

OBSTACLES CONTROL MANUAL

State Civil Aviation Agency of the Republic of Azerbaijan

Document № G-AGA-016

Date of issue: 01 OCTOBER 2020

Edition № 01

Baku

SCAA

APPROVAL FORM

Number of copies shall be included in the "Distribution list" and printed copies confirmed by QC as "COPY".

Reg №:	G-AGA-016	CR Reg. №:	--

OBSTACLES CONTROL MANUAL

Issue date:	01.10.2020	Ed.:	01	Rev.:	00	Approval date:	01.10.2020

SCAA official's: _____
(signature)

Name / Surname: H. Aliyev

Position: DDG

0. ADMINISTRATION AND CONTROL OF THE DOCUMENT

0.1. TABLE OF CONTENTS

0. ADMINISTRATION AND CONTROL OF THE DOCUMENT 1

0.1. Table of Contents 1

0.2. List of Effective Pages 3

0.3. Distribution Control 5

0.4. Record of Amendments and Revisions 6

0.5. Terms and Definitions 7

0.6. Abbreviation 9

0.7. Terms Shall, Should, May 10

0.8. Administration and Control 10

1. SURFACES 1

1.1. General 1

1.2. AAR-AGA-001 Obstacles Limitation Surfaces 1

1.2.1. Function of the Surfaces 1

1.2.2. Outer Horizontal Surface 1

1.2.3. Inner Horizontal Surface and Conical Surface 4

1.2.4. Approach and Transitional Surfaces 4

1.2.5. Take-off Climb Surface 5

1.2.6. The Inner Approach, Inner Transitional and Balked Landing Surfaces 5

1.3. PANS-OPS Surfaces 6

1.3.1. General 6

1.3.2. Basic ILS Surfaces 7

1.3.3. Obstacle Assessment Surfaces 7

1.3.4. ILS Collision Risk Model (CRM) 9

1.3.5. Visual Manoeuvring (circling procedure) 9

1.3.6. Operational Minima 9

1.4. Inner Transitional and Balked Landing Surfaces versus Y Surfaces and Missed Approach Surfaces 9

1.5. Background of the Collision Risk Model 12

2. CONTROLLING OBSTACLES AT AN AIRPORT 1

2.1. Background 1

2.2. SCAA and its Responsiibility 1

2.3. Height Zoning 2

2.4. Purchase of Easements and Property Rights....3
2.5. Notification of Proposed Construction....4
2.6. Establishment of Obtacle Limitation Surfaces....5
2.7. Obstacle Surveys....6
2.8. Removal of Obstacles....7
2.9. Shielding....7
2.10. Marking and Lighting of Obstacles....8
2.11. Reporting of Obstacles....9

3. TEMPORARY HAZARDS. PREFERRED PROCEDURE FOR DEALING WITH TEMPORARY HAZARDS ON RUNWAY STRIPS....1

3.1. Introduction....1
3.2. Restrictions for Non-Instrument and Non-Precision Approach Runways....1
3.3. Restrictions for Precision Approach Runways....3
3.4. Pre-Construction Meeting....3

4. AIRPORT EQUIPMENT AND INSTALLATIONS WHICH MAY CONSTITUTE OBSTACLES....1

4.1. Introduction....1
4.2. Frangybility....1
4.3. Types of Airport Equipment and Installation which may Constitute Obtacles....1
4.3.1. General....1

APPENDIX – INFLUSTRATION OF OBSTACLE LIMITATION SURFACES OTHER THAN THOSE CONSTITUTING AN OBSTACLE-FREE ZONE....1

0.2. LIST OF EFFECTIVE PAGES

	Chapter 0	
Page	**Effective date**	**Revision #**
1	01.OCT.2020	00
2	01.OCT.2020	00
3	01.OCT.2020	00
4	01.OCT.2020	00
5	01.OCT.2020	00
6	01.OCT.2020	00
7	01.OCT.2020	00
8	01.OCT.2020	00
9	01.OCT.2020	00
10	01.OCT.2020	00
	Chapter 1	
Page	**Effective date**	**Revision #**
1	01.OCT.2020	00
2	01.OCT.2020	00
3	01.OCT.2020	00
4	01.OCT.2020	00
5	01.OCT.2020	00
6	01.OCT.2020	00
7	01.OCT.2020	00
8	01.OCT.2020	00
9	01.OCT.2020	00
10	01.OCT.2020	00
11	01.OCT.2020	00
12	01.OCT.2020	00
13	01.OCT.2020	00
14	01.OCT.2020	00
	Chapter 2	
Page	**Effective date**	**Revision #**
1	01.OCT.2020	00
2	01.OCT.2020	00
3	01.OCT.2020	00
4	01.OCT.2020	00
5	01.OCT.2020	00
6	01.OCT.2020	00
7	01.OCT.2020	00
8	01.OCT.2020	00
9	01.OCT.2020	00
10	01.OCT.2020	00
	Chapter 3	
Page	**Effective date**	**Revision #**
1	01.OCT.2020	00
2	01.OCT.2020	00
3	01.OCT.2020	00
4	01.OCT.2020	00
	Chapter 4	
Page	**Effective date**	**Revision #**
1	01.OCT.2020	00
2	01.OCT.2020	00
	Appendix	
Page	**Effective date**	**Revision #**
1	01.OCT.2020	00
2	01.OCT.2020	00

INTENTIONALLY LEFT BLANK

0.3. DISTRIBUTION CONTROL

Copy #	Type of Copy	Department	Title
Master	**(S)**	Quality Control & Rulemaking Department	Head of the QC& Rulemaking Department
1	**(S)**	SCAA Q-Pulse	Head of the QC& Rulemaking Department
2	**(S)**	Aerodrome Operators Oversight Department	Head of AOOD
3	**(S)**	Official web-site of the SCAA	QC& Rulemaking Department

(S) Soft Copy - (electronic version)

(H) Hard Copy – (printed version)

Note: *Electronic and hard copies are considered "uncontrolled" if they are printed or not included into this distribution list.*

0.4. RECORD OF AMENDMENTS AND REVISIONS

Edition/ Revision №:	Date of Edition/ Revision:	Inserted by:	Para/ Page	Effective date:
Edition № 01	01.10.2020	AOOD	All	01.10.2020

Edition: - *Release of a document having incorporated all previous revisions until the current version. New edition of a document will not show revised text in blue color. Current edition of a document shown on each page in footer.*

Revision: *- A change made to a part of document, where it is reflected with blue text or accompanied with a vertical line on right side of a document. Basic information on revisions (number and date) given in the List of effective Pages and indicated in header of affected page and in context itself.*

0.5. TERMS AND DEFINITIONS

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

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

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

Balked landing. A landing manoeuvre that is unexpectedly discontinued at any point below the obstacle clearance altitude/height (OCA/H).

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.

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.

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

a. **Non-precision approach runway**. A runway served by visual aids and a non-visual aid(S) intended for landing operations following an instrument approach operation type A and a visibility not less than 1000m.

b. **Precision approach runway, category I**. A runway served by visual aids and non-visual aid(s) intended for operations following an instrument approach operation type B with a decision height (DH) not lower than 60 m (200 ft.) and either a visibility not less than 800 m or a runway visual range not less than 550 m.

c. **Precision approach runway, category II**. A runway served by visual aids and non-visual aid(s) intended for landing operations following and instrument approach type B with a decision height (DH) lower than 60 m (200 ft.) but not lower than 30 m (100 ft.) and a runway visual range not less than 300 m.

d. **Precision approach runway, category III.** A runway served by visual aids and non-visual aid(s) intended for landing operations following and instrument approach type B and along the surface of the runway and:

   A. Intended for operations with a decision height (DH) lower than 30 m (100 ft), or no decision height and a runway visual range not less than 175 m.
   B. Intended for operations with a decision height (DH) lower than 15 m (50 ft), or no decision height and a runway visual range less than 175 m but not less than 50m
   C. Intended for operations with no decision height (DH) and no runway visual range limitations.

Obstacle. All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that:

a. Are located on an area intended for the surface movement of aircraft; or

b. Extend above a defined surface intended to protect aircraft in flight**;** or

c. Stand outside those defined surfaces and that have been assessed as being a hazard to air navigation.

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.

Outer main gear wheel span (OMGWS). The distance between the outside edges of the main gear wheels.

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

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

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

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

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

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

0.6. ABBREVIATION

AAR-AGA-001	Azerbaijan Aviation Rules – Aerodrome Standards
CRM	Collision Risk Model
OCA/H	Obstacle Clearance Altitude/Height
OCP	Obstacle Clearance Panel
OAS	Obstacle Assessment Surfaces
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations
SCAA	State Civil Aviation Agency of Azerbaijan Republic

0.7. TERMS SHALL, SHOULD, MAY

The following terms shall have the meaning outlined below:

“Shall” - An action verb in the imperative sense means that the application of a rule or procedure or provision is mandatory.

“Should” - Means that the application of a procedure or provision is recommended.

“May” - Means that the application of a procedure or provision is optional.

0.8. ADMINISTRATION AND CONTROL

This document is published as a book on A4-sized sheets. The PDF files will be locked and signed to prevent changes.

This document is regularly revised and amended. All personnel must be familiarized with all revisions done.

This document will be Amended and Revised in accordance with requirements of “Documentation and Control” procedure.

1. SURFACES

1.1. GENERAL

1.1.1. The effective utilization of an aerodrome may be considerably influenced by natural features manmade constructions inside and outside its boundary. These may result in limitations on the distances available for take-off and landing and on the range of meteorological conditions in which take-off and landing can be undertaken. For these reasons, 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.

1.1.2. The significance of any existing or proposed object within the aerodrome boundary in the vicinity of the aerodrome is assessed by the use of two separate sets of criteria defining airspace requirements. The first of these comprises the obstacle limitation surfaces particular to a runway and its intended use detailed in Chapter 8 of Azerbaijan Aviation Regulation - Aerodrome Standarts (hereinafter the AAR-AGA-001). The broad purpose of these surfaces is to define the volume of airspace that should ideally be kept free from obstacles in order to minimize the dangers presented by obstacles to an aircraft, either during an entirely visual approach or during the visual segment of an instrument approach. The second set of criteria comprises the surfaces described in the Procedures for Air Navigation Services - Aircraft Operations PANS-OPS (ICAO Doc 8168), Volume II - Construction of Visual and Instrument Flight Procedures. The PANS-OPS surfaces are intended for use by procedure designers for the construction of instrument flight procedures and for specifying minimum safe altitudes/heights for each segment of the procedure. The procedure and/or minimum heights may vary with aeroplane speed, the navigational aid being used, and in some cases the equipment fitted to the aeroplane.

1.1.3. The surfaces of AAR-AGA-001 are intended to be of a permanent nature. To be effective, they should therefore be enacted in local zoning laws or ordinances or as part of a national planning consultation scheme. The surfaces established should allow not only for existing operations but also for the ultimate development envisaged for each aerodrome. There may also be a need to restrict obstacles in areas other than those covered by AAR-AGA-001 if operational minima calculated using the PANS-OPS criteria are not to be increased, thereby limiting aerodrome utilization.

1.2. AAR-AGA-001 OBSTACLES LIMITATION SURFACES

1.2.1. FUNCTION OF THE SURFACES

1.2.1.1. The following paragraphs describe the function of the various surfaces defined in Chapter 8 AAR-AGA-001, and in certain instances include additional information concerning their characteristics. For the benefit, of the reader, several illustrations of obstacle limitation surfaces are included in Appendix 1.

1.2.2. OUTER HORIZONTAL SURFACE

1.2.2.1. In the experience, significant operational problems can arise from the erection of tall structures in the vicinity of airports beyond the areas currently recognized in AAR-AGA-001 as areas in which restriction of new construction may be necessary. The operational implications fall broadly under the headings of safety and efficiency.

1.2.2.2. Safety implications. It is particularly desirable to review carefully any proposal to erect high masts or other skeletal structures in areas which would otherwise be suitable for use by aircraft on wide visual circuits, on arrival routes towards the airport 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, and notification of their existence will similarly not always guarantee avoidance.

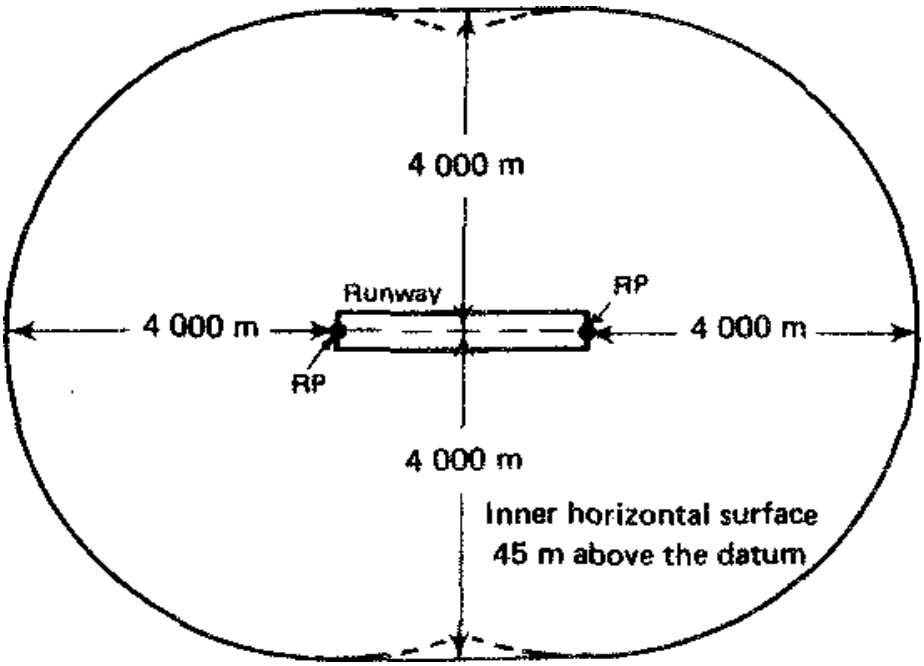


Figure 1-1. Inner horizontal surface for a single runway (where the runway code number is 4)

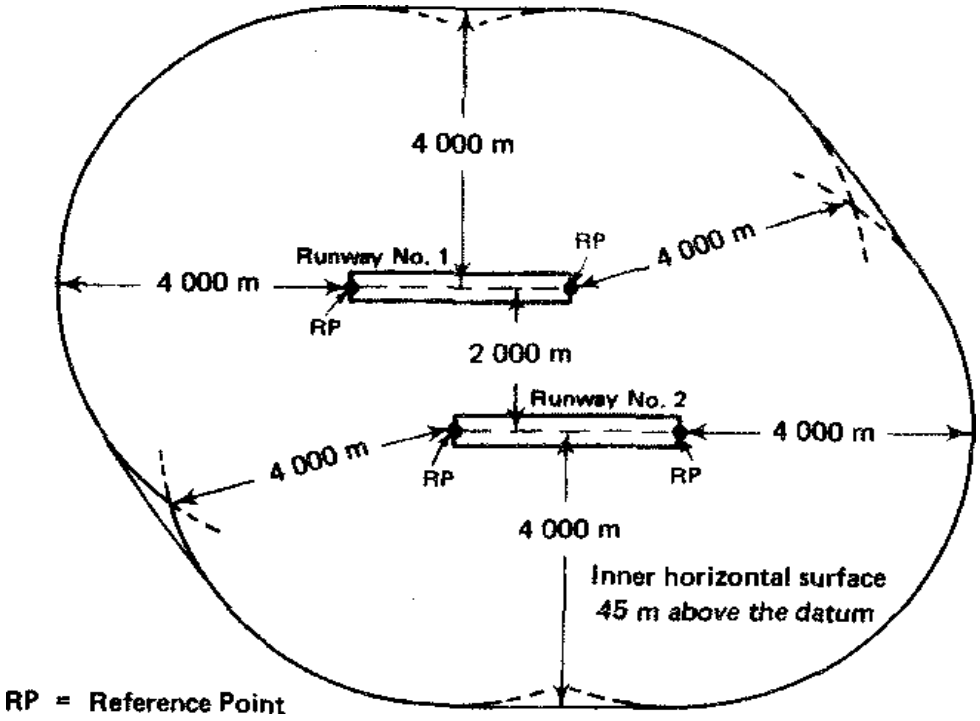


Figure 1-2. Composite inner horizontal surface for two parallel runways (where the runway code number is 4)

1.2.2.3. Efficiency implications. If tall structures are erected in or near areas otherwise suitable for instrument approach procedures, increased procedure heights may need to be adopted, with consequent adverse effects on regularity and on the duration of the approach procedure, such as the denial of useful altitude allocations to aircraft in associated holding patterns. Such structures may furthermore limit desirable flexibility for radar vectored initial approaches and the facility to turn en route during the departure climb or missed approach.

1.2.2.4. In view of these potentially important operational considerations, authorities may consider it desirable 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. In assessing the operational effect of proposed new construction, tail structures would not be of immediate significance if they are proposed to be located in:

a) an area already substantially obstructed by terrain or existing structures of equivalent height; and

b) an area which would be safety avoided by prescribed procedures associated with navigational guidance when appropriate,

1.2.2.5. As a broad specification for the outer horizontal surface, tail structures can be considered to be of possible significance if they are both higher than 30 m above local ground level, and higher than 150 m above aerodrome elevation within a radius of 15000 m of the centre of the airport 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 airport under consideration.

1.2.3. INNER HORIZONTAL SURFACE AND CONICAL SURFACE

1.2.3.1. The purpose of the inner horizontal surface 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.

1.2.3.2. In some instances, certain sectors of the visual circling areas will not be essential to aircraft operations and, provided procedures are established to ensure that aircraft do not fly in these sectors, the protection afforded by the inner horizontal surface need not extend into those sectors. Similar discretion can be exercised by the appropriate authorities when procedures have been established and navigational guidance provided to ensure that defined approach and missed approach paths will be followed.

1.2.3.3. 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 ends joined tangentially by straight lines. To protect two or more widely spaced runways, a more complex pattern could become necessary, involving four or more circular arcs. These situations are illustrated at Figures 1-1 and 1-2 respectively.

1.2.3.4. Inner horizontal surface — elevation datum. To satisfy the intention of the inner horizontal surface described above, it is desirable that authorities select a datum elevation from which the top elevation of the surface is determined. Selection of the datum should take account of:

a) the elevations of the most frequently used altimeter setting datum points;

b) minimum circling altitudes in use or required; and

c) the nature of operations at the airport.

For relatively level runways the choice of datum is not critical, but when the thresholds differ by more than 6 m, the datum selected should have particular regard to the factors above. For complex inner horizontal surfaces (Figure 1-2) a common elevation is not essential, but where surfaces overlap the lower surface should be regarded as dominant.

1.2.4. APPROACH AND TRANSITIONAL SURFACES

1.2.4.1. These surfaces 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 manoeuvre. Their slopes and dimensions will vary with the aerodrome reference code and whether the runway is used for visual, non-precision or precision approaches.

1.2.5. TAKE-OFF CLIMB SURFACE

1.2.5.1. This surface provides protection for an aircraft on take-off by indicating which obstacles should be removed if possible, and marked or lighted if removal is impossible. The dimensions and slopes also vary with the aerodrome reference code.

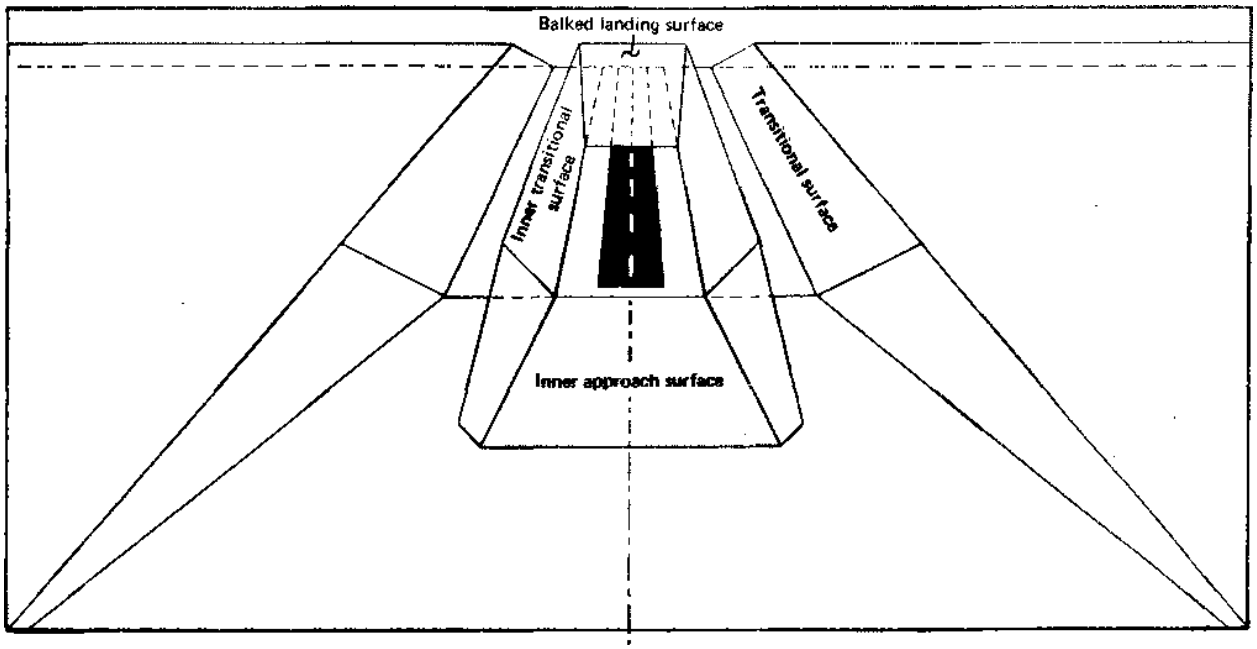


Figure 1-3

1.2.6. THE INNER APPROACH, INNER TRANSITIONAL AND BALKED LANDING SURFACES

1.2.6.1. Together, these surfaces (see Figure 1-3) define a volume of airspace in the immediate vicinity of a precision approach runway which is known as the obstacle-free zone (OFZ). This zone shall be kept free from fixed objects, other than lightweight frangibly mounted aids to air navigation 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.

1.2.6.2. 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 60 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 centre line 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 1800 m from threshold to the start of the balked landing surface assumes that the latest point for a pilot to initiate A balked lauding 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 15s A slop of 33.33 per cent for the inner transitional surfaces results from a 3.33 per cent climb gradient with a splay of 10 per cent. The splay of 10 per cent is based upon recorded dispersion data.

1.2.6.3. The OFZ for a precision approach runway category I where the code number is 1 or 2 is designed to protect an aeroplane with a wing span of 30 m to climb at a gradient of 4 per cent and diverge from the runway centre line at a splay no greater than 10 per cent. The gradient of 4 per cent is that of the normal take-off climb surface for these aeroplanes. When allied to a 10 per cent splay, it results in a slope for the inner transitional surfaces of 40 per cent. The balked landing surface originates at 60 m beyond the far end of the runway from threshold and is coincident with the take-off climb surface for the runway.

1.3. PANS-OPS SURFACES

1.3.1. GENERAL

1.3.1.1. The PANS-OPS surfaces are intended for use by procedure designers primarily in the construction of instrument flight procedures which are designed to safeguard an airplane from collision with obstacles when flying on instruments. In designing procedures, the designer will determine areas (horizontally) needed for various segments of the procedure. Then he will analyze the obstacles within the determined areas, and based on this analysis he will specify minimum safe altitude heights for each segment of the procedure for use by pilots.

1.3.1.2. The minimum safe altitude/height specified for the final approach phase of a flight is called “obstacle clearance altitude/height (OCA/H)”. A missed approach procedure initiated by the pilot at or above this altitude/height will ensure that, even if the pilot has no outside visual reference to the ground at any point, the aeroplane will pass safely above all potentially dangerous obstacles. The pilot may descend below the OCA/H only if he has visually confirmed that the aeroplane is correctly aligned with the runway and that there are sufficient visual cues to continue the approach. The pilot is permitted to discontinue the approach at any point below the OCA/H, e.g if the required visual reference ceases to be available. Such a late missed approach is called balked landing. Because the initiation point of the balked landing procedure is known more accurately than the initiation point of the missed approach procedure, a smaller airspace needs to be protected.

Note: *Not all of the above is applicable to category lll operations carried out with no decision height.*

1.3.1.3. The size and dimensions of the obstacle-free airspace needed for the approach, for the missed approach initiated at or above the OCA/H and for the visual manoeuvring (circling) procedure are specified in PANS-OPS. Aeroplanes continuing their descent below the specified OCA/H, and therefore having visual confirmation that they are correctly aligned, are protected from obstacles by the AAR-AGA-001 obstacle limitation surfaces and related obstacle limitation and marking/lighting requirements. Similarly, the AAR-AGA-001 surfaces provide protection for the balked landing. In other than low visibilities, it may be necessary for the pilot to avoid some obstacles visually.

1.3.1.4. The airspace required for an approach (including missed approach and visual circling) is bounded by surfaces which do not usually coincide with the obstacle limitation surfaces specified in AAR-AGA-001. In the case of a non-precision approach, missed approach and visual manoeuvring, the surfaces have a rather simple form. Typical cross-sections of such obstacle-free airspace are shown in Figures 1.4 and 1.5, The plan view of such an obstacle-free area depends on the characteristics of the navigational facility used for the approach but not on the characteristics of the aeroplane. A typical plan view is shown in Figure 1.6.

1.3.1.5. In the case of a precision approach, the form of the obstacle-free airspace becomes more complicated because it depends on several variables, such as aeroplane characteristics (dimensions, equipment, performance) and ILS facility characteristics (facility performance category, reference datum height, localizer course width and the distance between the threshold and localizer antenna). The airspace can be bounded by plane or curved surfaces which have resulted in "basic ILS surfaces", "obstacle assessment surfaces (OAS)" and the Collision Risk Model (CRM). (see further, 1.3.2 to 1.3.4 below).

1.3.2. BASIC ILS SURFACES

The "basic ILS surfaces" defined in PANS-OPS represent the simplest form of protection for ILS operations. These surfaces are extensions of certain AAR-AGA-001 surfaces, referenced to threshold level throughout and modified after threshold to protect the instrument missed approach. The airspace bounded by the basic ILS surfaces is however usually too conservative and therefore another set of surfaces, "obstacle assessment surfaces", is specified in PANS-OPS.

1.3.3. OBSTACLE ASSESSMENT SURFACES

The obstacle assessment surfaces (OAS) establish a volume of airspace, inside which it is assumed the flight paths of aeroplanes making ILS approaches and subsequent missed approaches will be contained with sufficiently high probability. Accordingly, aeroplanes need normally only be protected from those obstacles that penetrate this airspace; objects that do not penetrate it usually present no danger to ILS operations. However, if the density of obstacles below the OAS is very high, these obstacles will add to the total risk and may need to be evaluated (see below). The above airspace (funnel) is illustrated in Figure 1-2. It is formed by a set of plane surfaces, an approach surface (W), a ground or "footprint" surface (A) and a missed approach surface (Z); all bounded by side surfaces (X and Y). The dimensions of the surfaces are tabulated in PANS-OPS, Volume II. The lateral boundaries of the funnel represent estimates of the maximum divergence of an aeroplane from the runway centre line during the approach and missed approach so that the probability of an aeroplane touching the funnel at any one point is 1:10-7 or less. The probable flight paths, both vertical and lateral, for aeroplanes tracking the ILS beams during an approach, have been based on a consideration of possible tolerances in both the ground and airborne navigational equipment and the extent to which the pilot may allow the aeroplane to deviate from the beam whilst attempting to follow the ILS guidance (pilotage). The probable flight paths in the missed approach are based on arbitrary assumptions of minimum climb performance and max mum splay angle of the aeroplane in a missed approach manoeuvre. Note that, the precise dimensions of a funnel do vary with a number of factors. Having defined this volume of airspace, simple calculations allow an OCA/H to be catenated which would protect the aeroplane from all obstacles. The difference between the basic ILS surfaces and the OAS is that the dimensions of the latter are based upon a collection of data on aircraft ILS precision approach performance during actual instrument meteorological conditions, rather than existing AAR-AGA-001 surfaces.

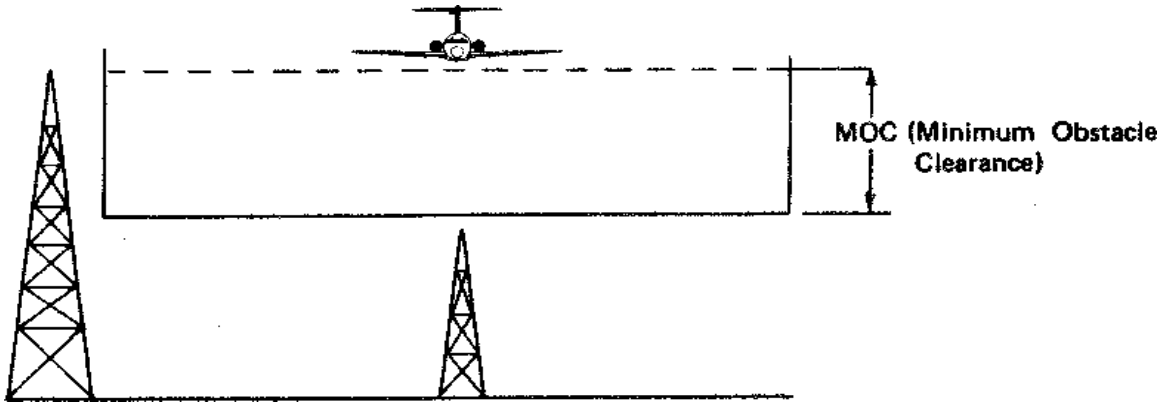


Figure 1-4

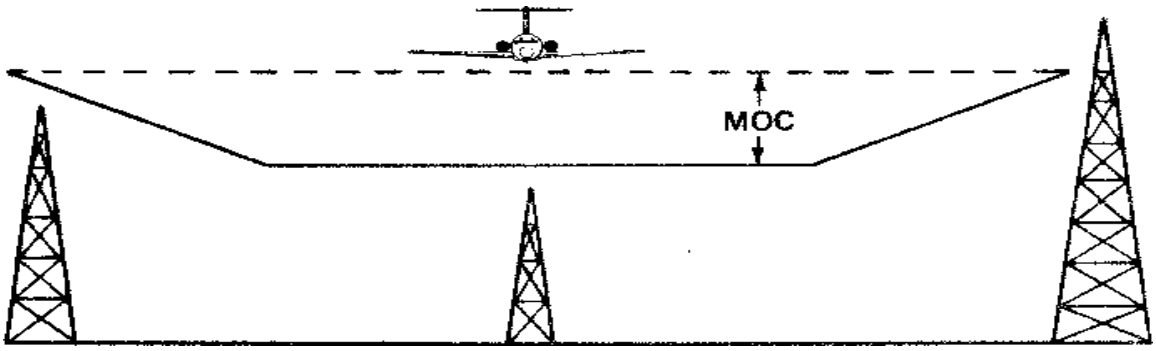


Figure 1-5

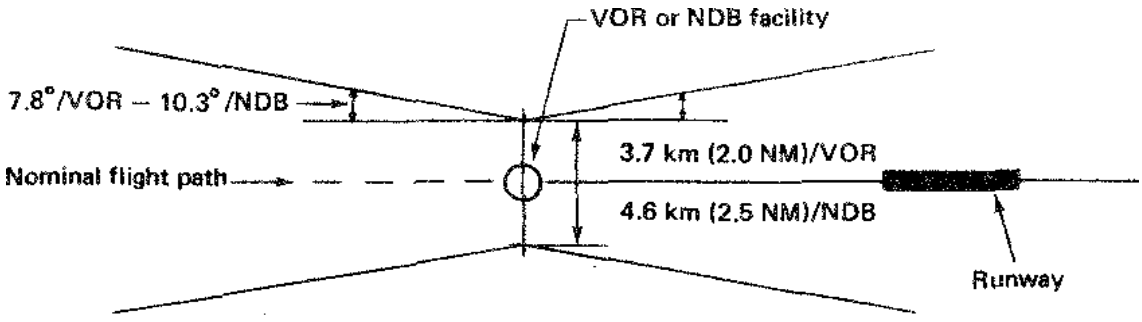


Figure 1-6

1.3.4. ILS COLLISION RISK MODEL (CRM)

The approach funnel of the OAS was designed against an over-all risk budget of one accident in 10 million approaches (i.e. a target level of safety of 1 x 10~7 per approach). One consequence was that an operational judgement was required to assess the acceptable density of obstacles in the vicinity of the OAS, although they might be below the surface itself. In addition, the OAS were overprotective in certain areas, because they were relatively simple plane surfaces designed to enclose a complex shape and to allow easy manual application. As a consequence of these factors, a more sophisticated method of relating obstacle heights and locations to total risk and OCA/H was developed. This method was embodied in a computer programme called the Collision Risk Model (CRM). It enables a far more realistic assessment of the effects of obstacles, both individually and collectively. The actual construction approach funnel (illustrated in Figure 1-8) involves some fairly detailed mathematics and cannot be done manually. However, its application is easy, because all calculations will be done by a computer. The Collision Risk Model is widely available.

1.3.5. VISUAL MANOEUVRING (CIRCLING PROCEDURE)

Visual manoeuvring (circling procedure), described in the PANS-OPS, is a visual extension of an instrument approach procedure. The size of the area for a visual manoeuvring (circling) varies with the flight speed. It is permissible to eliminate from consideration a particular sector where a prominent obstacle exists by establishing appropriate operational procedures. In many cases, the size of the area will be considerably larger than that covered by the AAR-AGA-001 inner horizontal surface. Therefore, circling altitudes/heights calculated according to PANS-OPS for actual operations may be higher than those based only on obstacles penetrating the inner horizontal surface area.

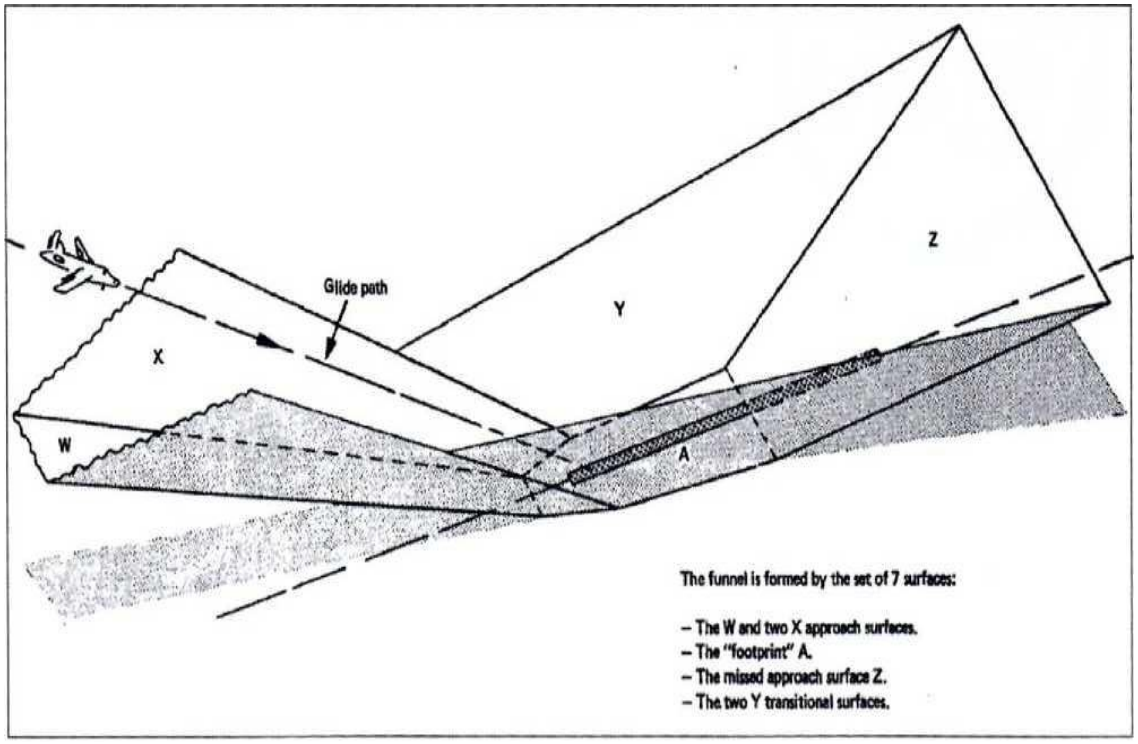
1.3.6. OPERATIONAL MINIMA

In conclusion, it must be stressed that a runway protected only by the obstacle limitation surfaces of AAR-AGA-001 will not necessarily allow the achievement of the lowest possible operational minima if it does not, at the same time, satisfy the provisions of the PANS-OPS Consequently, consideration needs to be given to objects which penetrate the PANS-OPS surfaces, regardless of whether or not they penetrate an AAR-AGA-001 obstacle limitation surface, and such obstacles may result in an operational penalty.

1.4. INNER TRANSITIONAL AND BALKED LANDING SURFACES VERSUS Y SURFACES AND MISSED APPROACH SURFACES

1.4.1. When establishing the obstacle-free zone for precision approach category II operations, the Obstacle Clearance Panel (OCP) created the inner transitional and balked landing surfaces. When developing the new approach procedures contained in PANS-OPS, Volume II, First Edition, instead of using these surfaces for obstacle assessment, the OCP used the Y surface and a new surface referred to as the missed approach surface (see Figure 1-7), Both sets of surfaces are required. In determining the need for the two sets of surfaces, the difference between the objectives of AAR-AGA-001 and PANS-OPS has to be taken into account. The surfaces in PANS-OPS are intended for assessing the impact of objects on the determination of the obstacle clearance height, which in turn is used in determining approach minima and ensuring that the minimum acceptable safety level is achieved (i.e. probability of collision with objects is not more than 1:10*7). AAR-AGA-001 surfaces are intended to define the limits around airports to which objects can extend. A further difference, and one specifically associated with

these surfaces, is that PANS-OPS provides obstacle assessment for operations down to the obstacle clearance height and, for most aeroplanes, for a missed approach with one engine inoperative executed above or at this height. The AAR-AGA-001 surfaces are intended to protect a landing from the obstacle clearance height, or a balked landing executed with all engines operative and initiated below the obstacle clearance height. In the missed approach case, the PANS-OPS surfaces, which include a missed approach surface, are the controlling surfaces. The obstacle assessment surfaces (OAS) fall below a portion of AAR-AGA-001 inner approach surface and below that portion of the transitional surface near the end of the touchdown area. In cases such as these, the AAR-AGA-001 surfaces are used to determine OCH. In the landings and balked landing, the inner transitional and balked landing surfaces are the controlling surfaces.



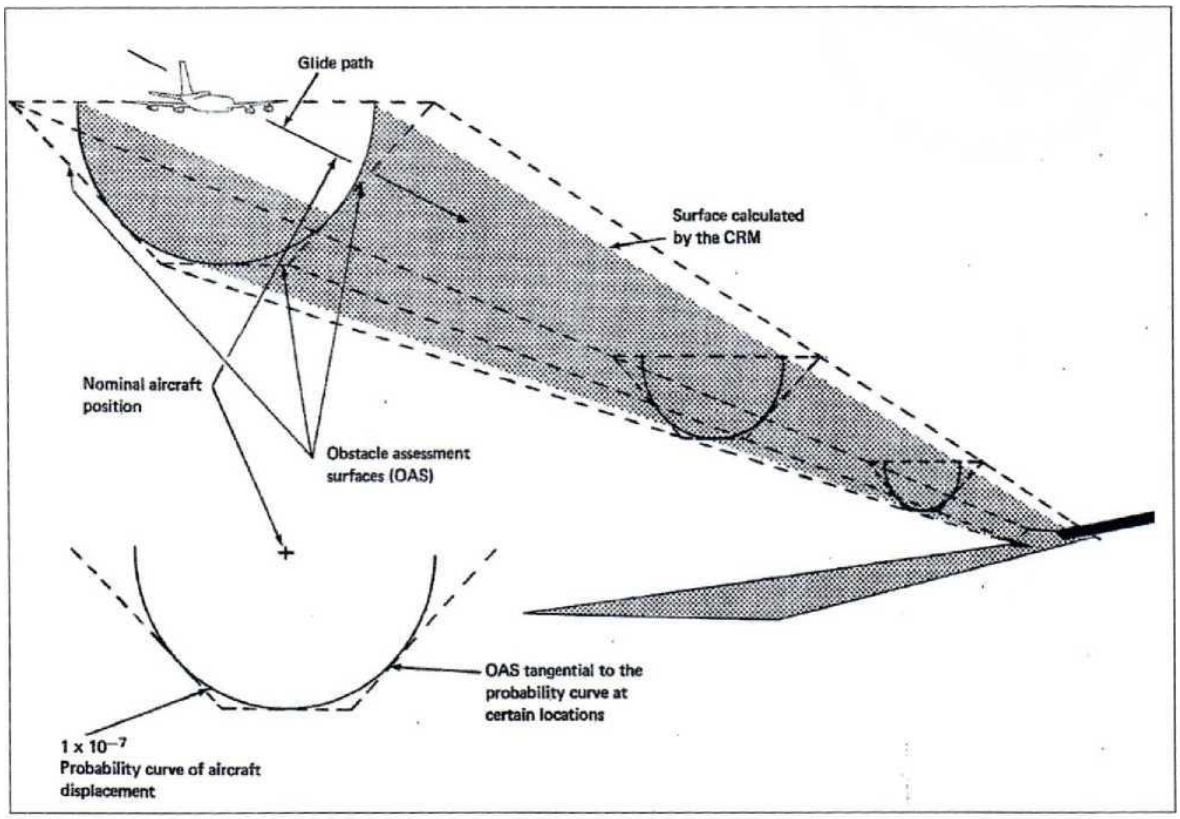


Figure 1-7. The approach funnel (OAH)

1.4.2. The PANS-OPS and AAR-AGA-001 surfaces are different for several reasons. A missed approach is to be executed at or above the obstacle clearance height. At this point, the aircraft can not be assumed to be aligned with the runway as precisely as in the case of a balked landing, as the pilot may never have had visual reference to the runway. The width required for executing the missed approach is therefore wider than for a balked landing; thus the use of the transitional surfaces, which are wider apart than the inner transitional surfaces. Secondly, since the missed approach may be assumed to be executed with one engine inoperative, the climb rate will be less than for a balked landing executed with all engines operating, and consequently the slope of the missed approach surface must be less than that of the balked landing surface. As the missed approach operation by definition has to be initiated at or above the obstacle clearance height, the origin of the missed approach surface may be closer to the threshold than that of the balked landing surface.

1.5. BACKGROUND OF THE COLLISION RISK MODEL

1.5.1. The Collision Risk Model (CRM) is a computer programme that calculates the probability of collision with obstacles by an aeroplane on an ILS approach and subsequent missed approach. The CRM was developed by the Obstacle Clearance Panel as a result of an extensive data collection programme followed by detailed mathematical analysis. The CRM is an important part of the criteria for ILS operations described in Part III of the PANS-OPS, Volume II.

1.5.2. Obstacle assessment and obstacle clearance calculations can be carried out by using obstacle assessment surfaces. However, this manual method, although simple in concept, involves tedious numerical calculations and is thus time-consuming, particularly if the number of obstacles is high. Furthermore, it suffers from two main drawbacks:

a) Firstly, the requirement that the OAS be of simple form (a set of plane surfaces) to allow easy manual application of the criteria, results in the surfaces being overprotective in certain areas, particularly in the vicinity of the runway. This is precisely the area where critical obstacles (glide path antenna, holding aircraft, etc.) are most likely to be sited. Hence, under the OAS criteria, such obstacles may unnecessarily prevent aeroplanes operating to low minima.

b) Secondly, the use of the OAS implies that these surfaces could become solid wails without any operational penalty in terms of an increase in OCA/H Clearly such a situation would degrade safety. If left entirely to the operational judgement of the procedures specialist to decide at what point there exists an excessive density of obstacles around the runway, an insufficient operational penalty could result.

1.5.3. Therefore, although the OAS criteria are designed to achieve a specified target level of safety, they may result in a greater level of safety being imposed and consequently unnecessarily prevent operations to low minima or, alternatively, they may result in the safety of operations being degraded below the required standards. The CRM has been developed in response to these problems. It will:

a) provide risk computations (separately for all obstacles and for individual obstacles) to a specific set of conditions and runway environment; and

b) provide minimum acceptable OCA/H values for a specific set of conditions and runway environment.

1.5.4. *The CRM may also be used to assist:*

a) in aerodrome planning (in evaluating possible locations for new runways in a given geographical and obstacle environment);

b) in deciding whether or not an existing object should be removed; and

c) in deciding whether or not a particular new construction would result in an operational penalty (i.e. in an increase in OCA/H).

1.5.5. ICAO-Doc 9274-AN/904 (Manual on the use of the Collision Risk Model (CRM) for ILS operations.), entitled Manual on the Use of the Collision Risk Model (CRM) for ILS Operations, provides a comprehensive description of the CRM and instructions for its use.

INTENTIONALLY LEFT BLANK

2. CONTROLLING OBSTACLES AT AN AIRPORT

2.1. BACKGROUND

2.1.1. In the early days of aviation, the rights of property owners were considered to extend from the surface downward to the center of the earth and upward to infinity. Accordingly, the owner was free to erect structures on his land to unlimited heights and any encroachment in the airspace by others constituted a trespass. This meant that aircraft could not fly over private property at any altitude without permission of each property owner. Obviously, that policy could have prevented the development of civil aviation and scheduled air transportation. Gradually, courts and legislatures have modified the ownership doctrine to specify that a property owner has exclusive rights to the airspace over his land only to the greatest height which he might reasonably be expected to use, with a right of free public transit through the air above such height.

2.1.2. When buildings encroach on the airspace needed for aircraft operations, a conflict of interest arises between property owners and airport operators. If such differences cannot be resolved, it may be necessary for the national authority charged with approving aircraft operating procedures to establish restrictions limiting operations in the interest of safety. Such restrictions might take the form of requiring displaced thresholds (resulting in a reduction in effective runway length), higher weather minima for operations, reductions in authorized aircraft masses and possibly restrictions of certain aircraft types. Any of these actions could seriously affect orderly and efficient air transportation to an airport and adversely affect the economy of the communities served by the airport.

2.1.3. Control of obstacles in the vicinity of airports is, therefore, a matter of interest and concern to national government, local communities, property owners and airport operators. There are severe legal, economic, social and political limitations to what can be achieved by any of these interests with respect to an existing airport where obstacles already exist. Even in the ideal situation of developing a new airport in an open area with no obstacles, prevention of future obstacles may be difficult because historically airports have expanded towards neighboring communities and, conversely, communities have grown towards the airport boundaries. Every effort shall be exerted by all interested parties to prevent erection of future obstacles and to remove or lower existing obstacles.

2.2. SCAA AND ITS RESPONSIIBILITY

2.2.1. SCAA generally have the basic authority and primary responsibility to establish criteria for the limitation of obstacles and to provide guidance and assistance to those directly concerned with control of obstacles. These criteria shall take the form of the obstacle limitation surfaces set forth in “1.Surfaces”, and shall be compatible with those in AAR-AGA-001, Chapter 8. In addition, national authorities shall make dear to community and airport officials the social and economic problems which may result from failure to maintain obstacle limitation surfaces free from obstacles.

2.2.2. In addition to setting criteria, SCAA shall, where feasible or necessary, authorize local community officials to adopt zoning regulations to limit heights of buildings and trees to minimize future penetrations of obstacle limitation surfaces. Also, SCAA shall authorize airport operators (or local communities) to acquire air easements or property rights (where such authority does not already exist), including the power to condemn property in the public interest by the exercise of eminent domain. SCAA may also adopt rules

and regulations designed to ensure notification of possible future obstacles in the interest or safety of aircraft operations.

2.2.3. Local community bodies such as municipal or county administrations, planning agencies and construction licensing authorities shall, when properly authorized, adopt height zoning regulations based on appropriate obstacle limitation surfaces, and limit future developments accordingly. They may require property owners or developers to give formal notice of any proposed structure which may penetrate an obstacle limitation surface. Local bodies shall co-operate closely with airport operators to ensure that the measures taken provide the greatest possible degree of safety and efficiency for aircraft operations, the maximum economic benefits to neighboring communities and the least possible interference with the rights of property owners.

2.2.4. Ultimate responsibility for limitation and control of obstacles must, in practice, rest with the airport operator. This includes the responsibility for controlling obstacles on airport property and for arranging the removal or lowering of existing obstacles outside the airport boundaries. The latter obligation can be met by negotiations leading to purchase or condemnation (where authorized) of air easements or title to the property.

2.2.5. Each airport manager shall designate a member of his staff to be responsible for the continuing process of making sure that airport approach, departure and maneuvering areas remain dear of obstacles which may jeopardize safety. The airport manager, or his designee, shall work closely with government agencies at all levels, national and local, to ensure that all possible steps have been taken to prevent erection of obstacles, including providing information to zoning authorities on the location, length, orientation and elevation of runways on which obstacle limitation surfaces are based. The airport manager must maintain constant vigilance to prevent erection of obstacles around his airport and he shall alert other agencies to potential problems which may arise under their jurisdiction, in order to fulfil these obligations, the airport manager shall establish a programme of regular and frequent visual inspections of all areas around the airport 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. This inspection programme shall also include a daily observation of all obstacle lights, both on and off the airport, and corrective action in the case of light failure.

2.2.6. In summary, once the SCAA has set forth the necessary criteria, the principal methods of controlling obstacles available to community authorities and airport operators are height zoning, purchase of easements and purchase of property. Each of these issues is dealt with in greater detail in the following paragraphs.

2.3. HEIGHT ZONING

2.3.1. Enactment of zoning regulations incorporating height limits related to airport obstacle limitation surfaces is a difficult and complex process but a necessary one. As a general rule, any community desiring to adopt such an ordinance will need legal authority to do so from a higher level of government. Even when so authorized, the effectiveness of height zoning as a means of protecting airports may be severely limited.

2.3.2. It has become a well-established principle of law that zoning cannot be so restrictive as to deprive a property owner of his right to the use of his property without adequate compensation. Many height zoning ordinances have been ruled invalid by the courts when property owners have claimed invasion of their property rights.

2.3.3. Such considerations limit the effectiveness of height zoning, particularly in the most critical areas dose to runway ends, where obstacle limitation surfaces may require very low heights. Any height zoning must recognize this fact and provide for a minimum allowable height which is reasonable in terms of existing land use in the vicinity. Even so, local opposition to aircraft operations and to any form of restrictions on use of property may give rise to Segal challenges leading to possible invalidation of any but the most carefully drafted zoning ordinance.

2.3.4. Height zoning, and indeed any form of zoning, cannot be made retroactive. Existing structures and trees which do not conform to the zoning limits are generally permitted to continue as non-conforming uses. Obstacles of this nature must be dealt with by other methods, such as purchase of easements or property rights.

2.3.5. The fact that obstacle limitation surfaces for a single airport may overlie the property of several independent communities or legal jurisdictions further complicates the problem of adopting effective zoning. Airport operators have no zoning powers and must rely on the co-operation of neighboring communities. This may involve as many as thirty or forty separate jurisdictions, some of which may be uncooperative. In some cases, higher governmental bodies have authorized the creation of regional planning groups with the power to adopt uniform zoning standards. For example, in one such instance, a state government has authorized establishment of joint airport zoning boards with membership from the airport operator and each surrounding municipality. The board is empowered to adopt land use restrictions within 3.2 km of the airport boundary under approach areas, and 1.6 km elsewhere. The board may also enact height-restriction zoning within 1,6 and 2,4 km from the airport boundary.

2.3.6. As suggested by the above, land use zoning may also be helpful in certain areas as a means of preventing erection of obstacles. Where feasible, undeveloped areas may be zoned for uses which do not normally involve tall structures. Such uses may include agriculture, recreational activities, parks, cemeteries, auto parking and low (one-story) industrial buildings.

2.3.7. Typical zoning ordinances generally include a statement of the purpose of or necessity for the action, a description of the obstacle limitation surfaces which shall conform to the surfaces described “1. Surfaces”, and a statement of allowable heights which should conform to the specifications in AAR-AGA-001, Chapter 8. Provisions are also made for a minimum allowable height, for existing non-conforming uses, for marking and lighting of obstacles and for appeals from the provisions of the ordinance.

2.4. PURCHASE OF EASEMENTS AND PROPERTY RIGHTS

2.4.1. In those areas where zoning is inadequate, such as locations dose to runway ends or where existing obstacles are present, the airport operator shall take steps to protect the obstacle limitation surfaces. These steps shall include removal or reduction in height of existing obstacles, as well as measures to ensure that no new obstacles may be erected in the future.

2.4.2. An airport authority could achieve these objectives either by purchase of easements or property rights. Of these two alternatives, the purchase of easements would often prove to be more simple and economical. In this case, the airport authority secures the consent of the owner after paying suitable compensation) to lower the height of the obstacle in question. This may be done by direct negotiation with the property owner. Such an agreement shall also include a provision to prevent erection of future

obstacles, if height zoning limits are not in effect or are inadequate to protect obstacle limitation surfaces.

2.4.3. Where negotiations to obtain easements are not successful, then the airport operator should give consideration to the second alternative, i.e. purchase of the property. The airport operator could resort to the acquisition of the property by condemnation if the government has authorized such action. In such cases, the airport operator must pay a reasonable compensation to the property owner, i.e. at the fair market value of the property.

2.4.4. One major airport operator has been specifically authorized to use the power of condemnation for obstacle clearance to a maximum distance of 4.8 km from the ends of the runways. Condemnation of property for the purpose of installing navigational aids is also authorized, but without the restriction as to distance.

2.4.5. Purchase of property rights involves several obstacles. If the property to be acquired would be removed from the tax rolls, as is often the case when the airport is publicly owned, the community officials and the airport neighbors may oppose the action because of the added tax burden on other properties. Also, neighbors of the affected property may object to acquisition by the airport for a number of reasons. Ownership of property which is not needed for airport purposes may be a burden to the airport operator because of the added expense of maintaining the property.

2.4.6. The tax exemption problem could be met by agreement to pay a sum in lieu of taxes, but this could be an extra expense to the airport operator for property which is not really needed. A better solution, where feasible, would be to sell the bulk of the property to private owners subject to protective covenants designed to prevent creation of future obstacles. Resale of property would, of course, have to be consistent with applicable zoning in the area. Beyond a distance of about 300 m from a runway end and land needed for approach lighting systems or other navigational aids, the airport operator should be able to sell most other land subject to appropriate height and use restrictions. Such sales would help to recover a substantial part of the cost of acquisition, would eliminate the continuing cost of maintenance and would return the land to the tax rolls. Appropriate use restrictions would include if such uses are authorized by zoning regulations and acceptable to the community.

2.5. NOTIFICATION OF PROPOSED CONSTRUCTION

2.5.1. One of the difficult aspects of obstacle control is the problem of anticipating new construction which may penetrate obstacle limitation surfaces. Airport operators have no direct means of preventing such developments. As noted above, they should conduct frequent inspections of the airport environs to learn of any such projects. Although there is no legal obligation for airport operators to report proposed construction when they become aware of it, their own self-interest and the need to protect the airport indicate the wisdom of bringing such matters to the attention of the appropriate authorities. Of course, where an obstacle is to be located on airport property, such as electronic or visual aids, the airport operator is responsible for reporting such projects.

2.5.2. Several countries have enacted legislation or adopted regulations designed to assign responsibility for reporting new construction projects. The obligation to report such construction may rest with local agencies such as planning bodies or construction licensing authorities or with the developer himself. In some cases, height limits have been specified; these are generally consistent with the criteria of AAR-AGA-001,

Chapter 8, below which local authorities may authorize a project without higher review. If any part of a proposed development appears to penetrate an obstacle limitation surface, then the project should be referred to the appropriate civil aviation authority for review. This review would examine the effect of the envisaged construction on air navigation in general and on operational procedures in use in particular. If the conclusion of the above study is that the proposed construction can be permitted under some conditions, these should also be identified, e.g. display of obstacle marking and lighting, compliance with other appropriate measures for continued safety of air navigation, etc. Finally, all concerned should be notified of the new construction through charts (in accordance with AAR-Aeronautical Charts (AAR-ANS-003) and through Notices to Airmen (NOTAM) or Aeronautical Information Publications (AIP) pursuant to AAR-Aeronotical Information Service (AAR-ANS-005).

2.6. ESTABLISHMENT OF OBTACLE LIMITATION SURFACES

2.6.1. The following obstacle limitation surfaces are essential elements of a height zoning regulation associated with a precision approach runway:

a) conical surface,

b) inner horizontal surface;

c) approach surface;

d) transitional surfaces; and

e) balked landing surface.

Of these surfaces, only the balked landing surface does not form part of the height zoning regulations for noninstrument and non-precision approach runways. In the case of take-off runways, the only surface which affects the height zoning regulation is the take-off climb surface. The dimensions and slopes of ail of the above-mentioned surfaces are specified in AAR-AGA-001, Tables 4-1 and 4-2, and a brief description of the surfaces also appears in Chapter 1 of this Manual.

2.6.2. SCAA should establish obstacle limitation surfaces consistent with those defined in AAR-AGA-001. Airport operators should provide SCAA and local planning bodies (for use in developing height zoning limits) with pertinent information about each airport, including:

a) location, orientation, length and elevation of all runways,

b) locations and elevations of all reference points used in establishing obstacle limitation surfaces,

c) proposed categories of runway use — non-instrument, non-precision approach or precision approach (category I, II or III);

d) plans for future runway extension or change in category.

2.6.3. It would be desirable to base all obstacle limitation surfaces on the most critical airport design features anticipated for future development, since it is always easier to relax a strict standard than to increase the requirements of a lesser standard if plans are changed. Some major airports make a practice of attempting to protect all runways to the standards required for category III precision approaches, to maintain maximum flexibility for future development.

2.6.4. *Aerodrome reference point.* AAR-AGA-001 calls for the establishment of an aerodrome reference point to be used as the designated geographical location of the aerodrome. This reference point should be located near the geometric center of the aerodrome. Locations of aerodrome reference points should be measured and reported to the nearest second of latitude and longitude. These figures may also be converted into terms of local grid systems for the convenience of community authorities concerned with zoning or limitation of construction. Elevations of reference points should be measured and reported to the nearest meter above a specified datum, such, as mean sea level.

2.6.5. *Inner horizontal surface.* Although AAR-AGA-001 does not specify a point of origin for the inner horizontal surface, a common usage has evolved in several major aeronautical States. Originally, the inner horizontal surface was defined as a circle with its center at the airport reference point. As airports grew huger and runway patterns became more complex, this circle proved inadequate, and efforts were made to describe a larger surface by designating a secondary reference point and constructing an elliptical sort ace based on the two reference points as foci. More recently, has been found preferable to designate a reference point at or near each runway end. These reference points are usually located at the end of the runway strip (60 m from the. runway end where the runway code number is 3 or 4) and on the extended runway center line. The inner horizontal surface is then constructed by striking an arc of the proper radius from each such reference point. The boundary of the surface is completed by straight lines tangent to adjacent arcs. Such a surface is illustrated in Figure 1-2. The conical surface originates from the periphery of the surface so constructed. Where significant differences exist between runway end elevations (of the order of 6 m or more), it would be desirable to establish the elevation of the inner horizontal surface 45 m above the lowest reference point élévation to provide a greater margin of safety.

2.7. OBSTACLE SURVEYS

2.7.1. Identification of obstacles requires a complete engineering survey of all areas underlying the obstacle limitation surfaces. Such surveys are generally conducted by governmental authorities with the co-operation of the airport operator (see Chapter 4 of this manual). In the absence of a governmental survey, the airport operator should consider making the necessary survey with his own staff or with the assistance of a consultant or local operators.

2.7.2. *Initial survey.* The initial survey should produce a chart presenting a plan view of the entire airport and its environs to the outer limit of the conical surface (and the outer horizontal surface where established), together with profile views of all obstacles limitation surfaces. Each obstacle should be identified in both plan and profile with its description and height above the datum, which should be specified on the chart. More detailed requirements are contained in Chapters 3 and 4 of AAR-Aeronautical Charts (AAR-ANS-003), describing Aerodrome Obstruction Charts. Engineering field surveys may be supplemented by aerial photographs and photogrammetry to identify possible obstacles not readily visible from the airport.

2.7.3. *Periodic surveys.* The airport operator should, as previously suggested, make frequent visual observations of surrounding areas to determine the presence of new obstacles. Follow-up surveys should be conducted whenever significant changes occur. A detailed survey of a specific area may be necessary when the initial survey indicates the presence of obstacles for which a removal programme is contemplated. Following completion of an obstacle removal programme, the area should be resurveyed to

provide corrected data on the presence or absence of obstacles. Similarly, revision surveys should be made if changes are made (or planned) in airport characteristics such as runway length, elevation or orientation. No firm rule can be set down for the frequency of periodic surveys, but constant vigilance is required. Changes in obstacle data arising from such surveys should be reported to the aviation community in accordance with the provisions of AAR-Aeronotical Information Service (AAR-ANS-005).

2.8. REMOVAL OF OBSTACLES

2.8.1. When obstacles have been identified, the airport operator, with the assistance of local community agencies, shall make every effort to have them removed or reduced in height so that they no longer constitute an obstacle. This will require negotiation with the owner of the property. If the obstacle is a single object such as a tree, a television antenna or a chimney, it may be possible to reach agreement to reduce the height to acceptable limits without adverse effect. In other cases, such as a building, it may be necessary to arrange for removal of the entire structure. This will, in all probability, require purchase or condemnation of the property. In either case, the airport operator must be prepared to compensate the property owner for any loss of value.

2.8.2. Where agreement can be reached for the reduction in height of an existing obstacle, the agreement shall include a written aviation easement limiting future heights over the property to specific levels which conform to the pertinent obstacle limitation surfaces, unless effective height zoning has been established (see Sections 2.3 and 2.4 above).

2.8.3. *Trees.* 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 trees when necessary or by permitting access to the premises for the purpose of having such trimming done by representatives of the airport operator.

2.8.4. Some aids to navigation, both electronic (such as ILS components) and visual (such as approach and runway lights), constitute obstacles which cannot be removed. Such objects shall be frangibly designed and constructed, and mounted on frangible couplings so that they will fail on impact without damage to an aircraft. G-AGA-013 (Frangibility Manual) requirements of visual and non-visual aids to navigation is contained in Chapter 5 of this manual. Where necessary, such objects shall be marked and/or lighted.

2.9. SHIELDING

2.9.1. In many countries the principle of shielding is employed to permit a more logical approach to restricting new construction and prescribing obstacle marking and lighting. It also reduces the number of cases of new construction requiring review by authorities. Shielding principles are employed when some object, an existing building or natural terrain, already penetrates above one of the obstacle limitation surfaces described in AAR-AGA-001. 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.

2.9.2. The principle of shielding introduced to AAR-AGA-001. Though the use of shielding recognized in the specifications of AAR-AGA-001, it did not draft specifications concerning the details of its employment. It was discussed how shielding should be employed but decided to leave this material as guidance for the present time.

2.9.3. It was generally agreed that the formula for shielding should be based on a horizontal plane projected from the top of each obstacle away from the runway and a plane with a negative slope of 10 per cent towards the runway. Any object which is below either of the two planes would be considered shielded. The permission to allow objects to penetrate an obstacle limitation surface under the shielding principle should, however, be qualified by reference to the need for an aeronautical study in all cases.

2.9.4. The shielding effect of immovable obstacles laterally in approach and take-off climb areas is more uncertain. In certain circumstances, it may be advantageous to preserve existing unobstructed cross- section areas, particularly when the obstacle is close to the runway. This would guard against future changes in either approach or take-off climb area specifications or the adoption of a turned take-off procedure.

2.9.5. The permanency of the immovable obstacle which is to be considered as shielding an area should be given very careful review. An object should be classed as immovable only if, when taking the longest view possible, there is no prospect of removal being practicable, possible or justifiable, regardless of how the pattern, type or density of air operations might change.

2.9.6. In use, the methods for determining the extent of area shielded by a permanent obstacle and permissible height limits around it vary between States. It has often been found difficult to apply firm policies on this matter, and generally an aeronautical study is carried out to review the exact effect the construction of a new object will have.

2.10. MARKING AND LIGHTING OF OBSTACLES

2.10.1. Where it is impractical to eliminate an obstacle, it shall be appropriately marked and/or lighted so as to be dearly visible to pilots in all weather and visibility conditions. AAR-AGA-001, Chapter 10 contains detailed requirements concerning marking and/or lighting of obstacles. Some guidance on the characteristics of high intensity obstacle lights is included in the G-AGA-014 (Visual Aids).

2.10.2. It shall be noted that the marking and lighting of obstacles is intended to reduce hazards to aircraft by indicating the presence of obstacles. It does not necessarily reduce operating limitations which may be imposed by the obstacle. AAR-AGA-001 specifies that obstacles be marked and, if the airport is used at night, lighted, except that:

a) such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle; and

b) the marking may be omitted when the obstacle is lighted by high intensity obstacle lights by day.

Vehicles and other mobile objects, excluding aircraft, on movement areas of airports should be marked and lighted, unless used only on apron areas

2.10.3. Installation and maintenance of required marking and lighting may be done by the property owner, by community authorities or by the airport operator. The airport operator should make a daily visual inspection of all obstacle lights on and around the airport, and take steps to have inoperative lights repaired, in some cases, principally at commercial or industrial sites, the property owner may provide for maintenance, repair and replacement of lights. Otherwise, the airport operator should have agreements permitting his representatives to enter the property and perform the necessary maintenance. Many airport operators have found it helpful to use dual light fixtures with

an automatic switch to the second light fixture if the first one sails. Such an arrangement provides greater assurance of continued obstacle lighting and reduces the number of visits to replace inoperative lamps.

2.11. REPORTING OF OBSTACLES

2.11.1. AAR-AGA-001, Chapter 6 (Aerodrome data) specifies that the location, top elevation and type of each significant obstacle on or in the vicinity of an aerodrome snail be made available. Specifications concerning the services to which the above details are to be made available and the manner in which they are to be published are prescribed in AAR-Aeronautical Charts and AAR-Aeronotical Information Service. From the standpoint of safety and regularity of civil aviation, every effort should be made to comply with the above requirements.

2.11.2. Whenever an obstacle, either temporary or permanent in nature, is identified, it shall be reported promptly to the SCAA. To this end, the airport operator conducting the obstacle survey shall be responsible for seeing that information on obstacles is promptly transmitted to the authority responsible for disseminating aeronautical information, viz. aeronautical information service. Reporting of new construction may be done by the project sponsor, the local planning body, the construction licensing authority or the airport operator. The airport operator has the most direct interest in seeing that information is properly disseminated and, through visual inspections and periodic surveys, is most likely to be aware of the presence of new obstacles. It is, therefore, in his best interest for the airport operator to report all data on obstacles, including marking and lighting, to the aeronautical information service for further distribution. Reports may be verbal, but should be confirmed in writing as soon as possible.

2.11.3. AAR-Aeronotical Information Service contains detailed requirements on methods of disseminating aeronautical information, including data on obstacles. In addition to NOTAM, which may be given either Class I distribution (by means of telecommunication) or Class 0 (by other means), material may be issued in the form of Aeronautical Information Publications (AIPs) or Aeronautical Information Circulars. Where a critical situation may exist, information should be disseminated by verbal reports from the air traffic control to aircraft in the vicinity. AIPs should contain (among other items) current information on obstacles and obstacle marking and lighting. Each AIP should be amended or reissued at regular intervals as may be necessary to keep it up to date.

2.11.4. Obstacle information from obstacle surveys or other sources, such as reports from airport operators, is also presented in the form of Aerodrome Obstruction Charts A and B, Instrument Approach Charts, Visual Approach Charts and Landing Charts, which are described in Chapters 3, 4, 8, 11 and 12 of AAR-Aeronautical Charts . Charts produced in conformity with the provisions of AAR-Aeronautical Charts may form a part of the AIP, or may be distributed separately to recipients of the AIP.

2.11.5. A high degree of co-operation among government and local authorities, airport operators and property owners is required to control obstacles and to provide a safe environment for efficient operation of aircraft at airports.

INTENTIONALLY LEFT BLANK

3. TEMPORARY HAZARDS. PREFERRED PROCEDURE FOR DEALING WITH TEMPORARY HAZARDS ON RUNWAY STRIPS

3.1. INTRODUCTION

3.1.1. The term “temporary hazard’’ includes work in progress at the sides or ends of a runway in connection with airport construction or maintenance. It also includes the plant, machinery and material arising from such work and aircraft immobilized near runways.

3.1.2. The prime responsibility for determining the degree of hazard and the extent of tolerable obstacle must ultimately rest with the competent authority who should take into account:

a) runway width available;

b) types of aircraft using the airport and distribution of traffic;

c) whether or not alternative runways are available;

d) the possibility of cross-wind operations, bearing in mind seasonal wind variations;

e) the weather conditions likely to prevail at the time, such as the visibility and precipitation. The latter is significant as it adversely affects the braking coefficient of the runway, and thus an aircraft’s controllability during ground run;

f) the possibility of a compromise between a reduction in runway length and some degree of the approach surface infringement.

3.1.3. All such hazards should be promulgated by NOTAM and marked and lighted in accordance with the requirements of AAR-AGA-001. For unforeseeable hazards, such as aircraft running off runways, pilots must be informed by Air Traffic Control of the position and nature of the hazard.

3.2. RESTRICTIONS FOR NON-INSTRUMENT AND NON-PRECISION APPROACH RUNWAYS

3.2.1. Three zones alongside runways can be identified and are shown on Figure 3-1 as I, II and III.

Zone I

3.2.2. This zone ties within:

23 m of the runway edge where the runway code number is 2, 3 or 4;

21 m of the runway edge where the runway code number is 1.

3.2.3. Work may take place in this zone on only one side of the runway at a time. The area of the obstacle should not exceed 9 m^2, but narrow trenches may exceptionally be allowed up to 28 m^2 Any obstacle permitted should be limited in height to provide propeller or pod clearance for the type of aircraft using the aerodrome, and in no case should the height exceed 1 m above the ground. Any piles of earth or debris which could damage aircraft or engines must be removed. Trenches and other excavations should be backfilled and compacted as soon as possible.

3.2.4. No plant or vehicles should operate in this zone when the runway is in use.

3.2.5. An aircraft immobilized in this zone would automatically require the closure of the runway.

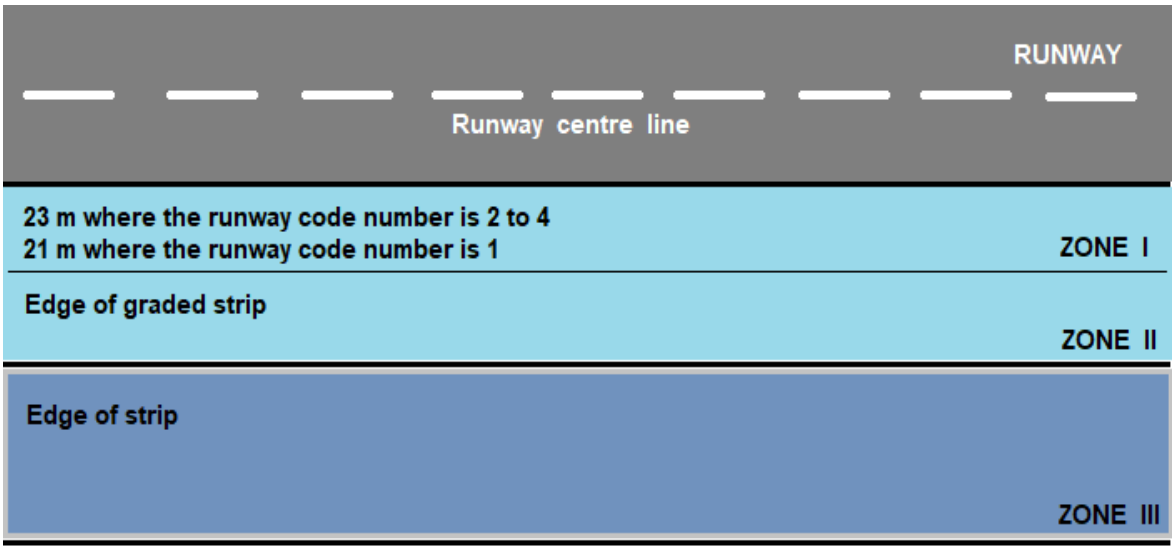


Figure 3-1. Limits of zones

Zone II

3.2.6. This zone extends from the outer edge of Zone I to the edge of the graded strip for each class of runway.

3.2.7. The restrictions to be applied depend on the type of operation taking place and the weather conditions.

3.2.8. With a dry runway and not more than 15 kt cross-wind component for runways of code number 4, and 10 kt cross-wind component for runways of code number 2 or 3, the following work may be permitted:

a) Visual flight conditions

1) Unrestricted areas of construction, with the length of excavation or excavated material parallel to the runway being kept to a minimum. The overall height of excavated material shall be limited to 2 m above the ground.

2) All construction equipment should be mobile and kept within normal height limits,

3) The runway may continue in use when an aircraft is immobilized in this zone.

b) Instrument flight conditions

1) Unrestricted areas of construction, with the length of excavation or excavated material parallel to the runway being kept to a minimum. The overall height of excavated material shall be limited to 2 m above the ground.

2) All construction equipment should be mobile and kept within normal height limits.

3) When an aircraft becomes immobilized in this zone, the runway should be closed.

Zone III

3.2.9. This zone applies only to non-precision approach runways used in conditions of poor visibility or low cloud base. It extends outwards from the edge of the graded strip to the edge of the strip required for missed approaches, i.e. 150 m from the runway center line.

3.2.10. There are no restrictions on the work in this area. However, care must be taken to ensure that the work and the vehicles associated with the work do not interfere with the operation of radio navigational aids. The critical zones for radio aids are described in AAR- Radio Navigation Aids (AAR-ANS-016).

Note: *Contractor's permanent and semi-permanent plant and mobile equipment withdrawn from the strips should not infringe the transitional surfaces described in AAR-AGA-001.*

Runway ends

3.2.11. In the case of work adjacent the runway ends, the maximum possible use should be made of alternate runways or the displacement of the threshold so that the obstacle does not fall within the effective strip length or penetrate the associated approach surfaces. However, where landing distance may be critical, it may be safer to permit such an infringement near the runway end rather than displace the threshold.

3.3. RESTRICTIONS FOR PRECISION APPROACH RUNWAYS

3.3.1. Precision approach runways category III. ICAO Circular 148, entitled Surface Movement Guidance and Control Systems, details what special procedures shall be followed to ensure safety when operations are taking place under low visibility conditions. The restrictions concerning the movement of vehicles and personnel detailed therein should be observed. In particular, no work should be permitted on any part of the movement area when the runway is being used. All equipment shall be outside the obstacle-free zone and all personnel should be withdrawn from the movement area. The restrictions concerning the height of piles and debris in and 3.2.8 are equally applicable to precision approach runways category III.

3.3.2. Precision approach runways category I and II. No work should be permitted within the OFZ when the runway is in use. All equipment and personnel should be outside the obstacle-free zone. The restrictions concerning the height of piles and debris in 3.2.3 and are equally applicable to these runways.

3.4. PRE-CONSTRUCTION MEETING

3.4.1. It is an excellent practice for the contractor, airport operator and traffic control authority (where traffic control exists) to meet well in advance of the start of construction. This meeting can then consider such matters as discussed above, and agree on:

a) means of control of construction vehicles so as to minimize interference with aircraft operations;

b) scheduling of construction activities to conform as much as possible to periods of minimum aircraft activity;

c) disposal of excavated material, storage of construction materials and equipment, and conditions of work site at the end of the period of work.

4. AIRPORT EQUIPMENT AND INSTALLATIONS WHICH MAY CONSTITUTE OBSTACLES

4.1. INTRODUCTION

4.1.1. All fixed 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, are obstacles. Certain airport equipment and installations, because of their air navigation functions, must inevitably be so located and/or constructed that they are obstacles. Equipment or installations other than these should not be permitted to be obstacles. This Chapter discusses the siting and construction of airport equipment and installations which of necessity must be located on: a runway strip; a runway end safety area; a taxiway strip, or within the taxiway clearance distance specified in AAR-AGA-001, Table 3-1, columns 5 and 6; or on a clearway, if it would endanger an aeroplane in the air.

4.1.2. When airport equipment, such as a vehicle or plant, is an obstacle, it is generally a temporary obstacle. However, when airport installations, such as visual aids, radio aids and meteorological installations, are obstacles, they are generally permanent obstacles.

4.1.3. Any equipment or installation which is situated on an airport and which is an obstacle should be of minimum practicable mass and height and be sited in such a manner as to reduce the hazard to aircraft to a minimum. Additionally, any such equipment or installation which is fixed at its base should incorporate frangible mountings.

4.1.4. The degree to which equipment and installations can be made to conform to the desired construction characteristics is often dependent on the performance requirements of the equipment or installation concerned. For example, frangibility and low-mass construction characteristics may have an adverse effect on the rigidity of a transmissometer support.

4.1.5. Many factors must be considered in the selection of aid fixtures and their mounting devices to ensure that the reliability of the aids is maintained and that the hazard to aircraft in flight or maneuvering on the ground is minimal. It is therefore important that appropriate structural characteristics of all aids which may be obstacles be specified and published as guidance material for designers.

4.2. FRANGYBILITY

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

4.2.2. An object which meets the above requirements is said to be frangible.

4.3. TYPES OF AIRPORT EQUIPMENT AND INSTALLATION WHICH MAY CONSTITUTE OBTACLES

4.3.1. GENERAL

4.3.1.1. There are many types of airport equipment and installations which, because of their particular air navigation functions, must be so located that they constitute obstacles. Such airport equipment and installations include;

a) ILS glide path antennas

b) ILS inner marker beacons;

c) ILS localizer antennas;

d) wind direction indicators;

e) landing direction indicators;

f) anemometers;

g) ceilometers;

h) transmissometers;

i) elevated runway edge, threshold, end and stopway lights:

j) elevated taxiway edge lights;

k) approach lights;

l) visual approach slope indicator system (VASIS) lights;

m) signs and markers;

n) components of the microwave landing system (MLS);

o) certain radar and other electronic installations and other devices not itemized above;

p) VOR or VOR/DME when located on aerodromes;

q) precision approach radar systems or elements;

r) VHF direction finders; and

s) airport maintenance equipment, e.g. trucks, tractors.

4.3.1.2. There is wide variation in the structural characteristics of these aids currently in use. Nevertheless, it is necessary that States develop material on appropriate structural characteristics of these aids for the guidance of designers.

APPENDIX – INFLUSTRATION OF OBSTACLE LIMITATION SURFACES OTHER THAN THOSE CONSTITUTING AN OBSTACLE-FREE ZONE

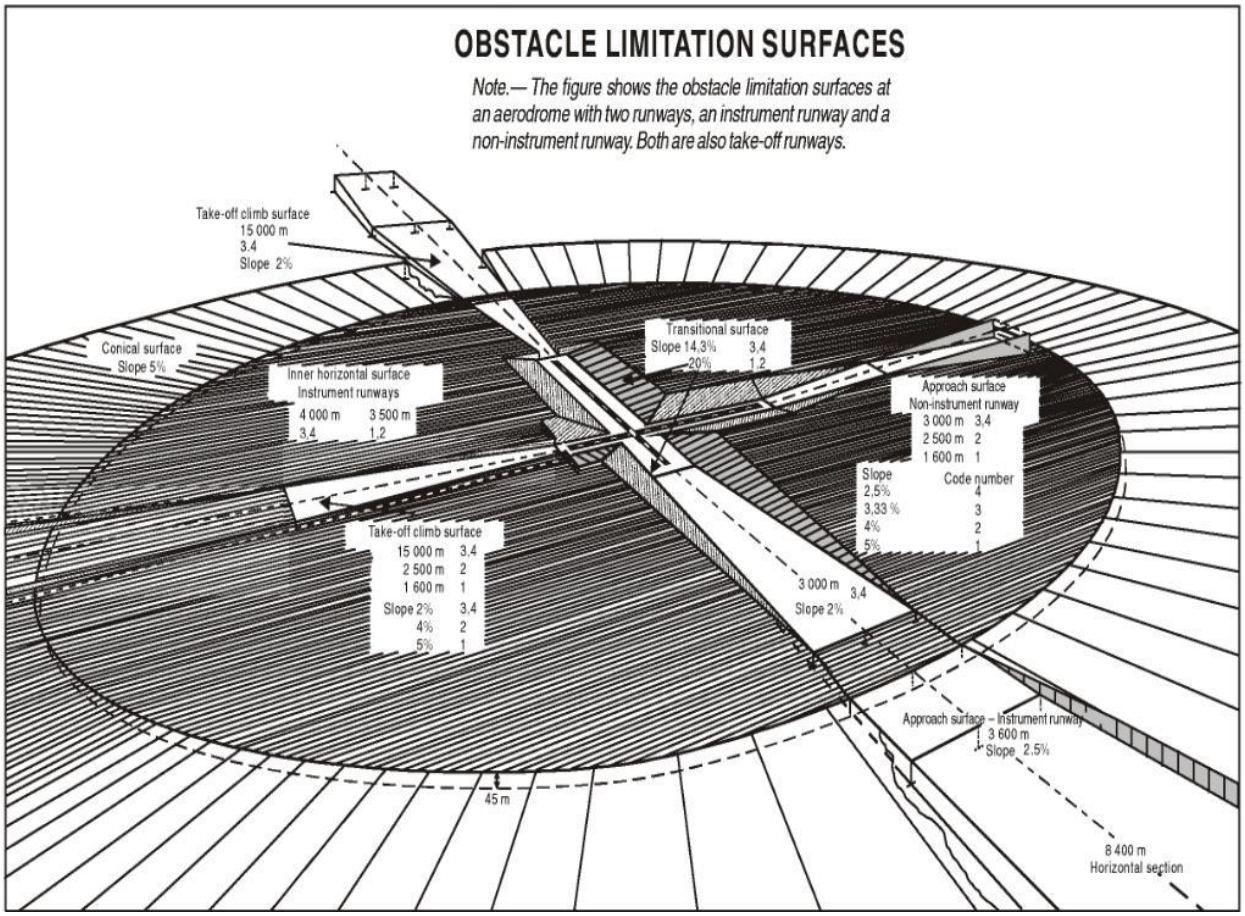


Figure A-1-1

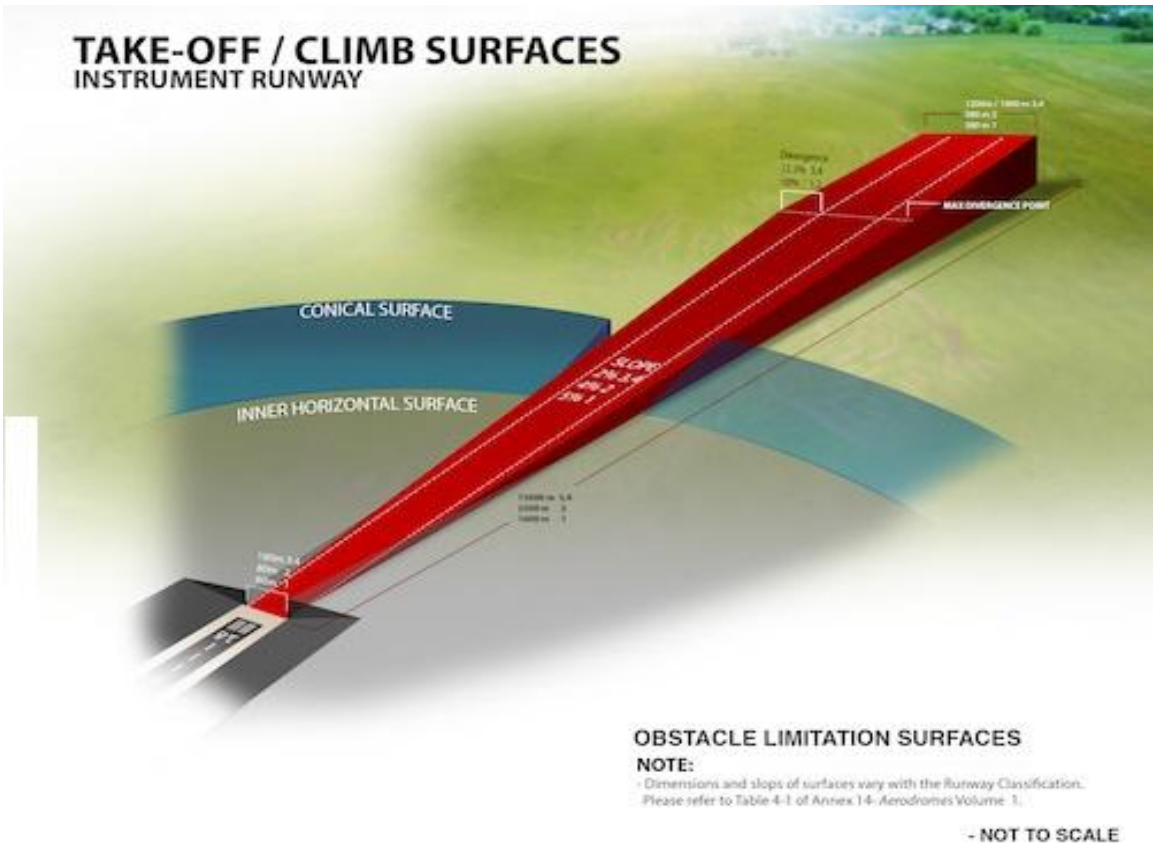


Figure A-1-2

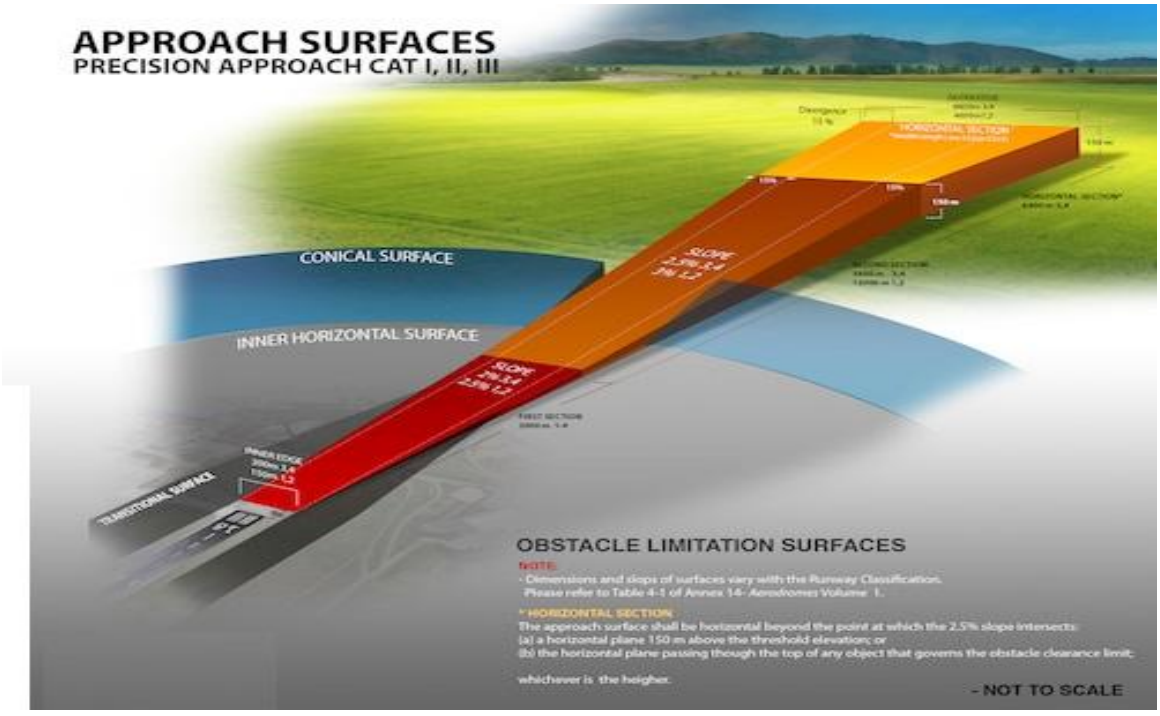


Figure A-1-3