CHAPTER 4 - OBSTACLE RESTRICTION AND REMOVAL

4.1 Introduction

4.1.1 This chapter describes obstacle limitation surfaces around an aerodrome that are to be maintained free from obstacles.

4.1.2 The shielding principles to be used for assessing whether an existing obstacle shields another one or a new one is explained in section 4.3 of this manual.

4.1.3 An aerodrome operator shall establish a systematic means of surveying and monitoring any object that penetrates these surfaces and report any penetration immediately to the Authority’s Safety Division and to promulgate them through the Aeronautical Information Services and air traffic services unit so that aeroplane operations can be conducted safely at all times.

4.1.4 When requested, an aerodrome operator shall also work jointly with the Authority’s Safety Division to plan and determine the allowable height limits for new developments in the vicinity of and outside its aerodrome and the type of instrument or visual flight operations that may be permitted taking the obstacle survey plan into account.

4.2 Obstacle limitation

Note 1 – The objectives of the specifications in this chapter are to define the airspace around aerodromes to be maintained free from obstacles so as to permit the intended aeroplane operations at the aerodromes to be conducted safely and to prevent the aerodromes from becoming unusable by the growth of obstacles around the aerodromes. This is achieved by establishing a series of obstacle limitation surfaces that define the limits to which objects may project into the airspace.

Note 2 — Objects which penetrate the obstacle limitation surfaces contained in this chapter may in certain circumstances cause an increase in the obstacle clearance altitude/height for an instrument approach procedure or any associated visual circling procedure or have other operational impact on flight procedure design. Criteria for evaluation obstacles are contained in Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS, Doc 8168).

Note 3 – The establishment of, and requirements for, an obstacle protection surface for visual approach slope indicator systems are specified in paragraphs 5.2.3.5.41 to 5.2.3.5.45 of this Manual.

4.2.1 Obstacle limitation surfaces

Note – See ICAO Annex 14 Vol. I, Figure 4.1.
Outer horizontal surface

*Note – Guidance on the need to provide an outer horizontal surface and its characteristics is contained in the ICAO Airport Services Manual, Part 6.*

Conical surface

4.2.1.1 Description – Conical surface - A surface sloping upwards and outwards from the periphery of the inner horizontal surface.

4.2.1.2 Characteristics – The limits of the conical surface shall comprise:

a) a lower edge coincident with the periphery of the inner horizontal surface; and
b) an upper edge located at a specified height above the inner horizontal surface.

4.2.1.3 The slope of the conical surface shall be measured in a vertical plane perpendicular to the periphery of the inner horizontal surface.

Inner horizontal surface

4.2.1.4 Description – Inner horizontal surface. A surface located in a horizontal plane above an aerodrome and its environs.

4.2.1.5 Characteristics – The radius or outer limits of the inner horizontal surface shall be measured from a reference point or points established for such purpose.

*Note: - The shape of the inner horizontal surface needs not necessarily to be circular. Guidance on determining the extent of the inner horizontal surface is contained in the ICAO Airport Services Manual, Part 6.*

4.2.1.6 The height of the inner horizontal surface shall be measured above an elevation datum established for such purpose.

*Note - Guidance on determining the elevation datum is contained in the ICAO Airport Services Manual, Part 6.*

Approach surface

4.2.1.7 Description – Approach surface. An inclined plane or combination of planes preceding the threshold

4.2.1.8 Characteristics – The limits of the approach surface shall comprise:

a) an inner edge of specified length, horizontal and perpendicular to the extended centre line of the runway and located at a specified distance before the threshold;

b) two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended centre line of the runway; and

c) an outer edge parallel to the inner edge.
4.2.1.9 The elevation of the inner edge shall be equal to the elevation of the mid-point of the threshold.

4.2.1.10 The slope(s) of the approach surface shall be measured in the vertical plane containing the centre line of the runway.

**Inner approach surface**

4.2.1.11 Description – Inner approach surface - A rectangular portion of the approach surface immediately preceding the threshold.

4.2.1.12 Characteristics – The limits of the inner approach surface shall comprise:

a) an inner edge coincident with the location of the inner edge of the approach surface but of its own specified length;

b) two sides originating at the ends of the inner edge and extending parallel to the vertical plane containing the centre line of the runway; and

c) an outer edge parallel to the inner edge.

**Transitional surface**

4.2.1.13 Description – Transitional surface-A complex surface along the side of the strip and part of the side of the approach surface, the slopes upwards and outwards to the inner horizontal surface.

4.2.1.14 Characteristics – The limits of the transitional surface shall comprise:

a) a lower edge beginning at the intersection of the side of the approach surface with the inner horizontal surface and extending down the side of the approach surface to the inner edge of the approach surface and from there along the length of the strip parallel to the runway centre line; and

b) an upper edge located in the plane in the inner horizontal surface.

4.2.1.15 The elevation of a point on the lower edge shall be:

a) along the side of the approach surface – equal to the elevation of the approach surface at that point; and

b) along the strip – equal to the elevation of the nearest point on the centre line of the runway or its extension.

*Note – As a result of b), the transitional surface along the strip will be curved if the runway profile is curved or a plane if the runway profile is a straight line. The intersection of the transitional surface with the inner horizontal surface will also be a curved or a straight line depending on the runway profile.*
4.2.1.16 The slope of the transitional surface shall be measured in a vertical plane at right angles to the centre line of the runway.

**Inner transitional surface**

*Note – It is intended that the inner transitional surface be the controlling obstacle limitation surface for navigation aids, aircraft and other vehicles that must be near the runway and which is not be penetrated except for frangible objects. The transitional surface described in paragraph 4.2.1.13 of this Manual is intended to remain as the controlling obstacle limitation surface for buildings, etc.*

4.2.1.17 Description – Inner transitional surface-A surface similar to the transitional surface but closer to the runway.

4.2.1.18 Characteristics – The limits of an inner transitional surface shall comprise:

a) a lower edge beginning at the end of the inner approach surface and extending down the side of the inner approach surface to the inner edge of that surface, from there along the strip parallel to the runway centre line to the inner edge of the balked landing surface and from there up the side of the balked landing surface to the point where the side intersects the inner horizontal surface; and

b) an upper edge located in the plane of the inner horizontal surface.

4.2.1.19 The elevation of a point on the lower edge shall be:

a) along the side of the inner approach surface and balked landing surface – equal to the elevation of the particular surface at that point; and

b) along the strip – equal to the elevation of the nearest point on the centre line of the runway or its extension.

*Note – As a result of b), the inner transitional surface along the strip will be curved if the runway profile is curved or a plane if the runway profile is a straight line. The intersection of the inner transitional surface with the inner horizontal surface will also be a curved or a straight line depending on the runway profile.*

4.2.1.20 The slope of inner transitional surface shall be measured in a vertical plane at right angles to the centre line of the runway.

**Balked landing surface**

4.2.1.21 Description – Balked landing surface-An inclined plane located at a specified distance after the threshold, extending between the inner transitional surfaces.

4.2.1.22 Characteristics – The limits of the balked landing surface shall comprise:

a) an inner edge horizontal and perpendicular to the centre line of the runway and location at a specified distance after the threshold;
b) two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the vertical plane containing the centre line of the runway; and

c) an outer edge parallel to the inner edge and located in the plane of the inner horizontal surface.

4.2.1.23 The elevation of the inner edge shall be equal to the elevation of the runway centre line at the location of the inner edge.

4.2.1.24 The slope of the balked landing surface shall be measured in the vertical plane containing the centre line of the runway.

**Take-off climb surface**

4.2.1.25 Description – Take-off climb surface. An inclined plane or other specified surface beyond the end of a runway or clearway.

4.2.1.26 Characteristics – The limits of the take-off climb surface shall comprise:

a) an inner edge horizontal and perpendicular to the centre line of the runway and located either at a specified distance beyond the end of the runway or at the end of the clearway when such is provided and its length exceeds the specified distance;

b) two sides originating at the ends of the inner edge, diverging uniformly at a specified rate from the take-off track to a specified final width and continuing thereafter at that width for the remainder of the length of the take-off climb surface; and

c) an outer edge horizontal and perpendicular to the specified takeoff track.

4.2.1.27 The elevation of the inner edge shall be equal to the highest point on the runway centre line between the end of the runway and the inner edge, except that when a clearway is provided the elevation shall be equal to the highest point on the ground on the centre line of the clearway.

4.2.1.28 In the case of a straight take-off flight path, the slope of the take-off climb surface shall be measured in the vertical plane containing the centre line of the runway.

4.2.1.29 In the case of a take-off flight path involving a turn, the take-off climb surface shall be a complex surface containing the horizontal normal to its centre line, and the slope of the centre line shall be the same as that for a straight take-off flight path.

**4.2.2 Obstacle limitation requirements**

*Note – The requirements for obstacle limitation surfaces are specified on the basis of the intended use of a runway, i.e. take-off or landing and type of approach, and are intended to be applied when such use is made of the runway. In case where operations*
are conducted to or from both directions of a runway; then the function of certain surfaces may be nullified because of more stringent requirements of another lower surface.

**Non-instrument runways**

4.2.2.1 The following obstacle limitation surfaces shall be established for a non-instrument runway.

- conical surface;
- inner horizontal surface;
- approach surface; and
- transitional surfaces.

4.2.2.2 The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 4-1 of this manual.

4.2.2.3 New objects or extensions of existing objects shall not be permitted above an approach or transitional surface except when the new object or extension would be shielded by an existing immovable object.

*Note – Circumstances in which the shielding principle may reasonably be applied are described in the ICAO Airport Services Manual, Part 6.*

4.2.2.4 New objects or extensions of existing objects shall not be permitted above the conical surface or inner horizontal surface except when the object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety of aeroplane operations.
Table 4-1 – Dimensions and slopes of obstacle limitation surfaces

**APPROACH RUNWAYS**

<table>
<thead>
<tr>
<th>Surfaces and Dimensions</th>
<th>RUNWAY CLASSIFICATION</th>
<th>Non-instrument</th>
<th>Non-precision approach</th>
<th>Precision approach Category</th>
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<tr>
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</table>

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**Notes:**

a. All dimensions are measured horizontally unless specified otherwise.
b. Variable length (See paragraph 4.2.2.9 or 4.2.2.17 of this Manual).
c. Distance to the end of strip.
d. Or end of runway whichever is less.
e. Where the code letter is F (Column (3) of Table 3-1 of this Manual), the width is increased to 155 m.
4.2.2.5 Existing objects above any of the surfaces required by paragraph 4.2.2.1 of this Manual should as far as practicable be removed except when, in the opinion of the Authority, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

Note – Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger aeroplanes.

4.2.2.6 In considering proposed construction, account should be taken of the possible future development of an instrument runway and consequent requirement for more stringent obstacle limitation surfaces.

**Non-precision approach runway**

4.2.2.7 The following obstacle limitation surfaces shall be established for a non precision approach runway:

- conical surface;
- inner horizontal surface;
- approach surface; and
- transitional surfaces.

4.2.2.8 The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 4-1 of this Manual, except in the case of the horizontal section of the approach surface as per section 4.2.2.9 of this Manual.

4.2.2.9 The approach surface shall be horizontal beyond the point at which the 2.5 per cent slope intersects:

a) a horizontal plane 150m above the threshold elevation; or

b) the horizontal plane passing through the top of any object that governs the obstacle clearance altitude/height (OCA/H);

whichever is the higher.

4.2.2.10 New objects or extensions of existing objects shall not be permitted above an approach surface within 3,000m of the inner edge or above a transitional surface except when the new object or extension would be shielded by an existing immovable object.
Note – Circumstances in which the shielding principle may reasonably be applied are described in the ICAO Airport Services Manual, Part 6.

4.2.2.11 New objects or extensions of existing objects should not be permitted above the approach surface beyond 3 000m from the inner edge, the conical surface or inner horizontal surface except when the object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety of aeroplane operations.

4.2.2.12 Existing objects above any of the surfaces required by paragraph - 4.2.2.7 of this Manual should as far as practicable be removed except when the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety of aeroplane operations.

Note – Because of the transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger aeroplanes.

**Precision approach runways**

*Note 1 – See paragraph 9.10 for information regarding siting and construction of equipment and installations on operational areas.*

*Note 2 – Guidance on obstacle limitation surfaces for precision approach runways is given in the ICAO Airport Services Manual, Part 6.*

4.2.2.13 The following obstacle limitation surfaces shall be established for a precision approach runway category I:

- conical surface;
- inner horizontal surface;
- approach surface; and
- transitional surfaces.

4.2.2.14 The following obstacle limitation surfaces shall be established for a precision approach runway category I:

- inner approach surface;
- inner transitional surfaces; and
- balked landing surface.
4.2.2.15 The following obstacle limitation surfaces shall be established for a precision approach runway category II.

- conical surface;
- inner horizontal surface;
- approach surface and inner approach surface;
- transitional surfaces;
- inner transitional surfaces; and
- balked landing surface.

4.2.2.16 The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 4-1 of this Manual, except in the case of the horizontal section of the approach surface as per section 4.2.2.17 of this Manual).

4.2.2.17 The approach surface shall be horizontal beyond the point at which the 2.5 per cent slope intersects:

a) a horizontal plane 150m above the threshold elevation; or

b) the horizontal plane passing through the top of any object that governs the obstacle clearance limit;

whichever is the higher.

4.2.2.18 Fixed objects shall not be permitted above the inner approach surface, the inner approach surface, the inner transitional surface or the balked landing surface, except for frangible objects which because of their function must be located on the strip. Mobile objects shall not be permitted above these surfaces during the use of the runway for landing.

4.2.2.19 New objects or extensions of existing objects shall not be permitted above an approach surface or a transitional surface except when, in the opinion of the Authority’s Safety Division, the new object or extension would be shielded by an existing immovable object.

*Note – Circumstances in which the shielding principle may reasonably be applied are described in the ICAO Airport Services Manual, Part 6.*

4.2.2.20 New objects or extensions of existing objects should not be permitted above the conical surface and the inner horizontal surface except when an object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety of aeroplane operations.

4.2.2.21 Existing objects above an approach surface, a transitional surface, the conical surface and inner horizontal surface should as far as practicable be removed except
when an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety aeroplane operations.

Note – Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered that may endanger aeroplanes.

**Runways meant for take-off**

4.2.2.22 The following obstacle limitation surface shall be established for a runway meant for take-off:

– take-off climb surface.

4.2.2.23 The dimension of the surface shall be not less than the dimensions specified in Table 4-2 of this Manual, except that a lesser length may be adopted or the take-off climb surface where such lesser length would be consistent with procedural measures adopted to govern the outward flight of aeroplanes.

4.2.2.24 The operational characteristics of aeroplanes for which the runway is intended should be examined to see if it is desirable to reduce the slope specified in Table 4-2 of this Manual when critical operating conditions are to be catered to. If the specified slope is reduced, corresponding adjustment in the length of take-off climb surface should be made so as to provide protection to a height of 300m.

Note – When local conditions differ widely from sea level standard atmospheric conditions, it may be advisable for the slope specified in Table 4-2 of this Manual to be reduced. The degree of this reduction depends on the divergence between local conditions and sea level standard atmospheric conditions, and on the performance characteristics and operational requirements of the aeroplanes for which the runway is intended.

**Table 4-2 – Dimensions and slopes of obstacle limitation surfaces**

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<thead>
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<th>Surface and dimensions a</th>
<th>Code number</th>
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<tr>
<td>(1)</td>
<td>(2)</td>
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<tr>
<td><strong>TAKE-OFF CLIMB</strong></td>
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<tr>
<td>Length of inner edge</td>
<td>60 m</td>
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<tr>
<td>Distance from runway end b</td>
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<tr>
<td>Divergence (each side)</td>
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<td>Final width</td>
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</table>
4.2.2.25 New objects or extensions of existing objects shall not be permitted above a take-off climb surface except when, in the opinion of the Authority, the new object or extension would be shielded by an existing immovable object.

Note – Circumstances in which the shielding principle may reasonably be applied are described in the ICAO Airport Services Manual, Part 6.

4.2.2.26 If no object reaches the 2 per cent (1:50) take-off climb surface, new objects should be limited to preserve the existing obstacle free surface or a surface down to a slope of 1.6 per cent (1:62.5).

4.2.2.27 Existing objects that extend above a take-off climb surface should as far as practicable be removed except when, in the opinion of the appropriate authority, an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety of aeroplane operations.

Note – Because of transverse slopes on a strip or clearway, in certain cases portions of the inner edge of the take-off climb surface may be below the corresponding elevation of the strip or clearway. It is not intended that the strip or clearway be graded to conform with the inner edge of the take-off climb surface, nor is it intended that terrain or objects, which are above the take-off, climb surface beyond the end of the strip of clearway, but below the level of the strip or clearway, be removed unless it is considered that they endanger aeroplanes. Similar considerations apply at the junction of a clearway and strip where differences in transverse slopes exist.

### 4.2.3 Objects outside the obstacle limitation surfaces

4.2.3.1 Arrangements should be made to enable the aerodrome operator to be consulted concerning proposed construction beyond the limits of the obstacle limitation surfaces that extend above a height established by the operator, in order to permit an aeronautical study of the effect of such construction on the operation of aeroplanes.
4.2.3.3 In areas beyond the limits of the obstacle limitation surfaces, at least those objects that extend to a height of 150 m or more above ground elevation should be regarded as obstacles, unless a special aeronautical study indicate that they do not constitute a hazard to operations.

Note – The study may have regard to the nature of operations concerned and may distinguish between day and night operations.

4.2.4 Other objects

4.2.4.1 Objects which do not project through the approach surface but which would nevertheless adversely affect the optimum siting or performance of visual or non-visual aids should, as far as practicable, be removed.

4.2.4.2 Anything which may, after aeronautical study, endanger aeroplanes on the movement area or in the air within the limits of the inner horizontal and conical surfaces should be regarded as an obstacle and should be removed in so far as practicable.

Note – In criteria circumstances, objects that do not project above any of the surfaces enumerated in paragraph 4.2.1 may constitute a hazard to aeroplanes as, for example, where there are one or more isolated objects in the vicinity of an aerodrome.

4.3 Principles of shielding

4.3.1 General

4.3.1.1 A new obstacle located in the vicinity of an existing obstacle and assessed as not being a hazard to aircraft is deemed to be shielded.

4.3.1.2 Unless specifically directed by the Authority, a shielded obstacle does not require removal, lowering, marking or lighting and should not impose any additional restrictions to aircraft operations.

4.3.1.3 The Authority will assess and determine whether an obstacle is shielded. An aerodrome operator shall notify the Authority of the presence of all obstacles and their detailed characteristics through the submission of its Aerodrome Manual.

4.3.1.4 Only existing permanent obstacles may be considered in assessing shielding of new obstacles.

4.3.2 Shielding principles

4.3.2.1 In assessing whether an existing obstacle shields an obstacle, the Authority will be guided by the principles of shielding detailed below.
Obstacle penetrating the approach and take-off climb surfaces

4.3.2.2 (a) An existing obstacle within the approach and take-off climb area is called the critical obstacle. Where a number of obstacles exist closely together, the critical obstacle is the one which subtends the greatest vertical angle measured from the appropriate inner edge.

(b) As illustrated in table 4-1, of this manual a new obstacle may be assessed as not imposing additional restrictions if:

(i) when located between the inner edge end and the critical obstacle, the new obstacle is below a plane sloping downwards at 10% from the top of the critical obstacle toward the inner edge;

(ii) when located beyond the critical obstacle from the inner edge end, the new obstacle is not higher than the height of the permanent obstacle; and

(iii) where there is more than one critical obstacle within the approach and take-off climb area, and the new obstacle is located between two critical obstacles, the height of the new obstacle is not above a plane sloping downwards at 10% from the top of the next critical obstacle.

Obstacle penetrating the inner and outer horizontal and conical surfaces

4.3.2.3 A new obstacle may be accepted if it is in the vicinity of an existing obstacle, and does not penetrate a 10% downward sloping conical shaped surface from the top of the existing obstacle, i.e. the new obstacle is shielded radially by the existing obstacle.

Obstacle penetrating the transitional surfaces

4.3.2.4 A new obstacle may be assessed as not imposing additional restrictions if it does not exceed the height of an existing obstacle which is closer to the runway strip and the new obstacle is located perpendicularly behind the existing obstacle relative to the runway centre line.
Figure 4-3 – Shielding of obstacles penetrating the approach and take-off climb surfaces