguarded, advice on their exact shape and location must be sought from an instrument procedure design expert. The obstacle limitation surfaces do not provide sufficient protection for instrument flight procedures. Then, for each UTM grid square: deduct the highest point of ground from the elevation permitted by the obstacle limitation surface or navigation/radio aid protected area, whichever gives the higher figure, and colour that grid square according to the colour code in 14.2.2 above. Continue until the entire approach, take-off climb (up to 15km) and conical or outer horizontal surfaces (as appropriate to the aerodrome) have been assessed for every grid square. The resolution of the grid squares can be selected according to the extent of variations in the ground terrain, typically 1,000m grid squares are sufficient. The completed safeguarding map can then be made available to persons and entities who need to identify the development restrictions in the vicinity of an aerodrome.

13.3 Proprietary software and electronic mapping. If the aerodrome operator has completed the appropriate WGS-84/EGM96 survey then it is a logical step to use this quality controlled data to evaluate obstacles. Aeronautical WGS-84 survey organisations may provide the operator with computer software to use the survey data to plot and report on any proposed development or obstacle. It is essential that this process recognises the difference in survey datum used by the aerodrome operator (WGS-84 based on aerodrome located and established survey control points, and EGM96 for elevations) and UTM 36 (based on national survey benchmarks and means sea level at Mombasa).

13.4 **Individual surveys**. In the absence of a safeguarding map, or a survey and safeguarding software, for a single development it is possible to make a valid safeguarding decision by independently (from any aeronautical survey) surveying the proposed ground elevation of the proposed development, its distance from the relevant location on the aerodrome, and the elevation on that point of the aerodrome to the same datum as the development, such as mean sea level Mombasa. The relevant point on the aerodrome in determined from the following figures.

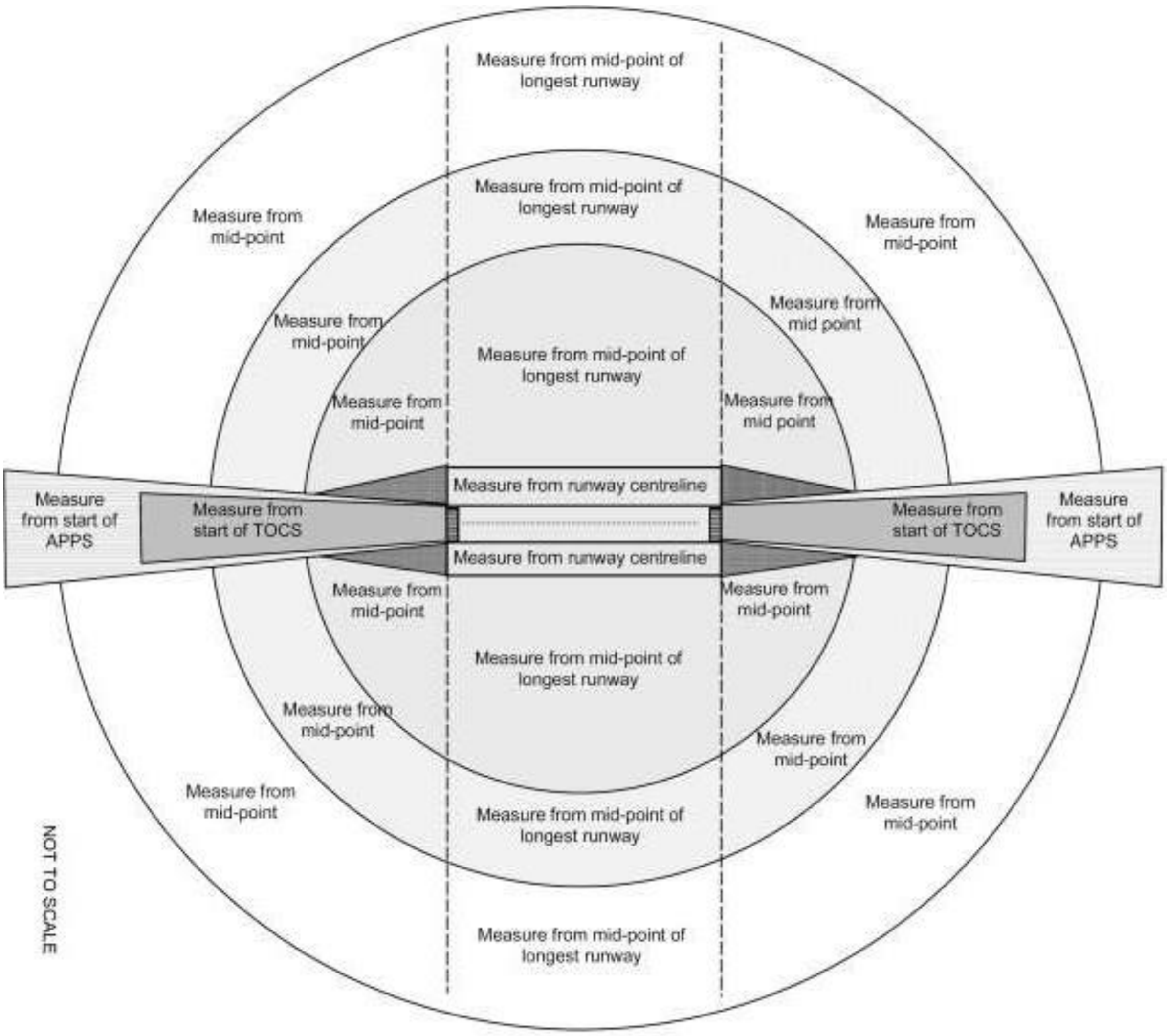
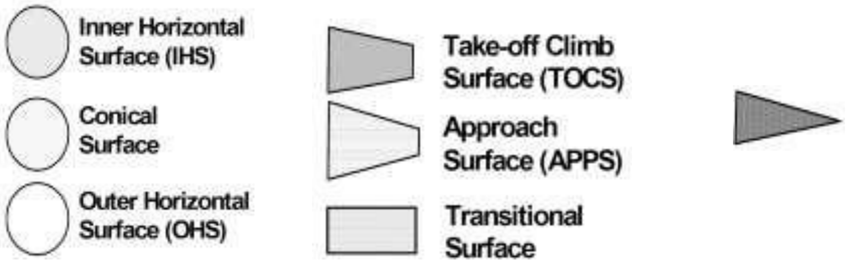


Figure 19: Measurement of the Location of a Development in Relation to the Aerodrome and OLS, for aerodrome reference codes 1, 2 and 3.

Key to figures 19 and 20:



Area in which visual and electronic aids to navigation may be affected

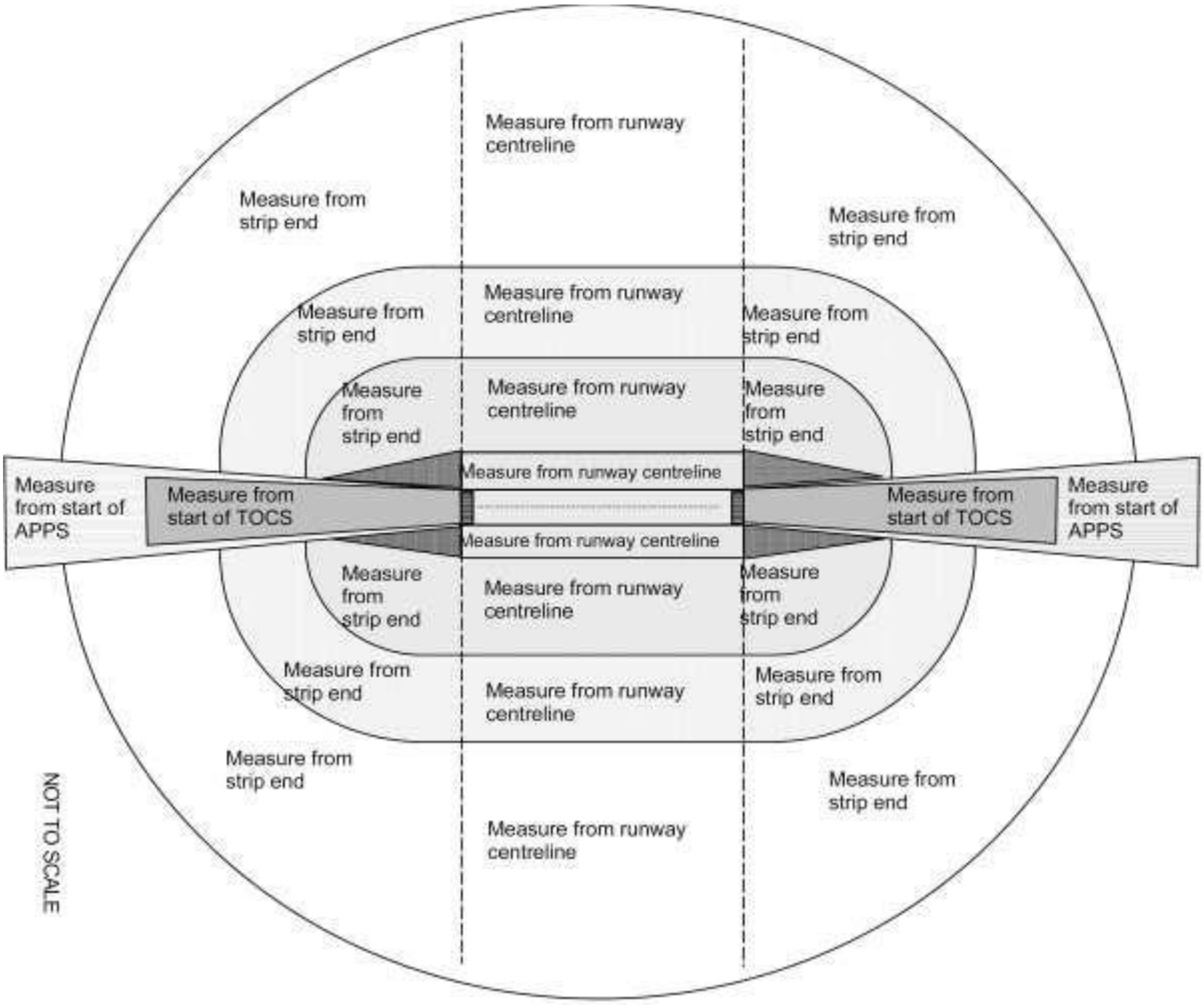


Figure 20: Measurement of the Location of a Development in Relation to the Aerodrome and OLS, for aerodrome reference code 4.

13.5 Procedure. The purpose of the safeguarding procedure is to use a series of steps, followed in a methodical manner, to complete the safeguarding process, describing what should be done, when and by whom; where and how each step should be carried out; what information, documentation and resources should be used; and how it should all be controlled. The flow chart overleaf illustrates a procedure for the aerodrome operator to follow to assist in meeting its obligations under the Regulations, whether using any of the above methods: safeguarding map, software or individual surveys.

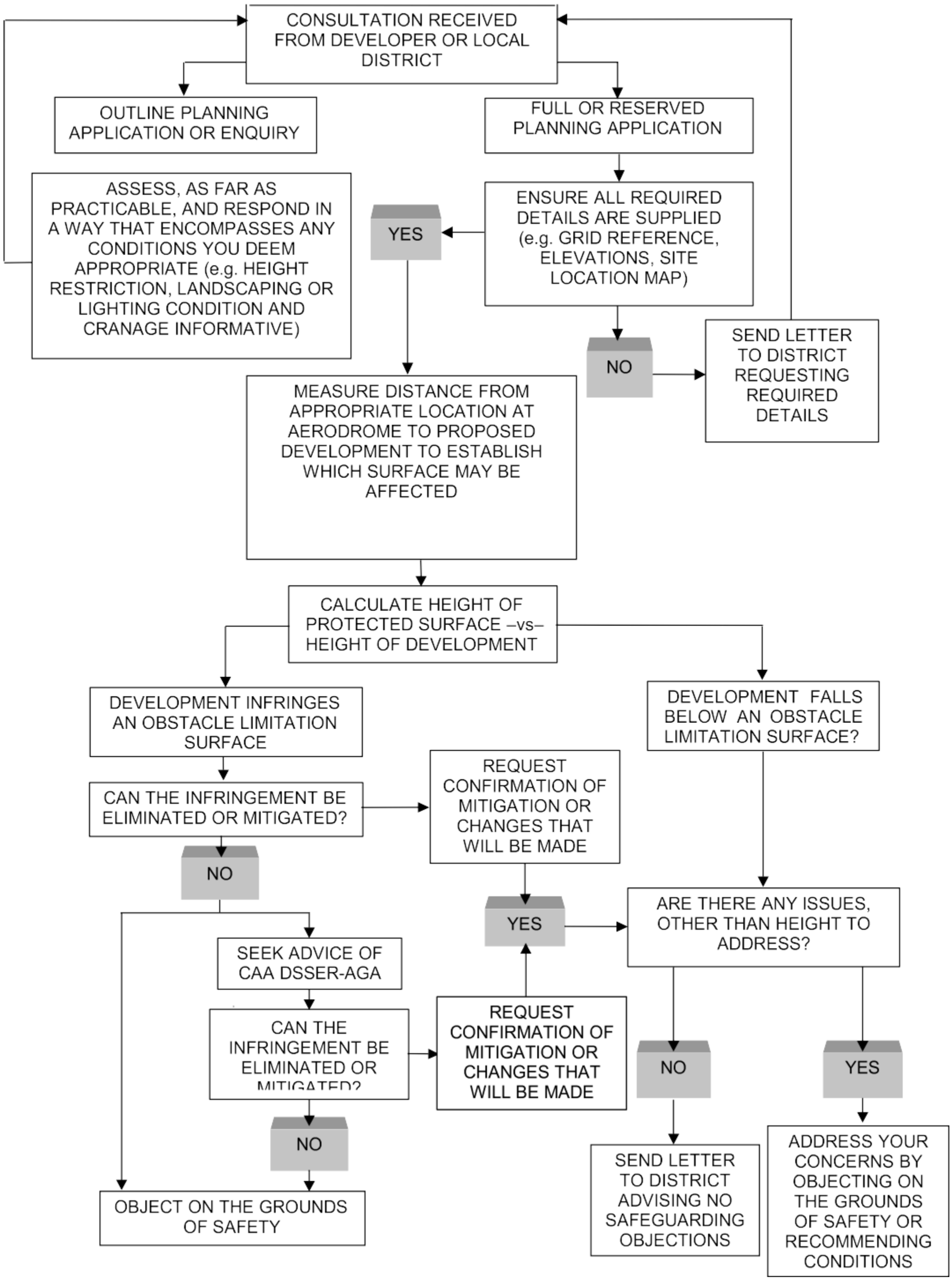


Figure 21: Safeguarding Process Flowchart

13.6 **When**: it is never too early to assess a new or proposed obstacle. Temporary obstacles, such as mobile cranes, should be assessed as soon as possible, preferably one month in advance of the erection. Construction assessments should be submitted to the aerodrome operator.

Who: the aerodrome operator is responsible under the Civil Aviation (Aerodrome) Regulations for the monitoring and control of obstacles on and in the vicinity of its aerodrome. Any constructor or developer person or entity is responsible under the Aerodromes (Control of Obstructions) Act for not erecting any obstruction in a prescribed area. Therefore, it is incumbent on all parties, under the coordination of the aerodrome operator to cooperate in the management and control of obstacles.

Where: this procedure is applicable to all licensed and certified aerodromes in the Republic of Uganda. The procedure will be undertaken at the premises of the aerodrome operator, and audited by the Aerodrome and Ground Aids Inspectorate of the Directorate of Safety, Security and Economic Regulation.

How: the assessment of obstacles is undertaken using the criteria in section 4 of this circular to compare with the height of any development, structure and natural obstacle above the relevant datum on the aerodrome or the relevant datum on the aeronautical electronic aid.

What information/data: the information and data described in this circular shall be used in the assessment of obstacles, including specifically:

Documentation: Particulars in the aerodrome manual for obstacle control must contain details setting out the procedures for:

a) Monitoring the obstacle limitation surfaces and Type A chart for obstacle in the take-off surface;
b) Controlling obstacles within the authority of the aerodrome operator;
c) Monitoring the height of buildings or structures within the boundaries of the obstacle limitation surfaces;
d) Controlling new developments in the vicinity of the aerodrome;
e) Notifying the Authority of the nature and location of obstacles and any subsequent addition or removal of obstacles for action as necessary, including amendment of AIS publications.
f) Arrangements for carrying out inspections of obstacles, on, near and away from the aerodrome, including frequency of such inspections, and the methods and equipment used;
g) Arrangements for keeping an inspection logbook and the location of the logbook or other record;
h) Details of inspection intervals and times;
i) Inspection obstacle checklist, including whether obstacles are lighted or not;
j) Arrangements for reporting the results of inspections and for taking prompt follow-up actions to ensure correction of unsafe conditions; and
k) The names and roles of persons responsible for carrying out inspections and their contact numbers during and after working hours.

13.7 Resources Control: The aerodrome and air navigation service operator shall comply with the requirements and quality control requirements of the Regulations, and retain records of safeguarding applications, deliberations, and outcomes. The Directorate of Safety, Security and Economic Regulation will audit the safeguarding process at its aerodrome audits.

13.8 Outcome: When obstacles have been identified, the aerodrome operator should make every effort to have them removed or reduced in height so that they are no longer obstacles. If the obstacle is a single object it may be possible to reach agreement with the owner of the property to reduce the eight to acceptable limits without adverse effect. In the case of trees, which are trimmed, agreement should be reached in writing with the property owner to ensure that future growth will not create new obstacles. Property owners can give such assurance by agreeing to trim the trees when necessary, or by permitting access to the premises to have the trimming done by the aerodrome operator's representative. Any trimming activity should be aimed at removing five years' growth, to avoid frequent revisiting the trimming operation,

14.8.1 Where agreement can be reached for the reduction in height of an obstacle, the agreement should include a written aviation assessment limiting heights over the property to specific levels unless effective height zoning has been established. If an obstacle is erected that infringes any of the surfaces included in this circular, whether it happens without consult6tlon, or the safeguarding procedures fails, then the aerodrome operator remains responsible for the safe and compliant operation of its aerodrome. This may mean closing a runway or reducing declared distances when the approach or take-off climb surfaces are infringed, for example, some aids to navigation both electronic, such as ILS components, and visual such as approach and runway 1ights, constitute obstacles which cannot be removed, and which may be approved by the Directorate of Safer, Security and Economic Regulation on the basis of essential navigation or safety aids that cannot fulfil their function if relocated. This includes elevated runway lights and PAPIs. Such objects should be frangibly designed and constructed, and mounted on frangible couplings so that they will fail on impact without significant damage to and aircraft, and on delethalisad bases.

14.8.2 Any such obstacles, other than aeronautical ground lighting, should be marked and/or lighted. It should be noted that the marking and lighting of obstacles is intended to reduce hazards to aircraft by indicating the presence of the obstacles. It does not necessarily reduce any operating limitations which may be imposed by the obstacle. The Regulations specify that obstacles be marked and, if the aerodrome is used at night, lighted, except that such marking and lighting may be omitted when the obstacle is shielded by another obstacle; and the marking may be omitted when the obstacle is lighted by high intensity obstacle lights by day. Installation and maintenance of required marking and lighting may be done by the property owner, by community authorities, or by the aerodrome operator.

The aerodrome operator should make a daily visual inspection of all obstacle lights and take steps to have inoperative lights repaired. Aerodrome operators may find it helpful to use dual light fixtures with an automatic switch to the second light fixture in case that first one fails. Such an arrangement provides greater assurance of continued obstacle lighting and reduces the number of visits to replace Inoperative lamps.

14.8.3 Any temporary or permanent obstacles must be published by NOTAM and then/or the AIP according to the duration and permanence of the obstacle.

14.8.4 Obstacle shielding. The principle of obstacle shielding is employed to permit a more logical approach to restricting new construction and to prescribing obstacles marking and lighting in an existing obstacle environment that was been accepted by the CAA due to aerodrome or flight limitations. Shielding principles are employed when some object, an existing building or natural terrain, already penetrates a6ove one of the aerodrome limitation surfaces. If it is considered that the nature of an object is such that its presence may be described as permanent, then additional objects within a specified area around it may be permitted to penetrate the surface without being considered as obstacles. The original obstacle is considered as dominating or shielding the surrounding area.

UGANDA CIVIL AVIATION AUTHORITY
DIRECTOR
SAFETY, SECURITY AND ECONOMIC REGULATION

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Director Safety, Security and Economic Regulation